Appendix F

Avian Use Report

Avian Use Study Report for the
Tatanka Ridge Wind Project
Deuel County, South Dakota

April 20, 2018 – March 26, 2019

Prepared for:

Tatanka Ridge Wind, LLC

1125 North West Couch Street, Suite 700
Portland, Oregon 97209

Prepared by:

Lindsey Dernovsek, Janelle Rieland, and John Lombardi

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

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WEST Inc.

EXECUTIVE SUMMARY

Tatanka Ridge Wind, LLC (Tatanka Ridge), a subsidiary of Avangrid Renewables, LLC has proposed development of the Tatanka Ridge Wind Project (Project) in Deuel County, South Dakota. Tatanka Ridge Wind contracted Western EcoSystems Technology, Inc. (WEST) to conduct baseline avian studies at the Project to estimate levels of use by avian species and document seasonal and spatial trends in avian use data for evaluating potential impacts from the proposed wind-energy facility.

The study was designed to address the questions posed under Tier 3 of the US Fish and Wildlife Service (USFWS) *Land-Based Wind Energy Guidelines* and Stage 2 of the *Eagle Conservation Plan Guidance*. This document provides the results of fixed-point avian use surveys (including large bird surveys, small bird surveys, and incidental observations) conducted from April 20, 2018 to March 26, 2019.

Land cover within the approximately 22,905-acre 2018–2019 Project boundary was predominately cultivated cropland (65.1%) and herbaceous vegetation (24.3%). Wooded habitat was scarce in the Project area, and trees were generally adjacent to creeks and in tree rows associated with rural homesteads and farms.

Fixed-point avian use surveys estimated the seasonal, spatial, and temporal use patterns of avian species within the study area. For 10 months, fixed-point avian use surveys were conducted at 14 points located within the 2018–2019 Project boundary; this increased to 21 points for the final two months of the study due to a change in the Project boundary in early 2019. Small bird surveys preceded the large bird surveys and were conducted for 10 minutes (min) within a 100-meter (m) radius. Large bird surveys were conducted for 60 min within 800-m radius survey plots.

One hundred seventy-eight surveys were conducted in 12 visits. Thirty-seven large bird species were identified, with 8,424 large bird observations recorded within 470 separate groups. Waterfowl accounted for 83.6% of all large bird observations. Thirty-four small bird species were identified, with 1,248 bird observations recorded within 455 separate groups. Passerines accounted for 99.6% of all small bird observations. Overall, avian use was higher during migration periods than other seasons, likely due to the Project's location in the Central Flyway.

Waterfowl were the most abundant large bird type observed at the Project. Spring observations of snow goose accounted for 89.6% of all waterfowl observations. Diurnal raptor use was highest during the fall (1.19 observations/800-m plot/60-min survey) with noticeably lower use in spring, summer, and winter (0.32, 0.29, and 0.03, respectively). The most common raptor observed during surveys was red-tailed hawk (41 of the 78 total raptor observations). Just two bald eagles and two golden eagles were documented during the 178 hours of surveys at the Project and no eagles of either species were recorded incidentally (outside of timed surveys). The raptor species with the highest exposure index was the red-tailed hawk, which ranked 8th highest of all avian

species with exposure indices at the Project. Diurnal raptor use was fairly even across the Project area. Passerines were the most abundant small bird type observed at the Project.

No species listed as threatened or endangered at the state or federal level were documented during surveys. However, nine sensitive species were observed within the Project: bald eagle and golden eagle (protected by the Bald and Golden Eagle Protection Act); American white pelican and trumpeter swan (designated as species of greatest conservation need in South Dakota); and upland sandpiper, grasshopper sparrow, red-headed woodpecker, dickcissel, and Swainson's hawk (designated as Birds of Conservation Concern by the USFWS).

STUDY PARTICIPANTS

Janelle Rieland	Project Manager
Carmen Boyd	Project Tracking & Data Manager
Lindsey Dernovsek	Report Writer & Wildlife Biologist
Julia Preston-Fulton	Technical Editor
Karl Kosciuch	Senior Reviewer
John Lombardi	Lead Client Analyst
Zoey Gustafson	Analyst
Martin Viereckl	GIS Technician

REPORT REFERENCE

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NOTES ON UNITS

Empirical units are used throughout this document, with the exception of the use of meters when describing avian use survey methodology, where metric units are used to be consistent with guidelines. Conversions are provided below.

Empirical	Metric
Unit Conversions	
1 foot	0.30 meter
3.28 feet	1 meter
1 mile	1.61 kilometers
0.621 mile	1 kilometer
1 acre	0.40 hectare
2.47 acres	1 hectare
Common Conversions	
0.06 mile	100 meters
0.12 mile	200 meters
0.5 mile	800 meters
10 miles	16.1 kilometers

INTRODUCTION

In 2018, Tatanka Ridge Wind, LLC, a subsidiary of Avangrid Renewables, LLC contracted Western EcoSystems Technology, Inc., (WEST) to conduct avian use surveys at the Tatanka Ridge Wind Project (Project) to estimate the potential impacts of wind energy facility construction and operations on avian species. The Project will have a nameplate capacity of up to 155 megawatts.

This study was designed to address questions posed under Tier 3 of the US Fish and Wildlife Service (USFWS) *Land-Based Wind Energy Guidelines* (USFWS 2012). The principal objectives of the study were to: 1) provide site-specific avian resource and use data essential to evaluating potential impacts from the proposed wind energy facility, 2) provide information that could be used for project planning and design of the facility to minimize impacts to avian species, and 3) collect data on eagle use in the area following the USFWS *Eagle Conservation Plan Guidance* (ECPG; USFWS 2013).

This document provides results of fixed-point large bird and fixed-point small bird use surveys, as well as incidental observations recorded at the Project from April 20, 2018 through March 26, 2019.

STUDY AREA

The Project is located in Deuel County, South Dakota. The Project is approximately six miles west of the South Dakota/Minnesota border, near the town of Toronto (Figure 1). The Project boundary utilized for the majority of this study (10 months) reflects the 2018 Project boundary prior to modification in early 2019, at which time the project expanded and shifted westward. Both the 2018 and 2019 Project boundaries are depicted on Figure 1.

The Project falls within the Northern Glaciated Plains Ecoregion, which covers much of the eastern portion of South Dakota (USEPA 2016). Flat to gently rolling landscape composed of glacial drift characterizes the Northern Glaciated Plains. This ecoregion serves as a transitional zone between tall and shortgrass prairie with high concentrations of temporary and seasonal wetlands that are favorable for duck nesting and migration.

Approximately 65.1% of the 22,905-acre 2018–2019 Project boundary area consisted of cropland (Figure 2, Table 1). The next most common land cover types were herbaceous (24.3%), developed areas (e.g., farmsteads and roads; 4.6%), and hay/pasture (3.9%). All other land cover types collectively accounted for less than 3.0% of the Project area (Table 1). The current (2019–2020) Project boundary encompasses similar land cover types.

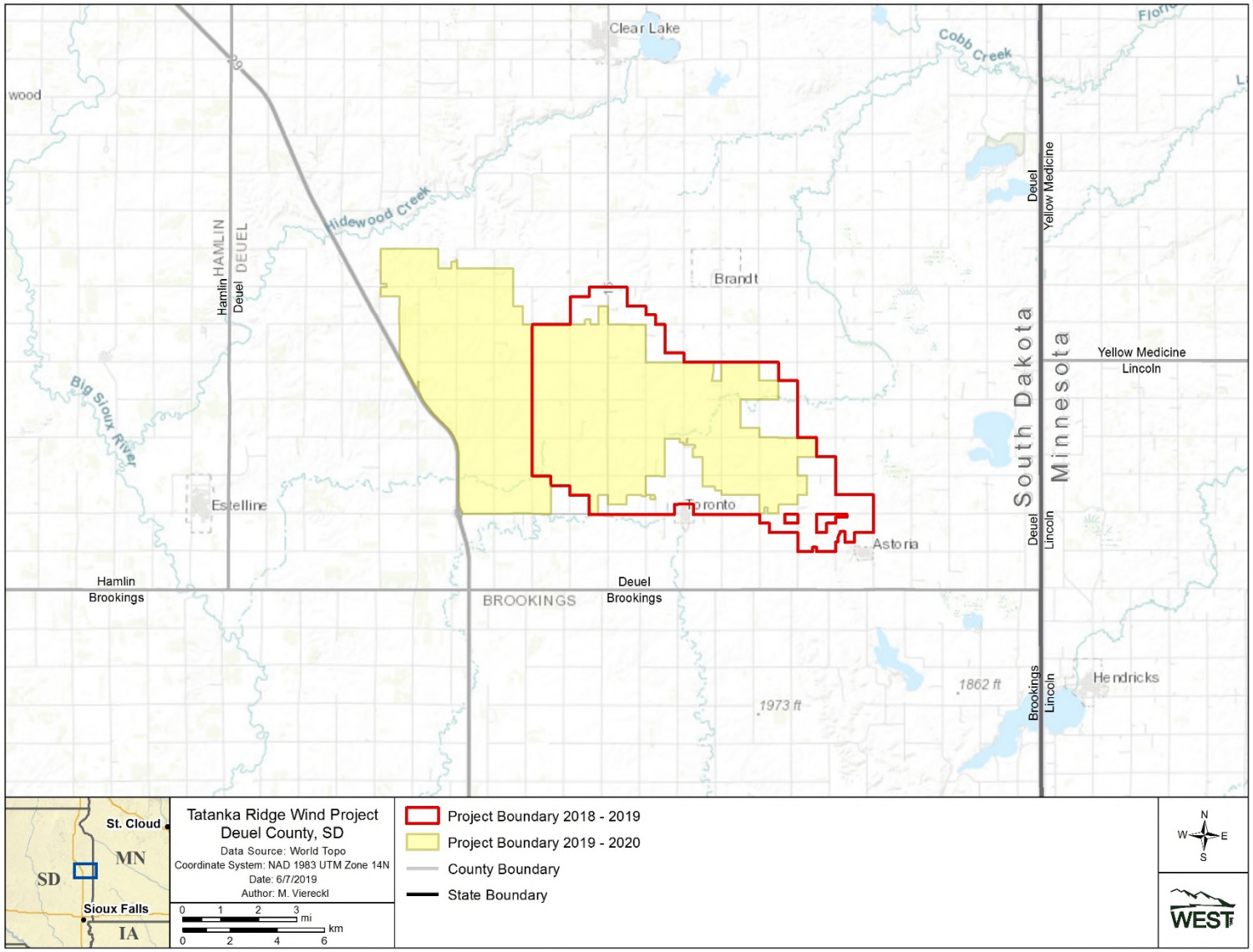

Figure 1. Location of the Tatanka Ridge Wind Project, Deuel County, South Dakota.

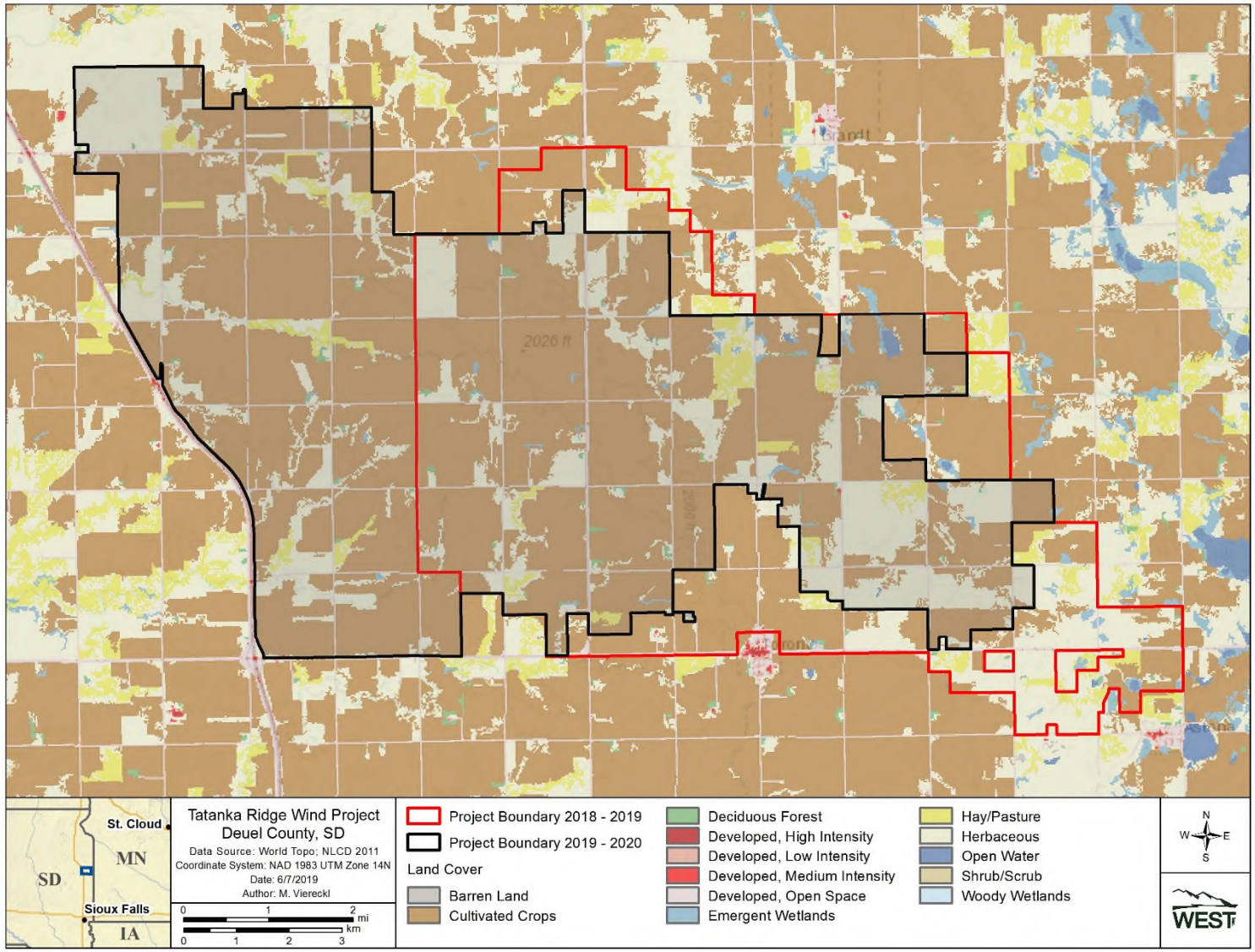

Figure 2. Land cover at the Tatanka Ridge Wind Project (US Geological Survey National Land Cover Database 2011, Homer et al. 2015) in Deuel County, South Dakota.

Table 1. Land cover types, coverage, and composition within the Tatanka Ridge Wind Project, Deuel County, South Dakota.

Habitat	Acres	% Composition
Cultivated Crops	14,907	65.1
Herbaceous	5,576	24.3
Developed, Open Space	1,058	4.6
Hay/Pasture	893	3.9
Emergent Herbaceous Wetlands	256	1.1
Deciduous Forest	127	0.6
Open Water	60	0.3
Developed, Low Intensity	25	0.1
Developed, Medium Intensity	3	<0.1
Developed, High Intensity	<1	<0.1
Total	**22,905**	**100**

Data from the US Geological Survey National Landcover Database (2011), Homer et al. 2015.
Sums may not equal total values shown due to rounding.

METHODS

This study contains the following survey types: 1) fixed-point large bird use surveys, 2) fixed-point small bird use surveys, and 3) incidental wildlife observations.

Fixed-point Large Bird and Eagle Use Surveys

The objective of the fixed-point large bird use surveys was to estimate the spatial and temporal use of the Project area by large birds, particularly eagle species. Fixed-point avian use surveys (variable circular plots) were conducted using methods described by Reynolds et al. (1980). Eagle data were collected in accordance with the ECPG (USFWS 2013) as well as the eagle permit rules published on December 16, 2016.

Survey Plots

Fourteen points were originally selected to survey the representative habitats and topography of the Project, while achieving relatively even coverage of the overall Project area (Figure 3). One of the original survey locations, Point 15, was relocated to Point 18 after eight months of survey, as it was consistently difficult to access safely in the original location. Additionally, due to an expansion of the Project boundary, and in order to achieve the ECPG recommended 30% coverage, the number of survey locations increased to 21 for the final two months of the study; these new locations were Points 19–25. Consequently, avian spatial use across all locations is not directly comparable. To avoid overlap, WEST generated observation points using a systematic sampling scheme with a random start in ArcGIS (Geographic Information System software), then micro-sited the locations along public roads. Large bird observations were recorded within an 800-meter (m) radius circle centered on each survey point.

Survey Methods

Surveys were conducted for 60 minutes (min) for all large birds, focusing on eagle species whenever they were observed. All large birds observed were assigned a unique observation number, regardless of distance from the observer. Some observations may have been repeated sightings of the same bird. Observations of birds outside the survey 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 height metrics. Large birds included waterbirds, waterfowl, grebes and loons, shorebirds, gulls and terns, diurnal raptors, owls, vultures, some upland game birds (ring-necked pheasant [*Phasianus colchicus*], wild turkey [*Meleagris gallopavo*]), doves and pigeons, large corvids (i.e., ravens, magpies, and crows), and goatsuckers. Sensitive species include federally or state-listed species, species of special concern as designated by South Dakota Game, Fish, and Parks (SDGFP), and Birds of Conservation Concern (BCC) within Bird Conservation Region (BCR) 11 (USFWS 2008).

WEST recorded the following information during each fixed-point avian 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:

- species (or best possible identification)
- number of individuals
- distance from plot center when first observed
- closest distance observed
- flight height above ground level (AGL)
- flight direction
- activity (e.g., flying or perched)

Approximate initial flight height, lowest height, highest height, flight direction, and distance from the plot center when first observed were recorded to the nearest 5-m. Distances were estimated based on mapped landmarks.

Bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos)* observations were recorded at 1-min intervals when an eagle was within the 800-m plot and at or below 200-m AGL, per the ECPG (USFWS 2013; [i.e., eagle minutes]). Flight height, distance, and activity (e.g., flying or perched) were also recorded during each 1-min interval. Eagles observed outside of plots, or at heights more than 200-m, were recorded, but not included in the eagle-minute analyses. Flight paths of large birds were mapped and subsequently digitized to qualitatively assess areas of eagle use within the proposed Project area.

Observation Schedule

Sampling intensity was designed to document avian use and behavior by habitat and season within the Project. Avian use surveys were conducted once per month during the following

seasons: spring (April 20 – May 31, 2018 and March 1 – March 31, 2019), summer (June 1 – August 31, 2018), fall (September 1 – November 30, 2018) and winter (December 1, 2018 – February 28, 2019). Surveys were conducted during daylight hours and the start location varied so that each location was surveyed across approximately all daylight hours during a season. This survey approach is consistent with the recommendations included in USFWS ECPG and the survey requirements described in the revised Eagle Permit Rules issued in 2016. Observation points were scheduled to be surveyed the same number of times. Surveys were missed on occasion due to poor visibility as a result of weather conditions or site access issues (e.g., sub-zero temperatures or impassable roads).

Fixed-point Small Bird Use Surveys

The objective of the fixed-point small bird use surveys was to provide a species list of small birds observed in the Project, document small bird relative abundance, and provide data to estimate temporal and spatial use of the Project area by small birds. The small-bird use survey locations were the same as the large bird survey points (Figure 3). Small birds included cuckoos, kingfishers, passerines, swifts, hummingbirds, woodpeckers, and unidentified birds.

In order to be in full compliance with the survey protocols codified in the December 16, 2016 Eagle Rule, the 10-min small bird surveys preceded the 60-min large bird survey observation period. The survey radius of the circular plots was 100-m for small birds, and the estimated distance to each bird observed was recorded to the nearest 5-m interval. The date, start and end time of the observation period, species or best possible identification, number of individuals, sex and age class, distance from plot center when first observed, closest distance, flight height above ground level, activity, and habitat were recorded.

Incidental Observations

To provide information on wildlife use of the Project area outside of observations recorded during standardized surveys, biologists also recorded wildlife observed incidentally. Biologists recorded all sensitive species, rare species or unusual behavior observations, and other notable birds observed. Sensitive species include those protected by the federal Endangered Species Act (1973), the Bald and Golden Eagle Protection Act (BGEPA 1940), BCC within BCR 11 (USFWS 2008), and the 2014 South Dakota Wildlife Action Plan (SDWAP 2014). Incidental observations were recorded in a similar fashion to standardized surveys, where the observation number, date, time, species, number of individuals, sex/age class, distance from observer, activity, habitat, and flight height were recorded. Locations were recorded by Universal Transverse Mercator coordinates using a hand-held Global Positioning System unit.

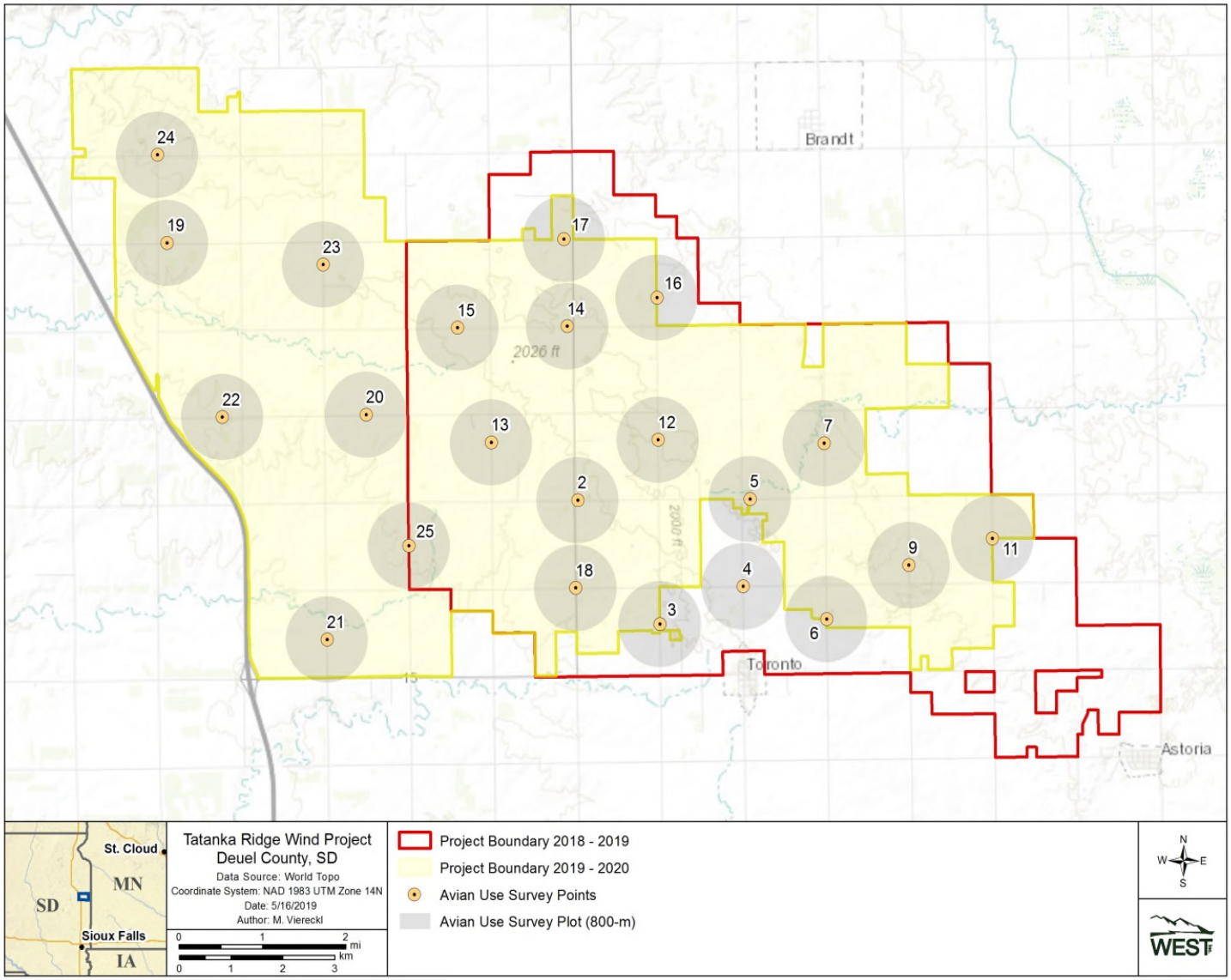

Figure 3. Survey locations for fixed-point avian use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota. Points 19–25 were added in February 2019.

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 study 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.

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 surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. Potentially erroneous data were identified using a series of database queries. Irregular codes or questionable data 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.

Data Compilation and Storage

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 protocol to facilitate subsequent QA/QC and data analysis. All data forms and electronic data files were retained for reference. QA/QC measurements implemented for report writing included review of the final document by a technical editor, peer (research biologist), project manager, and senior manager.

Avian Diversity and Species Richness

Avian diversity was illustrated by the total number of species observed. Species lists (with the number of observations and groups) were generated by season and included observations of avian species detected during surveys, regardless of their distance from the observer. In some cases, the tally may have represented repeated sightings of the same individual. For example, a sum of 50 observations of northern harrier (*Circus hudsonius*) may be 50 different birds, or it may be one bird observed on 50 separate visits, or something in between. Species richness, which is defined as the number of species observed per point, was calculated for each season 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. Overall species richness was calculated as a weighted average of seasonal values by the number of days in each season. Species diversity and richness were compared among seasons for fixed-point bird use surveys. Species diversity and richness were calculated separately for large birds and small birds.

Avian Use, Percent of Use, and Frequency of Occurrence

For generating standardized fixed-point avian use estimates, large birds detected within the 800-m radius plot during the 60-min survey were used in the analysis; small birds recorded within

a 100-m radius during the 10-min surveys were analyzed separately. The metric used to measure mean avian use was the number of individuals per plot per survey. These standardized estimates of mean avian use were used to compare differences among bird types, seasons, survey points, and other studies where similar methods were used. Mean use by season was calculated by summing the total number of birds seen within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season. Overall mean use was calculated as a weighted average of seasonal values by the number of days in each season. Estimates were calculated separately for large and small birds.

Exposure to risk at a wind facility is influenced by the extent to which a species uses the area (percent of use) and how often use occurs (frequency of occurrence). Percent of use and frequency of occurrence provide relative measures of species exposure to the proposed facility.

For the Project, percent of use was calculated as the proportion of large or small bird mean use attributable to a particular bird type or species. Frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed. For example, flocks of waterfowl, waterbirds, and shorebirds can compose several dozen, hundred, or thousands of individual birds, which would result in a very high percentage of use. However, examining the percent of use alone would not account for the acute exposure to the facility associated with a small number of very large flocks (low frequency of occurrence). A high percent of use may indicate that a species has higher exposure relative to other species, but when the exposure is acute, the species may be less likely to be affected. Conversely, a species that has a low percentage of use and a high frequency of occurrence would have long-term exposure to the facility, increasing the likelihood that this species may be affected by the facility. Therefore, exposure to facility infrastructure is assessed most accurately by evaluating both percent of use and frequency of occurrence.

Flight Height Characteristics and Behavior

Avian flight height characteristics are important metrics to assess relative exposure. Flight height information was used to calculate the percentage of large birds observed flying within the rotor-swept height (RSH) for turbine models likely to be used. A RSH for potential collision with a turbine blade of 25−150 m AGL was used for the purposes of the analysis. For this analysis, below the RSH is less than 25 m AGL, within the RSH is 25−150 m AGL, and above the RSH is greater than 150 m AGL. The flight height recorded during the initial observation was used to calculate the percentage of birds flying within the RSH and mean flight height. The percentage of birds flying within the RSH at any time was calculated using the lowest and highest flight heights recorded.

Exposure Index

The exposure index is used as a relative measure of species-specific risk of turbine collision and the species most likely to occur as fatalities at the wind energy facility. A relative index of large

bird exposure (R) was calculated for avian species observed during the surveys using the following formula:

$$R = A_i * P_f * P_t$$

Where A equals mean relative use for species *i* (large bird observations within 800 m of the observer or 100 m for small birds) averaged across all surveys. P_f equals the proportion of all observations of species *i* where activity was recorded as flying (an index to the approximate percentage of time species *i* spends flying during the daylight period), and P_t equals the proportion of all initial flight height observations of species *i* within the likely RSH. The exposure index does not account for other possible collision risk factors, such as foraging or courtship behavior.

Spatial Use

Large bird flight paths were qualitatively compared to study area characteristics (e.g., topographic features). The objective of mapping large bird locations and flight paths was to identify areas of concentrated use by diurnal raptors and other large birds and/or consistent flight patterns within the study area. This information can be useful in turbine layout design to reduce risk to avian species. Small bird spatial use was measured as mean use by survey point.

RESULTS

Fixed-Point Large Bird Use Surveys

One hundred seventy-eight fixed-point large bird use surveys were conducted from April 20, 2018 to March 26, 2019 (Table 2).

Avian Diversity and Species Richness

Forty-four large bird species were observed over the course of the fixed-point large bird use surveys (Table 2). A mean of 1.84 large bird species/800-m plot/60-min survey was recorded. Bird diversity (the number of species identified) for large birds was highest during spring (26 species), and fall (24 species), followed by summer (21 species), and winter (five species; Table 2). Large bird species richness was highest in summer (2.64 species/800-m plot/60-min survey), followed by spring (2.40), fall (1.79), and winter (0.49; Table 2).

Table 2. Summary of large bird diversity (number of species) and species richness (species/800-meter plot/60-minute survey), and sample size by season and overall during fixed-point large bird use surveys (FPLB) at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019.

Season	Number of Visits	Number of FPLB Surveys Conducted	Number of Species[a]	Species Richness
Spring	3	48	26	2.40
Summer	3	42	21	2.64
Fall	3	42	24	1.79
Winter	3	46	5	0.49
Overall	**12**	**178**	**44**	**1.84**

[a] Number of Species: count of bird species observed in the survey plots within and across seasons. Unidentified birds are included in this count.

During fixed-point large bird surveys, 8,424 large bird observations were recorded within 470 separate groups (defined as one or more individuals; Appendix A1). One species (snow goose [*Anser caerulescens*]; 2.7% of all species) accounted for 74.9% of all large bird observations (6,310 observations; Appendix A1). Franklin's gull (*Leucophaeus pipixcan*) was the second most abundant species observed, and accounted for 6.4% of all large bird observations (542 records; Appendix A1). All other large bird species each accounted for less than 3.5% of the total number of large bird observations. Seventy-eight diurnal raptor observations were recorded within the Project, representing nine species (Appendix A1).

Avian Use, Percent of Use, and Frequency of Occurrence

Mean avian use, percent of use, and frequency of occurrence were calculated by season for all bird types and species (Table 3, Appendix B1). The highest overall large bird use occurred during the spring (121.15 observations/800-m plot/60-min survey), followed by fall (21.21), summer (6.43), and winter (2.66; Table 3). Elevated large bird use in spring was influenced by high use of waterfowl, particularly snow goose (105.70). Fall use was highest by gulls/terns, whereas summer and winter use where highest by shorebirds and doves/pigeons respectively (Appendix B1).

Waterbirds

Waterbird use was recorded during fall, spring, and summer (Table 3); no waterbird use was recorded in winter. Waterbirds had the highest use during summer (1.21 observations/800-m plot/60-min survey). Summer waterbird use values were primarily shaped by American white pelican (*Pelecanus erythrorhynchos)* use (Appendix B1). Waterbirds made up 18.9% of all large bird observations in summer, 5.6% in fall, and less than 0.1% of spring observations (Table 3, Appendix B1). Waterbirds were recorded during 2.4% to 14.3% of surveys during seasons in which they occurred (Table 3, Appendix B1).

Waterfowl

Waterfowl use was the highest in spring (117.21 observations/800-m plot/60-min survey) and was lower in fall and summer (1.64 and 0.90 respectively; Table 3, Appendix B1). No use was recorded in the winter. Most waterfowl use was due to snow goose, and to a lesser extent Canada goose (*Branta Canadensis)* and greater-white-fronted goose (*Anser albifrons;* Appendix B1). Waterfowl

made up 96.8% of all large bird observation in the spring, 14.1% in summer, and 7.7% in fall (Table 3, Appendix B1). Waterfowl were recorded during 9.5% to 45.0% of surveys during seasons in which they occurred (Table 3, Appendix B1).

Shorebirds

Shorebirds showed the highest use of all bird types during the summer (1.71 observations/800-m plot/60-min survey) and accounted for 26.7% of all summer large bird observations (Table 3, Appendix B1). No shorebird use was recorded in the winter. Killdeer (*Charadrius vociferus)* had the highest use among shorebird species in all seasons (Appendix B1). Shorebird use in spring was 0.89 observations/800-m plot/60-min survey and 0.26 in the fall. Shorebirds were observed between 7.1% and 57.1% of surveys during seasons in which they occurred (Table 3, Appendix B1).

Gulls/Terns

Gull/tern use was only recorded during the summer and fall and had the highest use of all large bird types in the fall (13.86 observations/800-m plot/60-min survey; Table 3, Appendix B1). Franklin's gulls contributed the highest use in the summer and fall (Appendix B1) Gulls/terns accounted for 65.3% of overall large bird observations in fall and 0.4% in summer (Table 3, Appendix B1). Gulls/terns were observed during 2.4% of summer surveys and 14.3% of fall surveys (Table 3, Appendix B1).

Diurnal Raptors

Diurnal raptor use was observed over all seasons, with highest use during fall (1.19 observations/ 800-m plot/60-min survey), followed by spring (0.32), summer (0.29), and winter (0.03; Table 3, Appendix B1). Red-tailed hawk (*Buteo jamaicensis*) made up most diurnal raptor use during fall, spring, and summer, while bald eagle accounted for all diurnal raptor use during winter (Appendix B1). Diurnal raptors accounted for 5.6% of large bird use in fall, 4.4% of large bird use in summer, 1.0% in winter, and 0.3% in spring (Table 3, Appendix B1). Diurnal raptors were observed during 47.6% of surveys during fall, 24.8% of spring surveys, 21.4% of summer surveys, and 2.6% of winter surveys (Table 3, Appendix B1).

The total survey effort for eagle use was 178 hours. Two bald eagles and two golden eagles were observed during the fixed-point surveys with no additional eagles of either species observed incidentally. See the *Eagle Use* section for further information.

Vultures

Turkey vulture (*Cathartes aura*) was the only vulture species observed (Appendix A1 and B1), and use by turkey vultures was recorded during spring (0.21 observation/800-m plot/60-min survey), summer (0.05), and fall (0.12; Table 3, Appendix B1); no use was recorded during the winter. Turkey vultures accounted for 0.7% of overall large bird use during summer, 0.2% during spring, and 0.6% during fall (Table 3, Appendix B1). Turkey vultures were observed between 4.8% and 7.1% of surveys during season in which they occurred (Table 3, Appendix B1).

Table 3. Mean large bird use (number of observations/800-meter plot/60-minute [min] survey), percent of total use (%), and frequency of occurrence (%) for each large bird type by season during the 60-minute fixed-point large bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019.

	Mean Use				% of Use				% Frequency			
Type/Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Waterbirds	**0.04**	**1.21**	**1.19**	**0**	**<0.1**	**18.9**	**5.6**	**0**	**4.0**	**14.3**	**2.4**	**0**
Waterfowl	**117.21**	**0.90**	**1.64**	**0**	**96.8**	**14.1**	**7.7**	**0**	**45.0**	**21.4**	**9.5**	**0**
Shorebirds	**0.89**	**1.71**	**0.26**	**0**	**0.7**	**26.7**	**1.2**	**0**	**32.9**	**57.1**	**7.1**	**0**
Gulls/Terns	**0**	**0.02**	**13.86**	**0**	**0**	**0.4**	**65.3**	**0**	**0**	**2.4**	**14.3**	**0**
Diurnal Raptors	**0.32**	**0.29**	**1.19**	**0.03**	**0.3**	**4.4**	**5.6**	**1.0**	**24.8**	**21.4**	**47.6**	**2.6**
Accipiters	0	0	0.05	0	0	0	0.2	0	0	0	4.8	0
Buteos	0.28	0.26	0.69	0	0.2	4.1	3.3	0	23.1	19.0	31.0	0
Northern Harrier	0.02	0.02	0.26	0	<0.1	0.4	1.2	0	2.4	2.4	21.4	0
Eagles	0.02	0	0.02	0.03	<0.1	0	0.1	1.0	1.7	0	2.4	2.6
Falcons	0	0	0.12	0	0	0	0.6	0	0	0	7.1	0
Other Raptors	0	0	0.05	0	0	0	0.2	0	0	0	4.8	0
Vultures	**0.21**	**0.05**	**0.12**	**0**	**0.2**	**0.7**	**0.6**	**0**	**7.1**	**4.8**	**7.1**	**0**
Upland Game Birds	**0.64**	**0.62**	**0.17**	**0.99**	**0.5**	**9.6**	**0.8**	**37.4**	**36.0**	**40.5**	**11.9**	**15.8**
Doves/Pigeons	**0.63**	**1.57**	**1.98**	**1.48**	**0.5**	**24.4**	**9.3**	**55.6**	**21.7**	**59.5**	**33.3**	**22.0**
Large Corvids	**1.21**	**0.05**	**0.81**	**0.16**	**1.0**	**0.7**	**3.8**	**6.1**	**25.2**	**4.8**	**11.9**	**8.5**
Large Birds Overall	**121.15**	**6.43**	**21.21**	**2.66**	**100**	**100**	**100**	**100**				

Upland Game Birds

Upland game bird use was highest in winter (0.99 observation/800-m plot/60-min survey), followed by spring (0.64), summer (0.62), and fall (0.17; Table 3, Appendix B1). Two species were observed: ring-necked pheasant in all four seasons, and wild turkey in summer only (AppendixB1). Upland game birds made up 37.4% of use in winter, 9.6% of use in summer, 0.8% of use in fall, and 0.5% of use in spring (Table 3, Appendix B1). Upland game birds were observed between 11.9% and 40.5% of surveys (Table 3, Appendix B1).

Doves/Pigeons

Doves/pigeons were observed in every season. Use was highest in the fall (1.98 observation/ 800-m plot/60-min survey), followed by summer (1.57), winter (1.48), and spring (0.63; Table 3; Appendix B1). Rock pigeon (*Columba livia)* accounted for the majority of dove/pigeon use in all seasons, with the exception of summer where mourning dove (*Zenaida macroura)* use was higher. Doves/pigeons made up the majority (55.6%) of all large bird use in the winter. Doves/pigeons were observed between 21.7% and 59.5% of surveys (Table 3a, Appendix B1).

Large Corvids

American crow (*Corvus brachyrhynchos*) was the only large corvid observed and they were recorded in all four seasons (Appendix A1 and B1). American crow use was highest in spring (1.21 observation/800-m plot/60-min survey), followed by fall (0.81), winter (0.16), and summer (0.05; Appendix B1). American crows made up between 0.7% and 6.1% of large bird use and were observed between 4.8% and 25.2% of surveys each season (Appendix B1).

Avian Flight Height Characteristics and Behavior

Flight height characteristics, based on initial flight height observations and estimated use, were calculated for bird types and species (Table 4, Appendix C1). Overall, 83.6% of flying large birds were recorded within the RSH (i.e., 25−150 m AGL), 13.7% were below the RSH, and 2.7% were flying above the RSH (Table 4). Based on 74 observations, most of flying diurnal raptors were observed below the RSH (64.9%), 25.7% were within the RSH, and 9.5% were above the RSH. Diurnal raptors had the fourth highest percentage of birds within the RSH due to buteo observations recorded at this height (Table 4). Waterbirds had the highest percentage of all flying large birds recorded within the RSH (96.1%, based on 103 observations), followed closely by waterfowl (95.5%, based on 7,015 observations). Vultures were observed in the RSH 31.2% of the time, and 11.3% of flying gulls/terns were observed within the RSH (Table 4). One hundred percent of upland game birds, doves/pigeons, and large corvids, and 98.6% of shorebirds were observed flying below the RSH (Table 4).

Of the species recorded flying, 13 species were observed flying within the estimated RSH during half or more of initial observations and seven species were observed flying within the RSH during less than half of initial observations (Table 5).

Table 4. Group and individual observation flight height characteristics by large bird type and raptor subtype during fixed-point large bird use surveys at the Tatanka Ridge Wind Project from April 20, 2018 − March 26, 2019.

Bird Type	# Groups Flying	# Obs Flying	Mean Flight Height (m)	% Obs Flying	% within Flight height Categories		
					0−25 m	25−150 m[a]	>150 m
Waterbirds	**11**	**103**	**76.73**	**100**	**3.9**	**96.1**	**0**
Waterfowl	**83**	**7,015**	**45.39**	**99.6**	**2.0**	**95.5**	**2.6**
Shorebirds	**37**	**70**	**5.43**	**57.4**	**98.6**	**1.4**	**0**
Gulls/Terns	**11**	**583**	**54.91**	**100**	**81.8**	**11.3**	**6.9**
Diurnal Raptors	**67**	**74**	**42.70**	**96.1**	**64.9**	**25.7**	**9.5**
Accipiters	2	2	4.50	100	100	0	0
Buteos	43	49	55.28	94.2	57.1	30.6	12.2
Northern Harrier	12	13	6.83	100	100	0	0
Eagles	3	3	27.33	100	33.3	66.7	0
Falcons	5	5	14.20	100	80.0	20.0	0
Other Raptors	2	2	120.00	100	0	50.0	50.0
Vultures	**11**	**16**	**20.09**	**100**	**68.8**	**31.2**	**0**
Upland Game Birds	**12**	**56**	**4.42**	**49.1**	**100**	**0**	**0**
Doves/Pigeons	**77**	**229**	**8.31**	**91.6**	**100**	**0**	**0**
Large Corvids	**29**	**97**	**6.38**	**86.6**	**100**	**0**	**0**
Overall	**338**	**8,243**	**27.74**	**97.9**	**13.7**	**83.6**	**2.7**

[a] The likely rotor-swept height for potential collision with a turbine blade, or 25−150 m above ground level
Obs = observations.

Table 5. Relative exposure index and flight characteristics for large bird species[a] during 60-minute fixed-point large bird use surveys (FPLB) at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH[b] Based on Initial Obs.	Exposure Index	% Within RSH at Any Time
snow goose	8	26.64	100	98.0	26.12	98.0
greater white-fronted goose	4	1.22	100	100	1.22	100
Canada goose	32	1.29	99.2	68.3	0.87	78.0
Franklin's gull	9	3.22	100	12.2	0.39	81.4
double-crested cormorant	1	0.30	100	100	0.30	100
American white pelican	5	0.29	100	100	0.29	100
mallard	26	0.30	90.6	52.1	0.14	56.2
red-tailed hawk	35	0.24	95.1	33.3	0.08	64.1
unidentified duck	4	0.25	100	18.4	0.05	49.0
turkey vulture	11	0.10	100	31.2	0.03	81.2
common merganser	1	0.03	100	100	0.03	100
trumpeter swan	1	0.02	100	100	0.02	100
bald eagle	1	<0.01	100	100	<0.01	100
Wilson's snipe	1	0.04	16.7	100	<0.01	100
unidentified buteo	3	0.02	100	33.3	<0.01	33.3
Swainson's hawk	3	0.04	83.3	20.0	<0.01	80.0
unidentified raptor	2	0.01	100	50.0	<0.01	50.0
merlin	1	<0.01	100	100	<0.01	100
great blue heron	3	0.02	100	33.3	<0.01	66.7
golden eagle	2	0.01	100	50.0	<0.01	50.0

[a] Only includes species with actual exposure index values; see Appendix C for full listing.
[b] The likely "rotor-swept height" (RSH) for potential collision with a turbine blade, or 25−150 meters above ground level.
Obs = observations.

Exposure Index

A relative exposure index based on initial flight height observations and mean use estimate was calculated for each species. Species that had exposure to the RSH are listed in Table 5 and a complete list of all species is presented in Appendix C1. Due to observations within the RSH and relatively high use, snow goose had the highest exposure index (26.12), followed by greater white-fronted goose (1.22), Canada goose (0.87), and Franklin's gull (0.39; Table 5, Appendix C1).

Spatial Use

For all large bird species combined, use was highest at Point 5 (494.50 observations/60-min survey; Figure 4a, Appendix D1). Point 5 is centrally located within the Project area, and is without any discernable topographic or landscape features that distinguish it from other observations points. Large bird use at other points ranged from 1.00 to 43.58, with the exception of Point 19 where zero use was recorded. The high mean use estimate for Point 5 was due to high waterfowl use (specifically, snow goose) at this point (Figure 4b, Appendix D1). Diurnal raptor use was remarkably consistent at nearly all points where use was recorded, ranging from 0.08 at Point 3, to 0.75 at Point 12 (Figure 4c, Appendix D1). Five of the seven points added in the final two months of study did not have any diurnal raptor use recorded (Appendix D1). Gull/tern use was only documented at five locations (Figure 4d). Use by vultures was only documented at six points, and ranged from 0.08 to 0.50 at those points (Appendix D1).

In order to present qualitative use of the landscape, flight paths of all large birds were mapped and digitized by season (Appendix D2). Diurnal raptor flight paths were recorded throughout the Project in every season; no obvious movement corridors were observed, and there was fairly even use across the survey points surveyed for the full year. The survey locations added for the last two months of study (Points 19−25) showed little to no raptor use (Figure 5a, Appendix D2). Red-tailed hawks made up the majority of diurnal raptor flight paths in all four seasons, but more flight paths were recorded in fall than any other season (Appendix D2). Spatial use by eagles is presented below in *Eagle Use*.

Over the course of the year, flight paths for waterfowl were documented more frequently on the southeastern half of the Project than on the western half. Flight paths were recorded at all survey points except for Points 18−21 and 25 (Figure 5b); Despite remarkably high waterfowl use at Point 5 due to large flocks of snow goose, flight path distributions depict equally, if not higher, concentrations at Points 9 and 11 (Figure 5b, Appendix D2). Gull/tern flight paths were documented at only two points (Points 7 and 14); however, gull/tern use was documented at five locations (Figure 5c, Appendix D1).

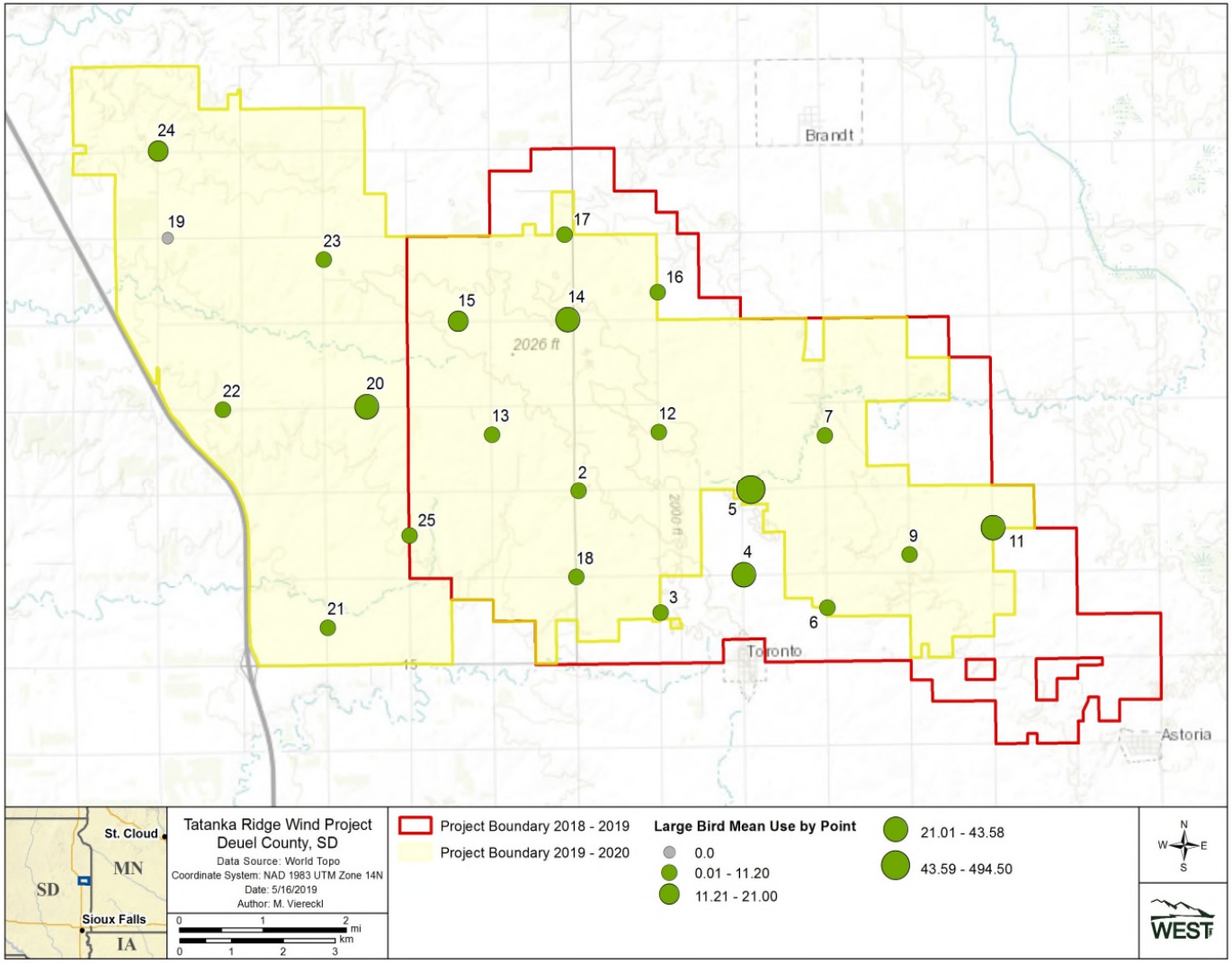

Figure 4a. Large bird use by observation point at the Tatanka Ridge Wind Project in Deuel County, South Dakota during fixed-point large bird surveys from April 20, 2018 − March 26, 2019. Points 19-25 were added in February 2019.

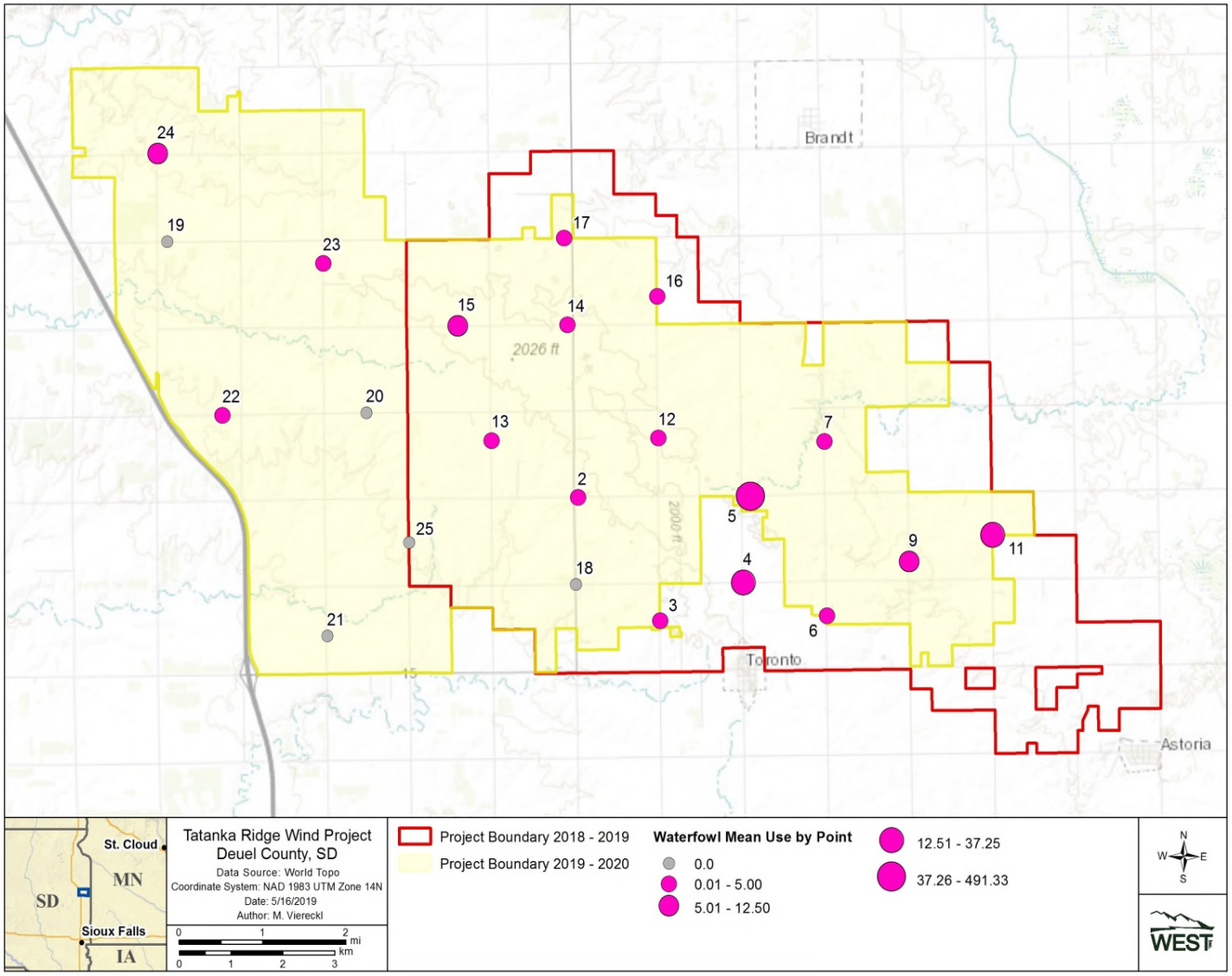

Figure 4b. Waterfowl use by observation point at the Tatanka Ridge Wind Project in Deuel County, South Dakota during fixed-point large bird surveys from April 20, 2018 − March 26, 2019. Points 19-25 were added in February 2019.

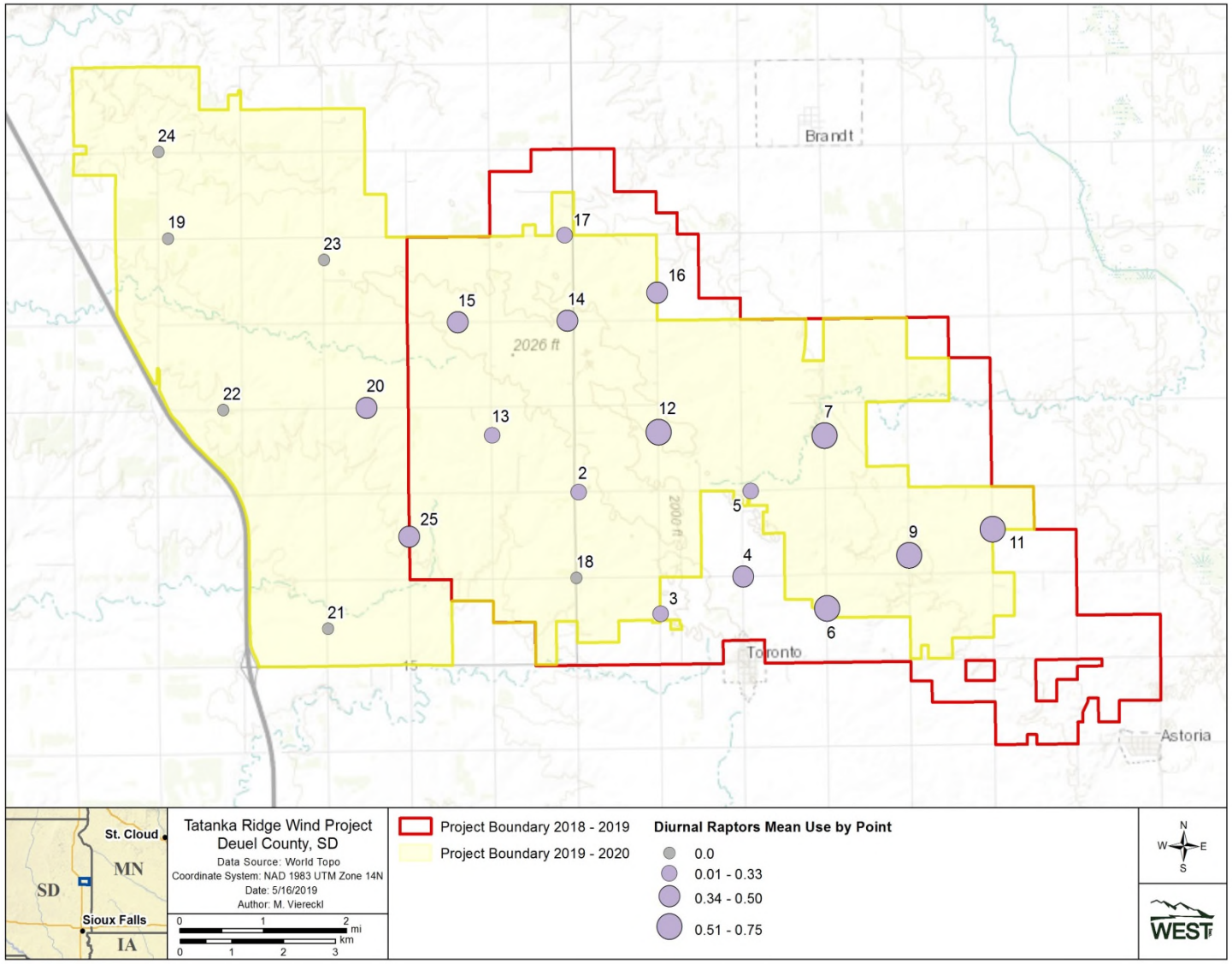

Figure 4c. Diurnal Raptor use by observation point at the Tatanka Ridge Wind Project in Deuel County, South Dakota during fixed-point large bird surveys from April 20, 2018 − March 26, 2019. Points 19-25 were added in February 2019.

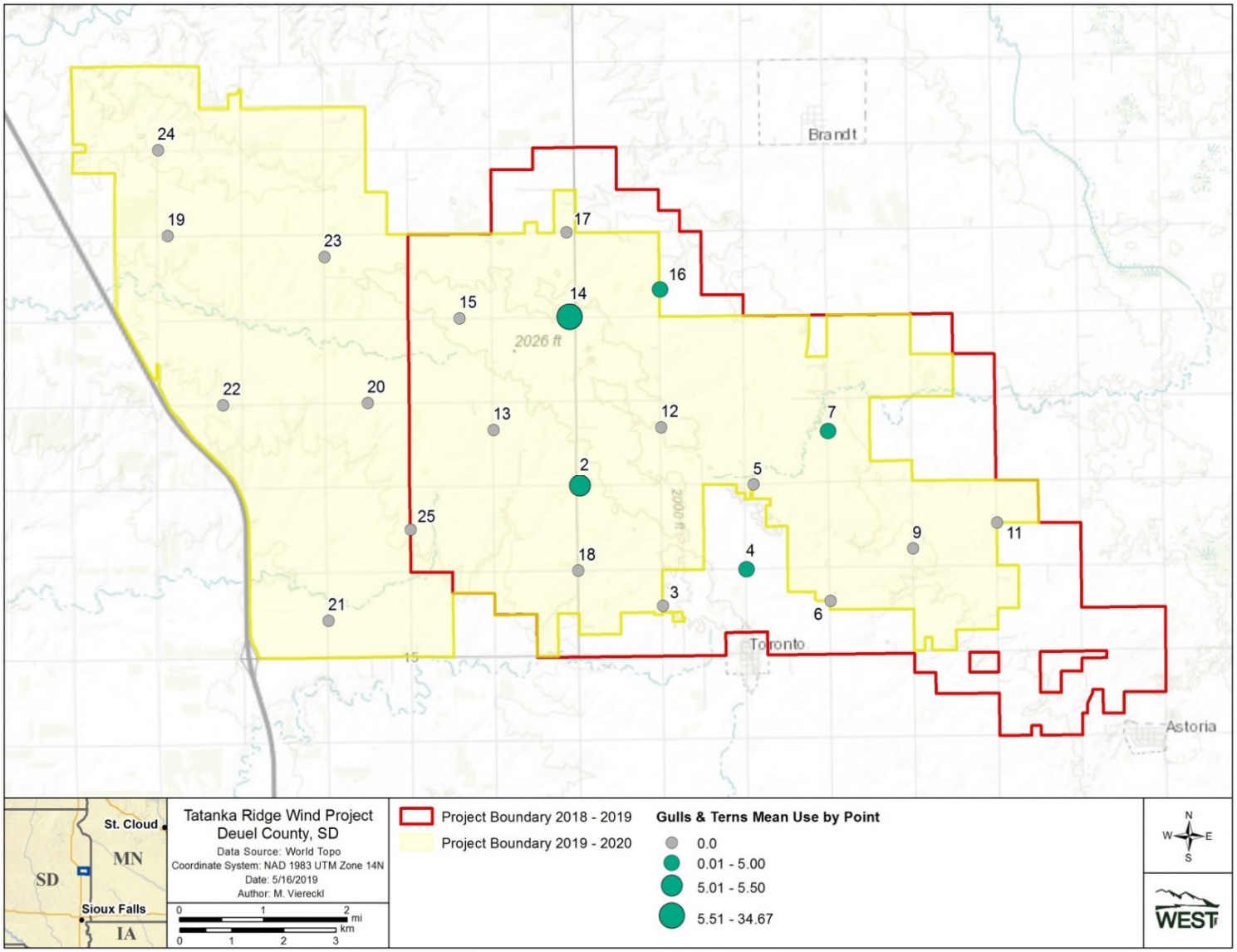

Figure 4d. Gull/Tern use by observation point at the Tatanka Ridge Wind Project in Deuel County, South Dakota during fixed-point large bird surveys from April 20, 2018 − March 26, 2019. Points 19-25 were added in February 2019

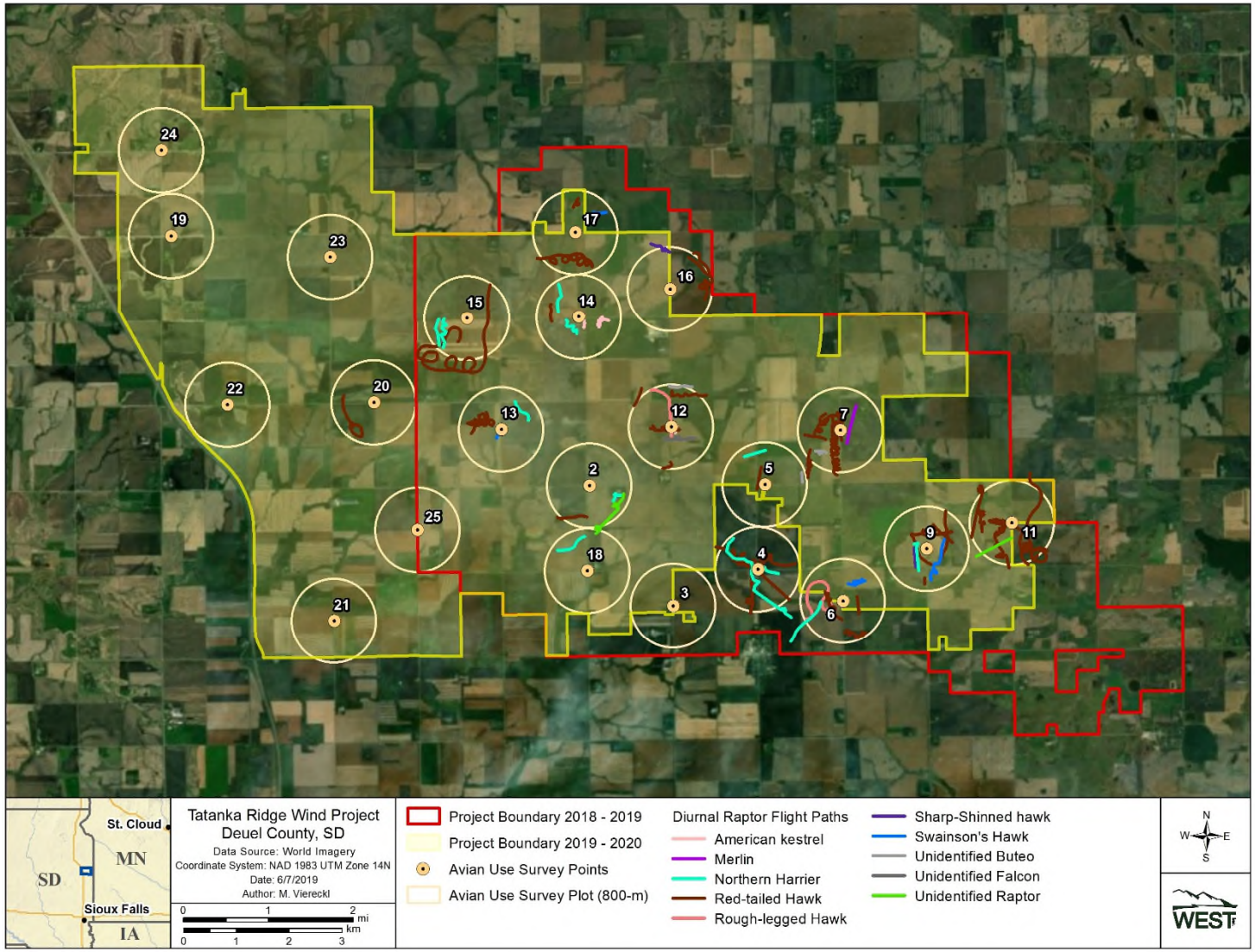

Figure 5a. Flight paths for diurnal raptors by species observed at the Tatanka Ridge Wind Project from April 20, 2018 to March 26, 2019. Points 19-25 were added in February 2019

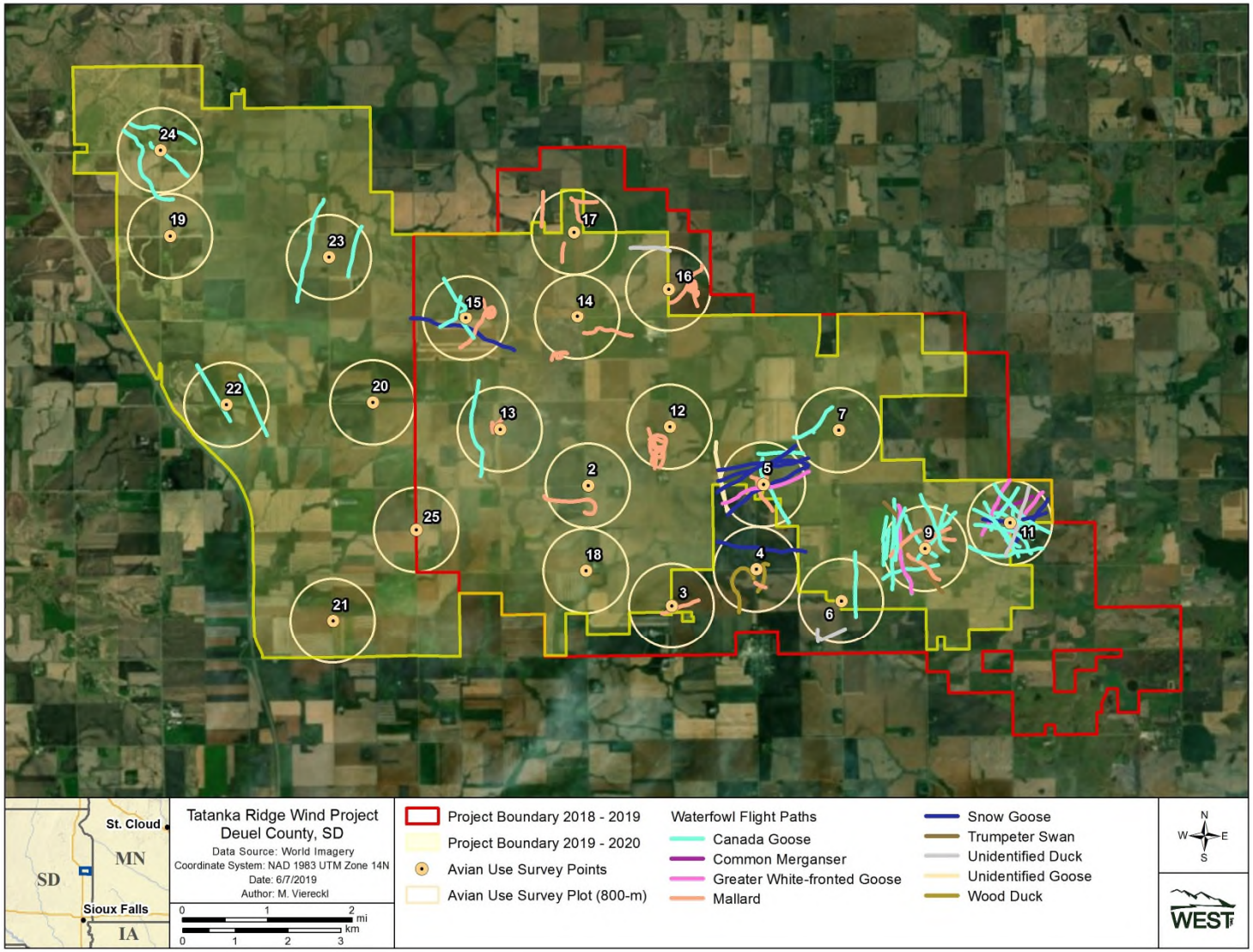

Figure 5b. Flight paths for waterfowl by species observed at the Tatanka Ridge Wind Project from April 20, 2018 – March 26, 2019. Points 19-25 were added in February 2019

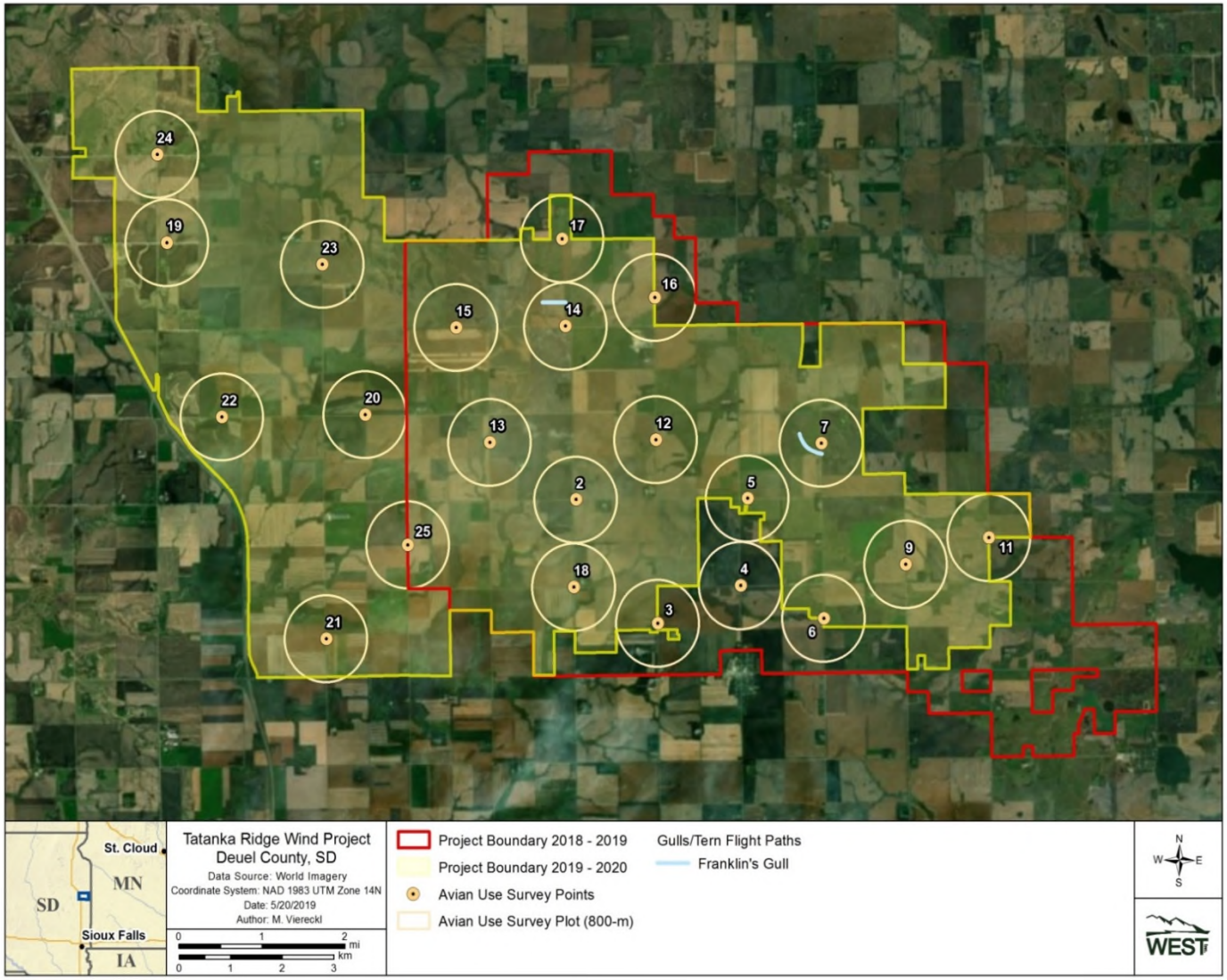

Figure 5c. Flight paths for gulls/terns by species observed at the Tatanka Ridge Wind Project from April 20, 2018 – March 26, 2019. Points 19-25 were added in February 2019

Fixed-point Small Bird Use Surveys

One hundred seventy-eight fixed-point small bird use surveys were conducted from April 20, 2018 to March 26, 2019 (Table 6). Overall, small bird use at the Project was low and was made up almost entirely of passerine species.

Table 6. Summary of small bird diversity (number of species) and species richness (species/100-meter plot/10-minute survey), and sample size by season and overall during the fixed-point small bird use surveys (FPSB) at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019.

Season	Number of Visits	Number of FPSB Surveys Conducted	Number of Species[a]	Species Richness
Spring	3	48	27	1.86
Summer	3	42	31	4.33
Fall	3	42	16	1.17
Winter	3	46	2	0.17
Overall	**12**	**178**	**39**	**1.89**

[a] Number of Species: count of bird species observed in the survey plots within and across seasons. Observations of birds that were not identifiable to type or species were included in this count.

Small Bird Diversity and Species Richness

Thirty-nine small bird species were identified over the course of the fixed-point small bird use surveys (Table 6). A mean of 1.89 small bird species/100-m plot/10-min survey were recorded. Avian diversity for small birds was highest during summer (31), followed by spring (27), fall (16), and was lowest in the winter (2). Small bird species richness was highest during summer (4.33) and spring (1.86), followed by fall (1.17) and winter (0.17; Table 6).

During small bird surveys, 1,248 small bird observations were recorded within 455 separate groups (Appendix A2). Three species (8.8% of all species) accounted for 49.8% of all observations: red-winged blackbird (*Agelaius phoeniceus;* 285 observations), Lapland longspur (*Calcarius lapponicus*; 170 observations), and horned lark (*Eremophila alpestris*; 166 observations; Appendix A2). No other small bird species accounted for more than 4.6% of observations.

Avian Use, Percent of Use, Frequency of Occurrence, and Spatial Use

A 100-m viewshed and 10-min observation period was used for small birds; therefore, descriptive statistics for small bird types are not directly comparable to large bird types. Small bird use was highest during summer and spring (10.33 observations/100-m plot/10-min survey and 9.75, respectively; Table 7, Appendix B2). Fall and winter use values were much lower (4.45 and 2.18; Appendix B2 and Table 7). Small bird use was dominated by passerines, though a few woodpeckers were also recorded. Red-winged blackbirds represented most of the small bird use during spring and fall, and barn swallow (*Hirundo rustica)* account for the majority of small bird use in the summer. Winter small bird use was only recorded for two species, horned lark and blue jay (*Cyanocitta cristata;* Appendix B2). Small bird use, focused within 100 m, was highest at Point 5, with 16.50 observations/10-min survey, and ranged from 0.50 to 12.18 at other points where use was recorded (Figure 6, Appendix D4). Three survey locations had no use documented.

Table 7. Mean small bird use (number of observations/100-meter plot/10-minute [min] survey), percent of total use (%), and frequency of occurrence (%) for each small bird type by season during the 10-min fixed-point small bird use surveys (FPSB) at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019

	Mean Use				% of Use				% Frequency			
Type	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Passerines	9.73	10.29	4.40	2.18	99.8	99.5	98.9	100	69.0	92.9	59.5	16.7
Woodpeckers	0.02	0.05	0.05	0	0.2	0.5	1.1	0	2.4	4.8	4.8	0
Small Birds Overall	**9.75**	**10.33**	**4.45**	**2.18**	**100**	**100**	**100**	**100**				

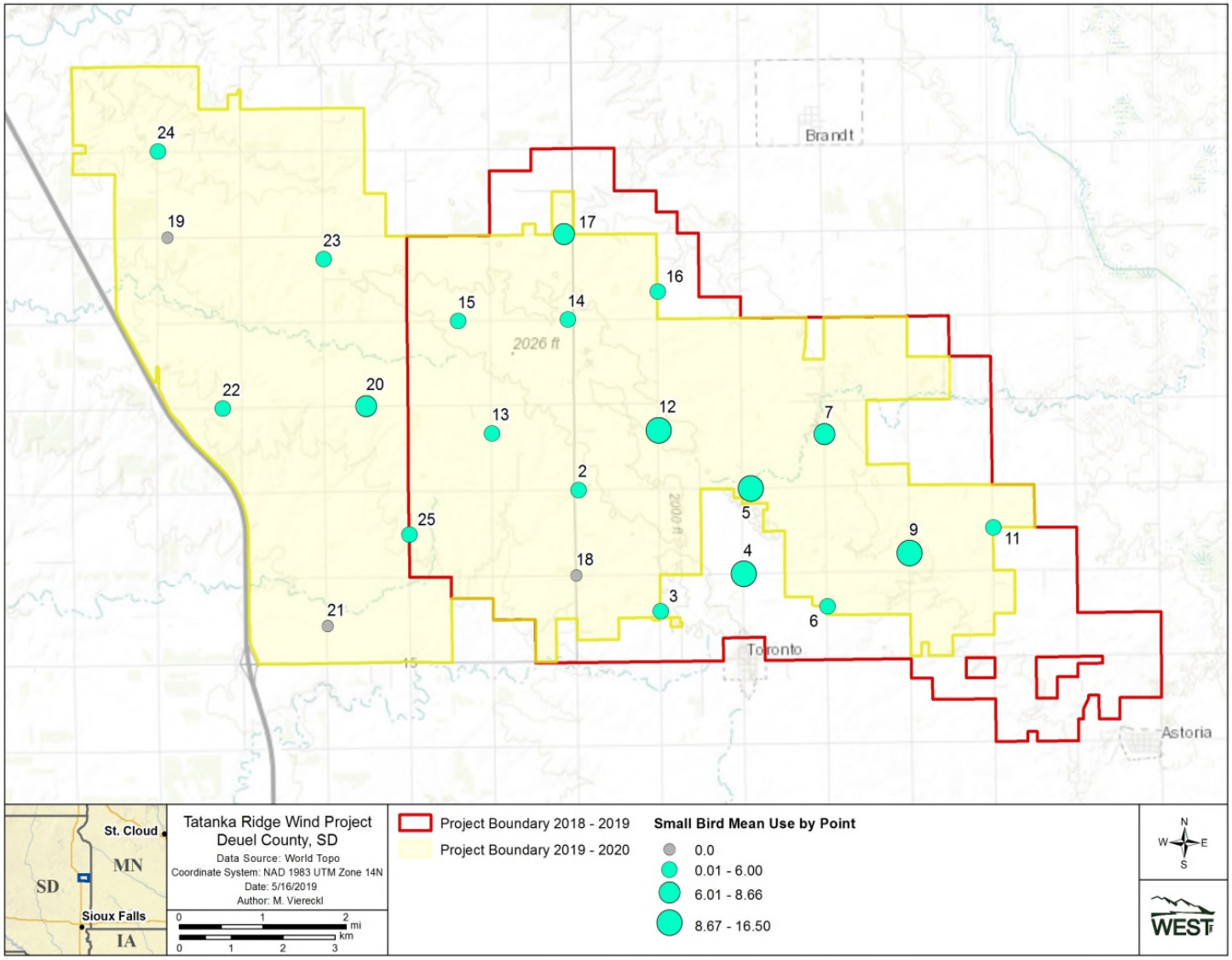

Figure 6. Small bird use by observation point at the Tatanka Ridge Wind Project in Deuel County, South Dakota during fixed-point small bird surveys from April 20, 2018- March 26, 2019. Points 19-25 were added in February 2019

Passerines

Passerines represented nearly all of the small bird use, and passerine use was highest during summer (10.29 observations/100-m plot/10-min survey) followed by spring (9.73), compared to fall (4.40) and winter (2.18; Table 7, Appendix B2). Passerines made up 100% of small bird use during winter, and between 98.9% and 99.8% of small bird use in all other seasons. Passerines were observed between 16.7% and 92.9% of surveys seasonally (Table 7, Appendix B1).

Woodpeckers

Four species of woodpecker were observed at the Project, northern flicker (*Colaptes auratus*), red-headed woodpecker (*Melanerpes erythrocephalus)*, downy woodpecker (*Dryobates pubescens*), and hairy woodpecker (*Dryobates villosus*); Appendix A2 and B2). Mean use was low in all seasons, but was higher in summer and fall (0.05 observation/100-m plot/10-min survey each), compared to spring (0.02); no woodpeckers were observed in winter (Table 7, Appendix B2). Woodpeckers accounted for between 0.2% and 1.1% of small bird use in the seasons in which they were observed. Woodpeckers were observed between 2.4 and 4.8% of surveys seasonally (Table 7, Appendix B2).

Eagle Use

One hundred seventy-eight hours of survey were conducted within the Project from April 20, 2018 to March 26, 2019. Four eagle observations, including two bald eagles and two golden eagles, were recorded during the 60-min fixed-point count large bird surveys, and no eagles were observed incidentally.

Eagle Use by Season

Mean use by eagles across the survey period was 0.0165 eagle observation/800-m survey plot/ 60-min, ranging from zero in summer to 0.026 in winter (Table 8). Spring had the highest number of eagle observations (two observations [one bald eagle and one golden eagle]; Appendix A1), while fall had the highest number of eagle risk minutes (three min; Table 8). In general, use by eagles was very low at the Project, and seasonal trends are difficult to distinguish based on so few observations.

Table 8. Bald and golden eagle risk minutes[a], mean use, and risk minutes per hour of survey, documented by season during 60-minute fixed-point large bird use surveys at the Tatanka Ridge Wind Project from April 20, 2018 − March 26, 2019.

Season	Bald Eagle Risk Minutes	Golden Eagle Risk Minutes	Survey Effort (hours)	Eagle Use (both species)	Bald Eagle Risk Minutes per Hour of Survey	Golden Eagle Risk Minutes per Hour of Survey
Spring	0	2	48	0.017	0	0.0417
Summer	0	0	42	0	0	0
Fall	0	3	42	0.024	0	0.0714
Winter	1	0	46	0.026	0.0217	0
Total	**1**	**5**	**178**	**0.0165**	**0.0056**	**0.0281**

[a] Minutes flying within 800 meters (m) of the observer and less than 200 m above ground level.

Monthly Trends – Eagle Observations and Minutes

Most months did include any eagle observations; each of the four eagle observations occurred in different months (May, October, and December 2018; and March 2019). Although there were an equal number of bald eagle and golden eagle observations (two each), only one bald eagle observation resulted in any risk minutes (one risk minute), whereas both golden eagle observations recorded risk minutes (Table 9). The month with the highest number of risk minutes was October 2018 (three risk minutes), followed by March 2019 (two risk minutes), and December 2018 (one risk minute; Table 9). Of the four eagles observed, two were observed in spring, one in fall, and one in winter.

Table 9. Total number of bald and golden eagle observations and total number of eagle risk minutes[a] by month recorded during 60-minute fixed-point large bird use surveys[b] at the Tatanka Ridge Wind Project from April 20, 2018 − March 26, 2019.

Month/Year	Bald Eagle Observations	Golden Eagle Observations	Bald Eagle Risk Minutes	Golden Eagle Risk Minutes
April 2018	0	0	0	0
May 2018	1	0	0	0
June 2018	0	0	0	0
July 2018	0	0	0	0
August 2018	0	0	0	0
September 2018	0	0	0	0
October 2018	0	1	0	3
November 2018	0	0	0	0
December 2018	1	0	1	0
January 2019	0	0	0	0
February 2019	0	0	0	0
March 2019	0	1	0	2
Total	**2**	**2**	**1**	**5**

[a] Minutes flying within 800 meters (m) of the observer and less than 200 m above ground level.

Spatial Patterns

Similar to temporal trends, spatial trends in eagle use are difficult to evaluate due to the low number of observations recorded. Although Point 25 was only surveyed for two months, one golden eagle was observed in March 2019, resulting in this point having the highest eagle use and the second-highest number of eagle risk minutes (two risk minutes; Figures 7 and 8, Table 10). Point 16 showed the greatest number of eagle risk minutes, also due to one golden eagle being observed, with three risk minutes recorded.

Golden eagles were observed at Points 16 and 25. The two observations of bald eagle were at Point 3 (one risk minute) and Point 14 (although the bald eagle was beyond the 800-m survey plot; therefore this observation was not included in the use analysis and zero risk minutes were recorded; Figures 7 and 8, Table 10).

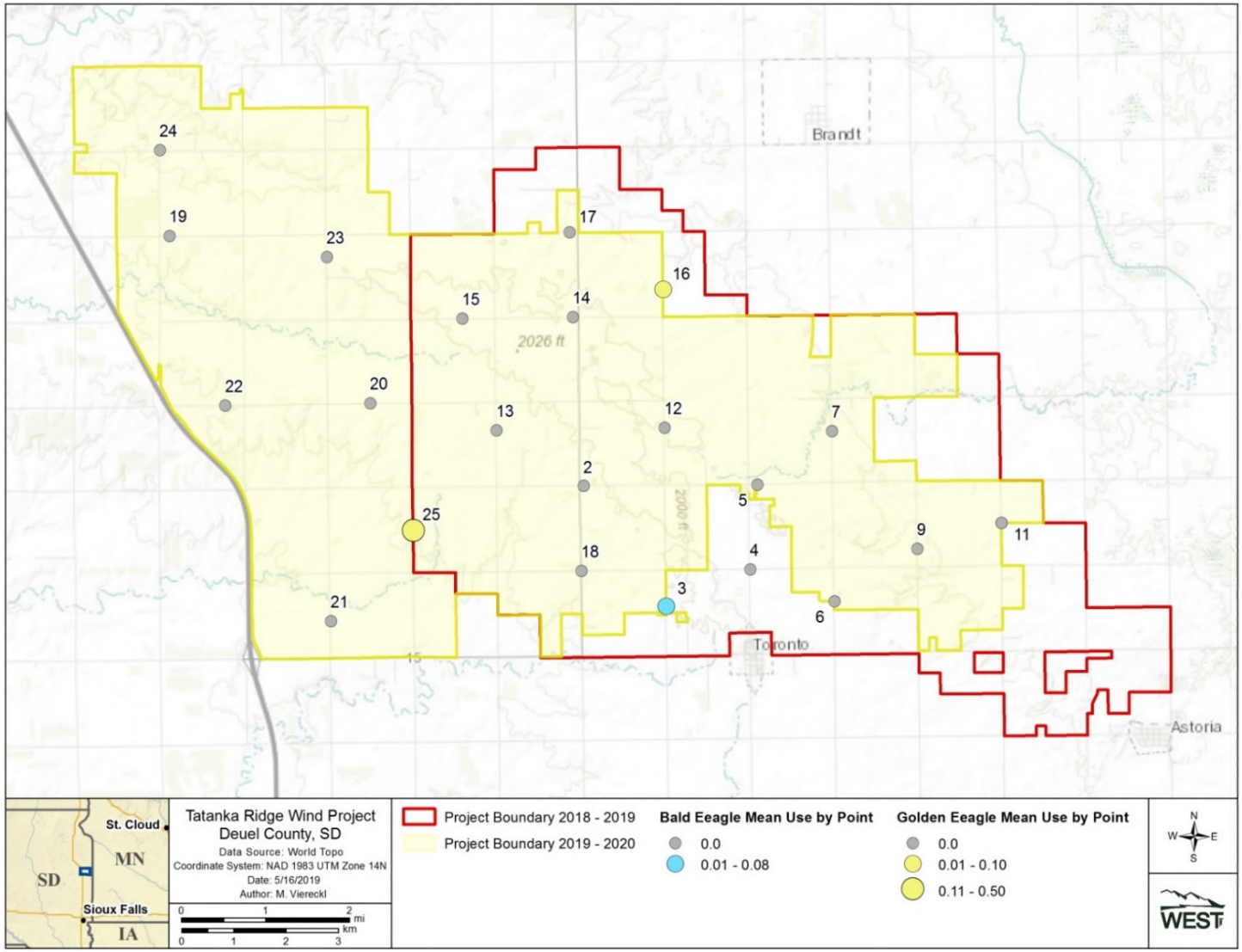

Figure 7. Eagle use by observation point at the Tatanka Ridge Wind Project in Deuel County, South Dakota during fixed-point large bird surveys from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019.

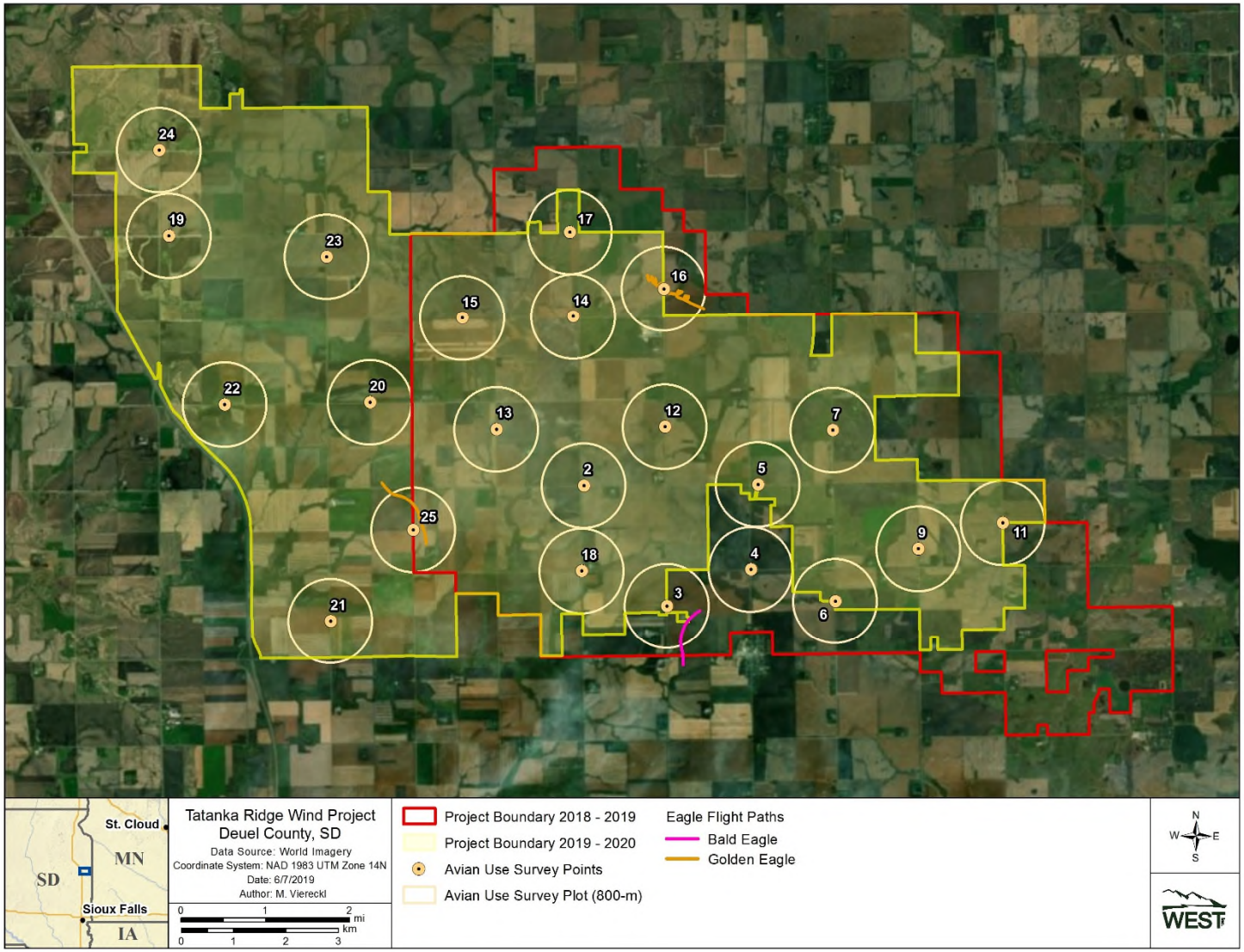

Figure 8. Flight paths for eagles by species observed at the Tatanka Ridge Wind Project from April 20, 2018 – March 26, 2019. Points 19–25 were added in February 2019.

Table 10. Survey effort, eagle observations, and mean eagle use (observations/800-meter plot/60-minute survey) by point at the Tatanka Ridge Wind Project from April 20, 2018 − March 26, 2019.

		Number of Observations		Number of Eagle Minutes			Mean Eagle Use
Point	Number of 60-minute surveys	Bald Eagles	Golden Eagles	All Bald Eagle Minutes	All Golden Eagle Minutes	Minutes within the Zone of Risk[a] (both species)	Within 800 m at All Heights (both species)
2	12	0	0	0	0	0	0
3	12	1	0	3	0	1	0.0833
4	11	0	0	0	0	0	0
5	12	0	0	0	0	0	0
6	12	0	0	0	0	0	0
7	12	0	0	0	0	0	0
9	12	0	0	0	0	0	0
11	12	0	0	0	0	0	0
12	12	0	0	0	0	0	0
13	12	0	0	0	0	0	0
14	12	1	0	6	0	0	0
15	8	0	0	0	0	0	0
16	10	0	1	0	3	3	0.1000
17	12	0	0	0	0	0	0
18	3	0	0	0	0	0	0
19	2	0	0	0	0	0	0
20	2	0	0	0	0	0	0
21	2	0	0	0	0	0	0
22	2	0	0	0	0	0	0
23	2	0	0	0	0	0	0
24	2	0	0	0	0	0	0
25	2	0	1	0	40	2	0.5
Overall	**178**	**2**	**2**	**9**	**43**	**5**	**0.0165**

[a] Zone of risk is within 800 meters (m) and below 200-m.

Sensitive Species Observations

No federally or state-listed threatened or endangered species were documented at the Project. Nine sensitive species were recorded, totaling 84 observations (Table 11). Bald and golden eagles are protected under the BGEPA and bald eagles are afforded additional protections under the SDWAP; two bald eagle observations and two golden eagle observations were recorded during fixed-point surveys, with no additional observations of either species recorded incidentally.

Three species designated by SDGFP as species of greatest conservation need were recorded at the Project, American white pelican (48 observations), bald eagle (two observations), and trumpeter swan (*Cygnus buccinator*; 15 observations; Table 11). Both bald eagle and American white pelican were documented only during fixed-point counts, while trumpeter swan was primarily observed incidentally. American white pelican was only observed in the spring (Appendix A1). Five species designated as BCC by USFWS within BCR 11 were also observed: upland sandpiper (*Bartramia longicauda*; 10 observations), Swainson's hawk (*Buteo swainsoni;* seven observations), grasshopper sparrow (*Ammodramus savannarum*; five observations), red-headed woodpecker (one observation), and dickcissel (*Spiza Americana*; 46 observations; Table 11). One observation of Swainson's hawk, and one observation of upland sandpiper were documented incidentally, while all other BCC listed species' observations were recorded during fixed-point count surveys (Table 11).

Table 11. Summary of group and individual observations of sensitive species observed at the Tatanka Ridge Wind Project during the fixed-point count avian use surveys (FPC) and as incidental wildlife observations (INC) from April 20, 2018 − March 26, 2019.

			FPC		INC		Total	
Species	**Scientific Name**	**Status**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
bald eagle	*Haliaeetus leucocephalus*	BGEPA, SGCN	2	2	0	0	2	2
golden eagle	*Aquila chrysaetos*	BGEPA	2	2	0	0	2	2
American white pelican	*Pelecanus erythrorhynchos*	SGCN	5	48	0	0	5	48
trumpeter swan	*Cygnus buccinator*	SGCN	1	4	1	11	2	15
Dickcissel	*Spiza americana*	BCC	24	46	0	0	24	46
grasshopper sparrow	*Ammodramus savannarum*	BCC	4	5	0	0	4	5
red-headed woodpecker	*Melanerpes erythrocephalus*	BCC	1	1	0	0	1	1
Swainson's hawk	*Buteo swainsoni*	BCC	4	6	1	1	5	7
upland sandpiper	*Bartramia longicauda*	BCC	8	9	1	1	9	10
Total	**9 species**		**51**	**123**	**3**	**13**	**54**	**136**

BGEPA = Bald and Golden Eagle Protection Act (1940)

BCC= Bird of Conservation Concern within Bird Conservation Region 11 (US Fish and Wildlife Service 2008)

SGCN= Species of Greatest Conservation Need in a restricted range (South Dakota Wildlife Action Plan 2014)

Grps = groups; obs = observations.

Incidental Observations

Eleven species were recorded as incidental observations outside of standard surveys totaling 75 individuals (Table 12). One species, Cooper's hawk (*Accipiter cooperii),* was only recorded incidentally and was not observed during standard surveys (Table 12, Appendix A1).

Table 12. Avian species observed incidentally at the Tatanka Ridge Wind Project from April 20, 2018 − March 26, 2019.

Species	Scientific Name	# groups	# observations
American kestrel	*Falco sparverius*	3	3
Cooper's hawk	*Accipiter cooperii*	1	1
northern flicker	*Colaptes auratus*	13	16
northern harrier	*Circus hudsonius*	6	6
red-tailed hawk	*Buteo jamaicensis*	26	28
sedge wren	*Cistothorus platensis*	1	1
Swainson's hawk	*Buteo swainsoni*	1	1
trumpeter swan	*Cygnus buccinator*	1	11
turkey vulture	*Cathartes aura*	2	4
unidentified buteo	*Buteo* spp.	3	3
upland sandpiper	*Bartramia longicauda*	1	1
Total	***11 species***	**58**	**75**

DISCUSSION

The avian species observed in the Project area during the study are typical of those commonly found in cultivated agriculture and pasturelands of the region (US Geological Survey 2018). For example, snow geese, the most abundant bird observed during the study (n = 6,310 individuals) are known to migrate in large flocks in the Central Flyway and forage within harvested grain fields (Mowbray et al., 2000). The most abundant passerine, red-winged blackbird (n = 285 individuals), is known to associate with agriculture and can occur in flocks numbering in the thousands (Yasukawa and Searcy, 2019). Grassland species such as western meadowlark (*Sturnella neglecta*; n = 53), savannah sparrow (*Passerculus sandwichensis*; n = 12), and vesper sparrow (*Pooecetes gramineus*; n = 11) were less abundant, reflecting the limited grassland habitat within the Project and surrounding landscape. Overall, the bird community consists primarily of migrant waterfowl, with bird species that use natural landscape features such as grasslands in lower abundance.

Distinct seasonal patterns of avian use were observed for both large and small birds. Large bird use was higher during spring migration than other seasons, which is typical for the Project's location in the Central Flyway (National Audubon Society 2019). High large bird use in spring and fall, and low large bird use in summer and winter, indicate the area is primarily used for migration and that breeding large birds do not occur in high density. Small bird use was highest in spring and summer, indicating the remnant natural habitat provides some functional value for passerines (Fletcher and Koford, 2002).

Spatial variation in mean use among points was detected for large birds with Point 5 having the highest use (494.50 observations/60-min survey), over 10-times the next highest mean use value. Bird species observed at Point 5 were primarily waterfowl, including snow geese. As flocks of waterfowl were observed in flight over Point 5, and not foraging on the ground within the point, it cannot be concluded that the waterfowl were physically using the landscape within the point, and it is uncertain if waterfowl use at this location will be high in subsequent years.

The study was also designed to document eagle use. During the 178 hours of surveys, just two bald eagle and two golden eagle observations were recorded for a total of 52 min of observation (9 minutes of bald eagle observation, and 43 minutes of golden eagle observation), of which just five min occurred in the zone of risk. Eagles were observed in spring, fall, and winter with no records in summer, and each of the observations occurred at different observation points. Due to the low number of observations, spatial and temporal patterns of use are not apparent. Risk to eagle and sensitive species will be analyzed and assessed in a subsequent report upon completion of the 2019−2020 surveys.

During large bird surveys, two bald eagles and two golden eagles were observed. Both species are known to occur in the region (eBird, 2019). The eBird database, housed and managed by the Cornell Lab of Ornithology, is currently the largest compendium of geospatial data on birds in the world, receiving over three million records per month, and providing an unparalleled resource for the analysis of bird distributional patterns over time and space for most of North America (Sullivan et al. 2009). According to eBird data, two golden eagle and 26 bald eagle observations were recorded in Deuel County since 2014 (eBird 2019). These data confirm that the low densities of eagles observed at the Project are consistent with typical distributions of these species in the region.

Risk Analysis

Wind energy facilities can directly and indirectly impact wildlife resources. Direct impacts include fatalities from facility construction and operation, and habitat loss and fragmentation from infrastructure placement (Erikson et al., 2014). Indirect impacts are not well studied, and may include displacement away from wind turbines (Stevens et al., 2013) These baseline Tier 3 studies provided site-specific data that, when combined with available literature, allow for a better-informed assessment of the potential impacts to avian species within the Project

Publicly available fatality rate data for avian species (bird fatalities per megawatt [MW] per year) are available for 37 studies from facilities in the Midwest (Appendix E). Passerine species are the most common fatality reported by publicly available wind-energy facility studies in the Midwest (54.8% of 1,811 fatalities; Appendix E1). For all avian species combined, fatality rates ranged from zero to 8.25 fatalities/MW/year, and averaged 2.74 fatalities/MW/year for these facilities (Appendix E2). The annual fatality rate is much lower when looking at raptors alone, where the fatality rate range is between zero and 0.47 fatality/MW/year, and averages 0.07 fatalities/MW/year (Appendix E2). Raptor use estimates and a resulting risk analyses for the Project will be developed at the completion of the 2019-2020 surveys currently in progress.

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Appendix A. All Bird Types and Species Observed at the Tatanka Ridge Wind Project during Fixed-Point Avian Use Surveys from April 20, 2018 to March 26, 2019.

Appendix A1. Summary of individuals and group observations[a] by bird type and species for 60-minute fixed-point large bird use surveys at the Tatanka Ridge Wind Project from April 20, 2018 − March 26, 2019.

		Spring		Summer		Fall		Winter		Total	
Type/Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Waterbirds		**2**	**2**	**8**	**51**	**1**	**50**	**0**	**0**	**11**	**103**
great egret	*Ardea alba*	0	0	2	2	0	0	0	0	2	2
great blue heron	*Ardea. herodias*	2	2	1	1	0	0	0	0	3	3
American white pelican	*Pelecanus erythrorhynchos*	0	0	5	48	0	0	0	0	5	48
double-crested cormorant	*Phalacrocorax auritus*	0	0	0	0	1	50	0	0	1	50
Waterfowl		**75**	**6,939**	**11**	**38**	**6**	**69**	**0**	**0**	**92**	**7,046**
wood duck	*Aix sponsa*	2	4	0	0	0	0	0	0	2	4
northern pintail	*Anas acuta*	1	7	0	0	0	0	0	0	1	7
northern shoveler	*Spatula clypeata*	2	15	0	0	0	0	0	0	2	15
blue-winged teal	*Spatula discors*	3	9	0	0	0	0	0	0	3	9
mallard	*Anas platyrhynchos*	22	40	8	13	0	0	0	0	30	53
gadwall	*Mareca strepera*	2	6	0	0	0	0	0	0	2	6
greater white-fronted goose	*Anser albifrons*	4	291	0	0	0	0	0	0	4	291
Canada goose	*Branta canadensis*	28	222	0	0	5	39	0	0	33	261
snow goose	*Anser caerulescens*	8	6,310	0	0	0	0	0	0	8	6,310
trumpeter swan	*Cygnus buccinator*	1	4	0	0	0	0	0	0	1	4
common merganser	*Mergus merganser*	1	7	0	0	0	0	0	0	1	7
unidentified duck		1	24	3	25	0	0	0	0	4	49
unidentified goose		0	0	0	0	1	30	0	0	1	30
Shorebirds		**31**	**39**	**45**	**72**	**4**	**11**	**0**	**0**	**80**	**122**
upland sandpiper	*Bartramia longicauda*	2	2	6	7	0	0	0	0	8	9
killdeer	*Charadrius vociferus*	26	34	35	61	3	10	0	0	64	105
Wilson's snipe	*Gallinago delicata*	3	3	3	3	0	0	0	0	6	6
unidentified yellowlegs	*Tringa* spp.	0	0	1	1	0	0	0	0	1	1
unidentified shorebird		0	0	0	0	1	1	0	0	1	1
Gulls/Terns		**0**	**0**	**1**	**1**	**10**	**582**	**0**	**0**	**11**	**583**
ring-billed gull	*Larus delawarensis*	0	0	0	0	1	1	0	0	1	1
Franklin's gull	*Leucophaeus pipixcan*	0	0	1	1	8	541	0	0	9	542
unidentified gull		0	0	0	0	1	40	0	0	1	40
Diurnal Raptors		**14**	**15**	**11**	**12**	**45**	**50**	**1**	**1**	**71**	**78**
Accipiters		0	0	0	0	2	2	0	0	2	2
sharp-shinned hawk	*Accipiter striatus*	0	0	0	0	2	2	0	0	2	2

Appendix A1. Summary of individuals and group observations[a] by bird type and species for 60-minute fixed-point large bird use surveys at the Tatanka Ridge Wind Project from April 20, 2018 − March 26, 2019.

		Spring		Summer		Fall		Winter		Total	
Type/Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Buteos		11	12	10	11	25	29	0	0	46	52
red-tailed hawk	*Buteo jamaicensis*	9	10	6	7	22	24	0	0	37	41
rough-legged hawk	*Buteo lagopus*	1	1	0	0	1	1	0	0	2	2
unidentified buteo	*Buteo* spp.	0	0	2	2	1	1	0	0	3	3
Swainson's hawk	*Buteo swainsoni*	1	1	2	2	1	3	0	0	4	6
Northern Harrier		1	1	1	1	10	11	0	0	12	13
northern harrier	*Circus hudsonius*	1	1	1	1	10	11	0	0	12	13
Eagles		2	2	0	0	1	1	1	1	4	4
golden eagle	*Aquila chrysaetos*	1	1	0	0	1	1	0	0	2	2
bald eagle	*Haliaeetus leucocephalus*	1	1	0	0	0	0	1	1	2	2
Falcons		0	0	0	0	5	5	0	0	5	5
merlin	*Falco columbarius*	0	0	0	0	1	1	0	0	1	1
American kestrel	*Falco sparverius*	0	0	0	0	3	3	0	0	3	3
unidentified falcon	*Falco* spp.	0	0	0	0	1	1	0	0	1	1
Other Raptors		0	0	0	0	2	2	0	0	2	2
unidentified raptor		0	0	0	0	2	2	0	0	2	2
Vultures		**4**	**9**	**2**	**2**	**5**	**5**	**0**	**0**	**11**	**16**
turkey vulture	*Cathartes aura*	4	9	2	2	5	5	0	0	11	16
Upland Game Birds		**23**	**28**	**25**	**26**	**6**	**7**	**9**	**53**	**63**	**114**
wild turkey	*Meleagris gallopavo*	0	0	1	1	0	0	0	0	1	1
ring-necked pheasant	*Phasianus colchicus*	23	28	24	25	6	7	9	53	62	113
Doves/Pigeons		**13**	**30**	**47**	**66**	**18**	**83**	**15**	**71**	**93**	**250**
rock pigeon	*Columba livia*	5	18	5	9	10	72	14	70	34	169
Eurasian collared-dove	*Streptopelia decaocto*	0	0	1	1	0	0	1	1	2	2
mourning dove	*Zenaida macroura*	8	12	41	56	8	11	0	0	57	79
Large Corvids		**20**	**69**	**2**	**2**	**11**	**34**	**5**	**7**	**38**	**112**
American crow	*Corvus brachyrhynchos*	20	69	2	2	11	34	5	7	38	112
Overall		**182**	**7,131**	**152**	**270**	**106**	**891**	**30**	**132**	**470**	**8,424**

[a] Regardless of distance from observer.

Appendix A2. Summary of individuals and group observations[a] by bird type and species for 10-minute fixed-point small bird use surveys at the Tatanka Ridge Wind Project in Deuel County, South Dakota April 20, 2018 − March 26, 2019.

		Spring		Summer		Fall		Winter		Total	
Type/Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Passerines		**128**	**508**	**256**	**432**	**58**	**185**	**8**	**118**	**450**	**1,243**
Passerines(Subtype)		2	2	16	22	18	36	0	0	36	60
unidentified passerine		2	2	16	22	18	36	0	0	36	60
Blackbirds/Orioles		69	263	75	132	20	114	0	0	164	509
red-winged blackbird	*Agelaius phoeniceus*	25	184	22	30	3	71	0	0	50	285
bobolink	*Dolichonyx oryzivorus*	4	7	9	16	0	0	0	0	13	23
Brewer's blackbird	*Euphagus cyanocephalus*	0	0	2	18	0	0	0	0	2	18
brown-headed cowbird	*Molothrus ater*	12	29	14	26	0	0	0	0	26	55
common grackle	*Quiscalus quiscula*	10	11	10	14	3	3	0	0	23	28
western meadowlark	*Sturnella neglecta*	10	15	17	27	6	11	0	0	33	53
European starling	*Sturnus vulgaris*	6	11	0	0	2	3	0	0	8	14
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	1	4	0	0	0	0	0	0	1	4
unidentified blackbird		1	2	1	1	6	26	0	0	8	29
Finches/Crossbills		4	6	19	19	5	8	0	0	28	33
American goldfinch	*Spinus tristis*	4	6	19	19	5	8	0	0	28	33
Flycatchers		1	2	6	8	0	0	0	0	7	10
eastern kingbird	*Tyrannus tyrannus*	1	2	6	8	0	0	0	0	7	10
Grassland/Sparrows		45	221	82	124	10	21	7	116	144	482
Henslow's sparrow	*Ammodramus henslowii*	0	0	1	1	0	0	0	0	1	1
grasshopper sparrow	*Ammodramus savannarum*	1	1	3	4	0	0	0	0	4	5
Lapland longspur	*Calcarius lapponicus*	10	170	0	0	0	0	0	0	10	170
unidentified longspur	*Calcarius* spp.	1	1	0	0	0	0	0	0	1	1
horned lark	*Eremophila alpestris*	17	27	7	11	6	12	7	116	37	166
song sparrow	*Melospiza melodia*	3	3	15	21	1	1	0	0	19	25
house sparrow	*Passer domesticus*	1	2	1	1	0	0	0	0	2	3
savannah sparrow	*Passerculus sandwichensis*	4	5	5	7	0	0	0	0	9	12
vesper sparrow	*Pooecetes gramineus*	2	3	8	8	0	0	0	0	10	11
dickcissel	*Spiza americana*	1	1	23	45	0	0	0	0	24	46
clay-colored sparrow	*Spizella pallida*	3	4	10	13	0	0	0	0	13	17
chipping sparrow	*Spizella passerina*	1	1	3	5	0	0	0	0	4	6
American tree sparrow	*Spizelloides arborea*	0	0	0	0	2	6	0	0	2	6
unidentified sparrow		1	3	6	8	1	2	0	0	8	13
Mimids		0	0	1	1	0	0	0	0	1	1
brown thrasher	*Toxostoma rufum*	0	0	1	1	0	0	0	0	1	1

Appendix A2. Summary of individuals and group observations[a] by bird type and species for 10-minute fixed-point small bird use surveys at the Tatanka Ridge Wind Project in Deuel County, South Dakota April 20, 2018 − March 26, 2019.

		Spring		Summer		Fall		Winter		Total	
Type/Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Swallows		2	7	32	93	1	2	0	0	35	102
barn swallow	*Hirundo rustica*	2	7	15	48	1	2	0	0	18	57
cliff swallow	*Petrochelidon pyrrhonota*	0	0	12	38	0	0	0	0	12	38
northern rough-winged swallow	*Stelgidopteryx serripennis*	0	0	1	2	0	0	0	0	1	2
unidentified swallow		0	0	4	5	0	0	0	0	4	5
Thrushes		2	3	6	8	1	1	0	0	9	12
American robin	*Turdus migratorius*	2	3	6	8	1	1	0	0	9	12
Warblers		3	4	5	6	0	0	0	0	8	10
common yellowthroat	*Geothlypis trichas*	3	4	5	6	0	0	0	0	8	10
Wrens		0	0	14	19	0	0	0	0	14	19
sedge wren	*Cistothorus platensis*	0	0	14	19	0	0	0	0	14	19
Corvids		0	0	0	0	3	3	1	2	4	5
blue jay	*Cyanocitta cristata*	0	0	0	0	3	3	1	2	4	5
Woodpeckers		**1**	**1**	**2**	**2**	**2**	**2**	**0**	**0**	**5**	**5**
northern flicker	*Colaptes auratus*	0	0	0	0	1	1	0	0	1	1
red-headed woodpecker	*Melanerpes erythrocephalus*	0	0	1	1	0	0	0	0	1	1
downy woodpecker	*Dryobates pubescens*	1	1	1	1	0	0	0	0	2	2
hairy woodpecker	*Dryobates villosus*	0	0	0	0	1	1	0	0	1	1
Overall		**129**	**509**	**258**	**434**	**60**	**187**	**8**	**118**	**455**	**1,248**

[a] Regardless of distance from observer.

Appendix B. Mean Use, Percent of Use, and Frequency of Occurrence for Large Birds and Small Birds Observed during Fixed-Point Avian Use Surveys at the Tatanka Ridge Wind Project from April 20, 2018 to March 26, 2019.

Appendix B1. Mean large bird use (number of large observations/800-meter plot/60-minute survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point large bird use surveys at the Tatanka Ridge Wind Project in Deuel County, South Dakota from April 20, 2018 − March 26, 2019.

	Mean Use				% of Use				% Frequency			
Type/Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Waterbirds	**0.04**	**1.21**	**1.19**	**0**	**<0.1**	**18.9**	**5.6**	**0**	**4.0**	**14.3**	**2.4**	**0**
great egret	0	0.05	0	0	0	0.7	0	0	0	4.8	0	0
great blue heron	0.04	0.02	0	0	<0.1	0.4	0	0	4.0	2.4	0	0
American white pelican	0	1.14	0	0	0	17.8	0	0	0	7.1	0	0
double-crested cormorant	0	0	1.19	0	0	0	5.6	0	0	0	2.4	0
Waterfowl	**117.21**	**0.90**	**1.64**	**0**	**96.8**	**14.1**	**7.7**	**0**	**45.0**	**21.4**	**9.5**	**0**
wood duck	0.10	0	0	0	<0.1	0	0	0	2.4	0	0	0
northern pintail	0.17	0	0	0	0.1	0	0	0	2.4	0	0	0
northern shoveler	0.36	0	0	0	0.3	0	0	0	2.4	0	0	0
blue-winged teal	0.21	0	0	0	0.2	0	0	0	4.8	0	0	0
mallard	0.87	0.31	0	0	0.7	4.8	0	0	24.8	16.7	0	0
gadwall	0.14	0	0	0	0.1	0	0	0	2.4	0	0	0
greater white-fronted goose	4.85	0	0	0	4.0	0	0	0	5.0	0	0	0
Canada goose	4.20	0	0.93	0	3.5	0	4.4	0	17.1	0	7.1	0
snow goose	105.70	0	0	0	87.3	0	0	0	7.4	0	0	0
trumpeter swan	0.10	0	0	0	<0.1	0	0	0	2.4	0	0	0
common merganser	0.12	0	0	0	<0.1	0	0	0	1.7	0	0	0
unidentified duck	0.40	0.60	0	0	0.3	9.3	0	0	1.7	7.1	0	0
unidentified goose	0	0	0.71	0	0	0	3.4	0	0	0	2.4	0
Shorebirds	**0.89**	**1.71**	**0.26**	**0**	**0.7**	**26.7**	**1.2**	**0**	**32.9**	**57.1**	**7.1**	**0**
upland sandpiper	0.05	0.17	0	0	<0.1	2.6	0	0	4.8	9.5	0	0
killdeer	0.77	1.45	0.24	0	0.6	22.6	1.1	0	32.9	57.1	4.8	0
Wilson's snipe	0.07	0.07	0	0	<0.1	1.1	0	0	7.1	7.1	0	0
unidentified yellowlegs	0	0.02	0	0	0	0.4	0	0	0	2.4	0	0
unidentified shorebird	0	0	0.02	0	0	0	0.1	0	0	0	2.4	0
Gulls/Terns	**0**	**0.02**	**13.86**	**0**	**0**	**0.4**	**65.3**	**0**	**0**	**2.4**	**14.3**	**0**
ring-billed gull	0	0	0.02	0	0	0	0.1	0	0	0	2.4	0
Franklin's gull	0	0.02	12.88	0	0	0.4	60.7	0	0	2.4	11.9	0
unidentified gull	0	0	0.95	0	0	0	4.5	0	0	0	2.4	0
Diurnal Raptors	**0.32**	**0.29**	**1.19**	**0.03**	**0.3**	**4.4**	**5.6**	**1.0**	**24.8**	**21.4**	**47.6**	**2.6**
Accipiters	0	0	0.05	0	0	0	0.2	0	0	0	4.8	0
sharp-shinned hawk	0	0	0.05	0	0	0	0.2	0	0	0	4.8	0

Appendix B1. Mean large bird use (number of large observations/800-meter plot/60-minute survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point large bird use surveys at the Tatanka Ridge Wind Project in Deuel County, South Dakota from April 20, 2018 − March 26, 2019.

	Mean Use				% of Use				% Frequency			
Type/Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Buteos	0.28	0.26	0.69	0	0.2	4.1	3.3	0	23.1	19.0	31.0	0
red-tailed hawk	0.23	0.17	0.57	0	0.2	2.6	2.7	0	18.3	14.3	28.6	0
rough-legged hawk	0.02	0	0.02	0	<0.1	0	0.1	0	2.4	0	2.4	0
unidentified buteo	0	0.05	0.02	0	0	0.7	0.1	0	0	4.8	2.4	0
Swainson's hawk	0.02	0.05	0.07	0	<0.1	0.7	0.3	0	2.4	4.8	2.4	0
Northern Harrier	0.02	0.02	0.26	0	<0.1	0.4	1.2	0	2.4	2.4	21.4	0
northern harrier	0.02	0.02	0.26	0	<0.1	0.4	1.2	0	2.4	2.4	21.4	0
Eagles	0.02	0	0.02	0.03	<0.1	0	0.1	1.0	1.7	0	2.4	2.6
golden eagle	0.02	0	0.02	0	<0.1	0	0.1	0	1.7	0	2.4	0
bald eagle	0	0	0	0.03	0	0	0	1.0	0	0	0	2.6
Falcons	0	0	0.12	0	0	0	0.6	0	0	0	7.1	0
merlin	0	0	0.02	0	0	0	0.1	0	0	0	2.4	0
American kestrel	0	0	0.07	0	0	0	0.3	0	0	0	4.8	0
unidentified falcon	0	0	0.02	0	0	0	0.1	0	0	0	2.4	0
Other Raptors	0	0	0.05	0	0	0	0.2	0	0	0	4.8	0
unidentified raptor	0	0	0.05	0	0	0	0.2	0	0	0	4.8	0
Vultures	**0.21**	**0.05**	**0.12**	**0**	**0.2**	**0.7**	**0.6**	**0**	**7.1**	**4.8**	**7.1**	**0**
turkey vulture	0.21	0.05	0.12	0	0.2	0.7	0.6	0	7.1	4.8	7.1	0
Upland Game Birds	**0.64**	**0.62**	**0.17**	**0.99**	**0.5**	**9.6**	**0.8**	**37.4**	**36.0**	**40.5**	**11.9**	**15.8**
wild turkey	0	0.02	0	0	0	0.4	0	0	0	2.4	0	0
ring-necked pheasant	0.64	0.60	0.17	0.99	0.5	9.3	0.8	37.4	36.0	38.1	11.9	15.8
Doves/Pigeons	**0.63**	**1.57**	**1.98**	**1.48**	**0.5**	**24.4**	**9.3**	**55.6**	**21.7**	**59.5**	**33.3**	**22.0**
rock pigeon	0.34	0.21	1.71	1.46	0.3	3.3	8.1	54.9	9.8	11.9	19.0	20.3
Eurasian collared-dove	0	0.02	0	0.02	0	0.4	0	0.7	0	2.4	0	1.8
mourning dove	0.29	1.33	0.26	0	0.2	20.7	1.2	0	11.9	57.1	14.3	0
Large Corvids	**1.21**	**0.05**	**0.81**	**0.16**	**1.0**	**0.7**	**3.8**	**6.1**	**25.2**	**4.8**	**11.9**	**8.5**
American crow	1.21	0.05	0.81	0.16	1.0	0.7	3.8	6.1	25.2	4.8	11.9	8.5
Overall	**121.15**	**6.43**	**21.21**	**2.66**	**100**	**100**	**100**	**100**				

Sums may not equal total values shown due to rounding.

Appendix B2. Mean small bird use (number of observations/100-meter plot/10-minute survey), percent of total use (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point avian use surveys at the Tatanka Ridge Wind Project in Deuel County, South Dakota from April 20, 2018 − March 26, 2019.

	Mean Use				% of Use				% Frequency			
Type/Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Passerines	**9.73**	**10.29**	**4.40**	**2.18**	**99.8**	**99.5**	**98.9**	**100**	**69.0**	**92.9**	**59.5**	**16.7**
Passerines(Subtype)	0.05	0.52	0.86	0	0.5	5.1	19.3	0	4.8	31.0	31.0	0
unidentified passerine	0.05	0.52	0.86	0	0.5	5.1	19.3	0	4.8	31.0	31.0	0
Blackbirds/Orioles	5.30	3.14	2.71	0	54.3	30.4	61.0	0	47.1	59.5	31.0	0
red-winged blackbird	3.42	0.71	1.69	0	35.0	6.9	38.0	0	28.1	19.0	7.1	0
bobolink	0.17	0.38	0	0	1.7	3.7	0	0	7.1	11.9	0	0
Brewer's blackbird	0	0.43	0	0	0	4.1	0	0	0	4.8	0	0
brown-headed cowbird	0.69	0.62	0	0	7.1	6.0	0	0	21.4	26.2	0	0
common grackle	0.26	0.33	0.07	0	2.7	3.2	1.6	0	7.1	19.0	7.1	0
western meadowlark	0.36	0.64	0.26	0	3.7	6.2	5.9	0	16.7	19.0	9.5	0
European starling	0.26	0	0.07	0	2.7	0	1.6	0	11.9	0	4.8	0
yellow-headed blackbird	0.10	0	0	0	1.0	0	0	0	2.4	0	0	0
unidentified blackbird	0.05	0.02	0.62	0	0.5	0.2	13.9	0	2.4	2.4	11.9	0
Finches/Crossbills	0.14	0.45	0.19	0	1.5	4.4	4.3	0	7.1	35.7	11.9	0
American goldfinch	0.14	0.45	0.19	0	1.5	4.4	4.3	0	7.1	35.7	11.9	0
Flycatchers	0.05	0.19	0	0	0.5	1.8	0	0	2.4	14.3	0	0
eastern kingbird	0.05	0.19	0	0	0.5	1.8	0	0	2.4	14.3	0	0
Grassland/Sparrows	3.87	2.95	0.50	2.13	39.7	28.6	11.2	97.8	50.7	73.8	19.0	14.3
Henslow's sparrow	0	0.02	0	0	0	0.2	0	0	0	2.4	0	0
grasshopper sparrow	0.02	0.10	0	0	0.2	0.9	0	0	2.4	7.1	0	0
Lapland longspur	2.83	0	0	0	29.1	0	0	0	5.0	0	0	0
unidentified longspur	0.02	0	0	0	0.2	0	0	0	2.4	0	0	0
horned lark	0.54	0.26	0.29	2.13	5.5	2.5	6.4	97.8	23.6	14.3	9.5	14.3
song sparrow	0.07	0.50	0.02	0	0.7	4.8	0.5	0	7.1	28.6	2.4	0
house sparrow	0.05	0.02	0	0	0.5	0.2	0	0	2.4	2.4	0	0
savannah sparrow	0.12	0.17	0	0	1.2	1.6	0	0	7.1	9.5	0	0
vesper sparrow	0.07	0.19	0	0	0.7	1.8	0	0	4.8	14.3	0	0
dickcissel	0.02	1.07	0	0	0.2	10.4	0	0	2.4	31.0	0	0
clay-colored sparrow	0.05	0.31	0	0	0.5	3.0	0	0	2.4	21.4	0	0
chipping sparrow	0.02	0.12	0	0	0.2	1.2	0	0	2.4	7.1	0	0
American tree sparrow	0	0	0.14	0	0	0	3.2	0	0	0	4.8	0
unidentified sparrow	0.05	0.19	0.05	0	0.5	1.8	1.1	0	1.7	14.3	2.4	0
Mimids	0	0.02	0	0	0	0.2	0	0	0	2.4	0	0
brown thrasher	0	0.02	0	0	0	0.2	0	0	0	2.4	0	0

Appendix B2. Mean small bird use (number of observations/100-meter plot/10-minute survey), percent of total use (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point avian use surveys at the Tatanka Ridge Wind Project in Deuel County, South Dakota from April 20, 2018 − March 26, 2019.

	Mean Use				% of Use				% Frequency			
Type/Species	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**
Swallows	0.17	2.21	0.05	0	1.7	21.4	1.1	0	2.4	33.3	2.4	0
barn swallow	0.17	1.14	0.05	0	1.7	11.1	1.1	0	2.4	19.0	2.4	0
cliff swallow	0	0.90	0	0	0	8.8	0	0	0	14.3	0	0
northern rough-winged swallow	0	0.05	0	0	0	0.5	0	0	0	2.4	0	0
unidentified swallow	0	0.12	0	0	0	1.2	0	0	0	9.5	0	0
Thrushes	0.06	0.19	0.02	0	0.6	1.8	0.5	0	4.0	11.9	2.4	0
American robin	0.06	0.19	0.02	0	0.6	1.8	0.5	0	4.0	11.9	2.4	0
Warblers	0.10	0.14	0	0	1.0	1.4	0	0	2.4	9.5	0	0
common yellowthroat	0.10	0.14	0	0	1.0	1.4	0	0	2.4	9.5	0	0
Wrens	0	0.45	0	0	0	4.4	0	0	0	23.8	0	0
sedge wren	0	0.45	0	0	0	4.4	0	0	0	23.8	0	0
Corvids	0	0	0.07	0.05	0	0	1.6	2.2	0	0	4.8	2.4
blue jay	0	0	0.07	0.05	0	0	1.6	2.2	0	0	4.8	2.4
Woodpeckers	**0.02**	**0.05**	**0.05**	**0**	**0.2**	**0.5**	**1.1**	**0**	**2.4**	**4.8**	**4.8**	**0**
northern flicker	0	0	0.02	0	0	0	0.5	0	0	0	2.4	0
red-headed woodpecker	0	0.02	0	0	0	0.2	0	0	0	2.4	0	0
downy woodpecker	0.02	0.02	0	0	0.2	0.2	0	0	2.4	2.4	0	0
hairy woodpecker	0	0	0.02	0	0	0	0.5	0	0	0	2.4	0
Overall	**9.75**	**10.33**	**4.45**	**2.18**	**100**	**100**	**100**	**100**				

Sums may not equal total values shown due to rounding.

Appendix C. Species Exposure Indices for Large Birds during Fixed-Point Avian Use Surveys at theTatanka Ridge Wind Project from April 20, 2018 to March 26, 2019.

Appendix C1. Relative exposure index and flight characteristics for each large bird species during the 60-minute fixed-point large bird use surveys at the Tatanka Ridge Wind Project in Deuel County, South Dakota from April 20, 2018 – March 26, 2019.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH[a] Based on Initial Observation	Exposure Index	% Within RSH at Any Time
snow goose	8	26.64	100	98.0	26.12	98.0
greater white-fronted goose	4	1.22	100	100	1.22	100
Canada goose	32	1.29	99.2	68.3	0.87	78.0
Franklin's gull	9	3.22	100	12.2	0.39	81.4
double-crested cormorant	1	0.30	100	100	0.30	100
American white pelican	5	0.29	100	100	0.29	100
mallard	26	0.30	90.6	52.1	0.14	56.2
red-tailed hawk	35	0.24	95.1	33.3	0.08	64.1
unidentified duck	4	0.25	100	18.4	0.05	49.0
turkey vulture	11	0.10	100	31.2	0.03	81.2
common merganser	1	0.03	100	100	0.03	100
trumpeter swan	1	0.02	100	100	0.02	100
bald eagle	1	<0.01	100	100	<0.01	100
Wilson's snipe	1	0.04	16.7	100	<0.01	100
unidentified buteo	3	0.02	100	33.3	<0.01	33.3
Swainson's hawk	3	0.04	83.3	20.0	<0.01	80.0
unidentified raptor	2	0.01	100	50.0	<0.01	50.0
merlin	1	<0.01	100	100	<0.01	100
great blue heron	3	0.02	100	33.3	<0.01	66.7
golden eagle	2	0.01	100	50.0	<0.01	50.0
American crow	29	0.56	86.6	0	0	0
mourning dove	42	0.47	74.7	0	0	3.4
Eurasian collared-dove	1	0.01	50.0	0	0	0
rock pigeon	34	0.93	100	0	0	13.0
ring-necked pheasant	12	0.60	49.6	0	0	0
unidentified falcon	1	<0.01	100	0	0	0
American kestrel	3	0.02	100	0	0	33.3
northern harrier	12	0.08	100	0	0	7.7
rough-legged hawk	2	0.01	100	0	0	0
sharp-shinned hawk	2	0.01	100	0	0	0
ring-billed gull	1	<0.01	100	0	0	0
unidentified gull	1	0.24	100	0	0	0
killdeer	35	0.62	64.8	0	0	0
unidentified shorebird	1	<0.01	100	0	0	0
gadwall	2	0.04	100	0	0	0
blue-winged teal	1	0.05	33.3	0	0	0
northern shoveler	1	0.09	26.7	0	0	0
wood duck	2	0.02	100	0	0	0
unidentified goose	1	0.18	100	0	0	0

Appendix C1. Relative exposure index and flight characteristics for each large bird species during the 60-minute fixed-point large bird use surveys at the Tatanka Ridge Wind Project in Deuel County, South Dakota from April 20, 2018 – March 26, 2019.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH[a] Based on Initial Observation	Exposure Index	% Within RSH at Any Time
great egret	2	0.01	100	0	0	50.0
wild turkey	0	<0.01	0			
unidentified yellowlegs	0	<0.01	0			
upland sandpiper	0	0.05	0			
northern pintail	0	0.04	0			

[a] RSH = The likely “rotor swept heights” for potential collision with a turbine blade, or 25−150 meters (82−492 feet) above ground level.

Appendix C2. Relative exposure index and flight characteristics for small bird species during the 10-minute fixed-point small bird use surveys at the Tatanka Ridge Wind Project in Deuel County, South Dakota from April 20, 2018 − March 26, 2019.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH[a] Based on Initial Observation	Exposure Index	% Within RSH at Any Time
Lapland longspur	8	0.71	96.5	3.0	0.02	64.0
unidentified swallow	4	0.03	100	40.0	0.01	40.0
downy woodpecker	1	0.01	50.0	0	0	0
northern flicker	1	<0.01	100	0	0	0
blue jay	3	0.03	80.0	0	0	0
northern rough-winged swallow	1	0.01	100	0	0	0
cliff swallow	12	0.23	100	0	0	0
barn swallow	18	0.34	100	0	0	0
clay-colored sparrow	2	0.09	20.0	0	0	0
vesper sparrow	4	0.07	36.4	0	0	0
house sparrow	1	0.02	33.3	0	0	0
song sparrow	1	0.15	12.0	0	0	0
horned lark	23	0.80	75.3	0	0	0
unidentified longspur	1	<0.01	100	0	0	0
unidentified sparrow	6	0.07	84.6	0	0	0
eastern kingbird	3	0.06	50.0	0	0	0
American goldfinch	7	0.20	21.2	0	0	0
yellow-headed blackbird	1	0.02	100	0	0	0
European starling	7	0.08	64.3	0	0	0
western meadowlark	12	0.32	28.3	0	0	0
common grackle	20	0.17	89.3	0	0	0
brown-headed cowbird	17	0.33	74.5	0	0	0
Brewer’s blackbird	2	0.11	100	0	0	0
bobolink	4	0.14	17.4	0	0	0
red-winged blackbird	31	1.46	91.6	0	0	0
unidentified blackbird	6	0.17	62.1	0	0	0
unidentified passerine	15	0.36	48.3	0	0	0
hairy woodpecker	0	<0.01	0			
red-headed woodpecker	0	<0.01	0			
sedge wren	0	0.11	0			
common yellowthroat	0	0.06	0			
American robin	0	0.07	0			
brown thrasher	0	<0.01	0			
American tree sparrow	0	0.04	0			
chipping sparrow	0	0.04	0			
dickcissel	0	0.28	0			
savannah sparrow	0	0.07	0			
grasshopper sparrow	0	0.03	0			
Henslow’s sparrow	0	<0.01	0			

[a]RSH = The likely “rotor swept heights (RSH)” for potential collision with a turbine blade, or 25−150 meters (82−492 feet) above ground level.

Appendix D. Spatial Use by Point during Fixed-Point Avian Use Surveys at the Tatanka Ridge Wind Project from April 20, 2018 to March 26, 2019.

Appendix D1. Mean use (number of observations/800-meter plot/60-minute survey) by point for all large birds, major bird types, and diurnal raptor subtypes observed at the Tatanka Ridge Wind Project from April 20, 2018 − March 26, 2019. Points 19-25 were added in February 2019

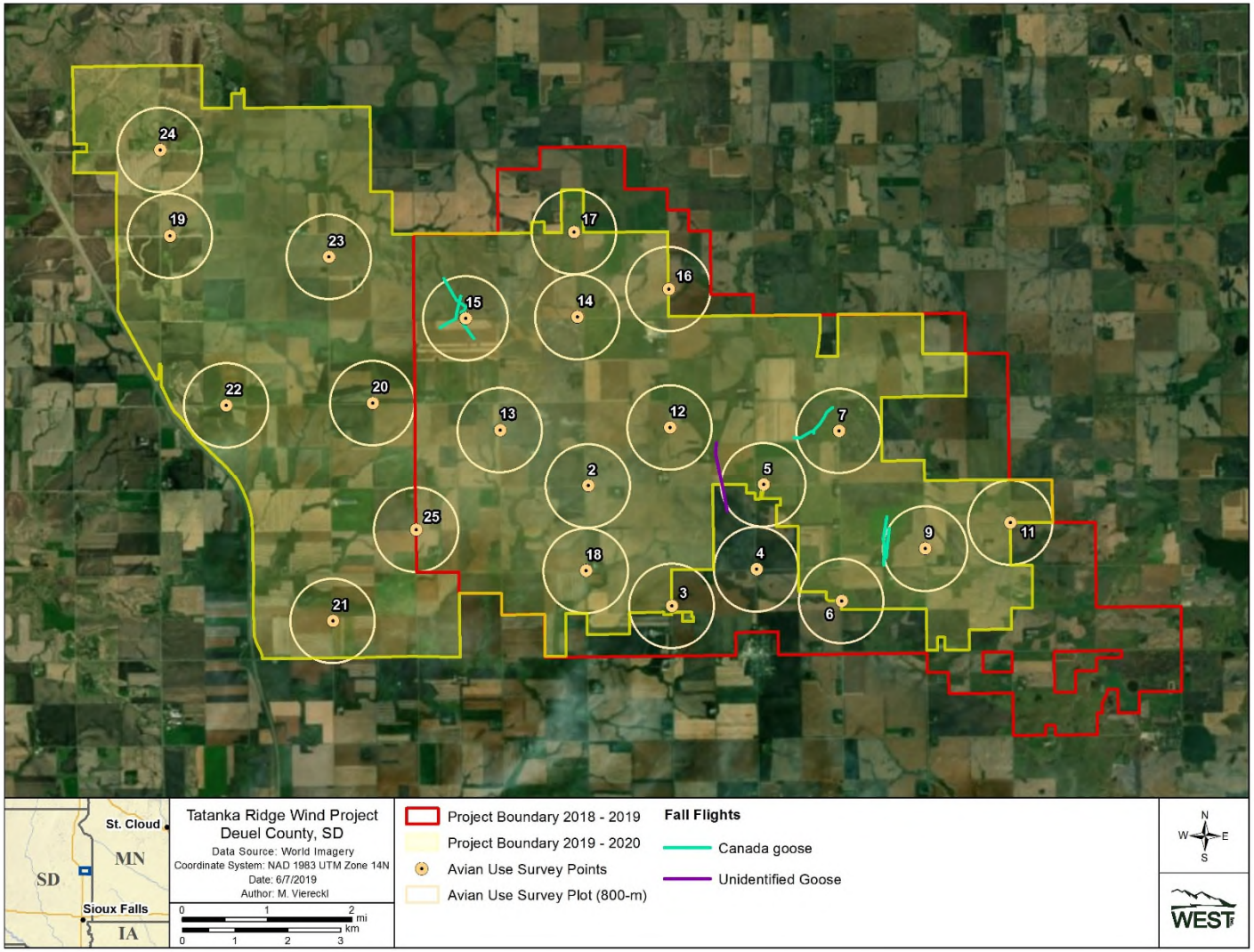
	Sur vey Point										
Bird Type	**2**	**3**	**4**	**5**	**6**	**7**	**9**	**11**	**12**	**13**	**14**
Waterbirds	**0**	**0**	**0.27**	**0**	**3.33**	**0.08**	**0**	**0**	**0.33**	**0**	**0**
Waterfowl	**0.25**	**0.08**	**27.91**	**491.33**	**2.08**	**2.25**	**9.25**	**37.25**	**0.92**	**2.75**	**3.58**
Shorebirds	**0**	**0.25**	**1.27**	**1.42**	**1.75**	**0.50**	**0**	**0.17**	**1.25**	**1.42**	**0.42**
Gulls/Terns	**5.50**	**0**	**4.55**	**0**	**0**	**0.08**	**0**	**0**	**0**	**0**	**34.67**
Diurnal Raptors	**0.33**	**0.08**	**0.45**	**0.25**	**0.67**	**0.67**	**0.67**	**0.58**	**0.75**	**0.33**	**0.42**
Accipiters	0	0	0	0	0	0	0.08	0	0	0	0
Buteos	0.08	0	0.27	0.17	0.58	0.58	0.50	0.50	0.58	0.25	0.08
Northern Harrier	0.17	0	0.18	0.08	0.08	0	0.08	0	0	0.08	0.17
Eagles	0	0.08	0	0	0	0	0	0	0	0	0
Falcons	0	0	0	0	0	0.08	0	0	0.17	0	0.17
Other Raptors	0.08	0	0	0	0	0	0	0.08	0	0	0
Vultures	**0.08**	**0**	**0**	**0**	**0**	**0.25**	**0**	**0.25**	**0.25**	**0**	**0.08**
Upland Game Birds	**0**	**0.25**	**0.36**	**0.83**	**0**	**0.67**	**0.25**	**0.67**	**0.33**	**1.00**	**0**
Doves/Pigeons	**2.42**	**2.08**	**0.27**	**0.67**	**1.00**	**0.33**	**0.83**	**0**	**4.33**	**0.58**	**3.25**
Large Corvids	**1.50**	**0.17**	**0**	**0**	**0.33**	**0**	**0.08**	**0**	**0.42**	**0.25**	**1.17**
All Large Birds	**10.08**	**2.92**	**35.09**	**494.50**	**9.17**	**4.83**	**11.08**	**38.92**	**8.58**	**6.33**	**43.58**

Sums may not equal total values shown due to rounding.

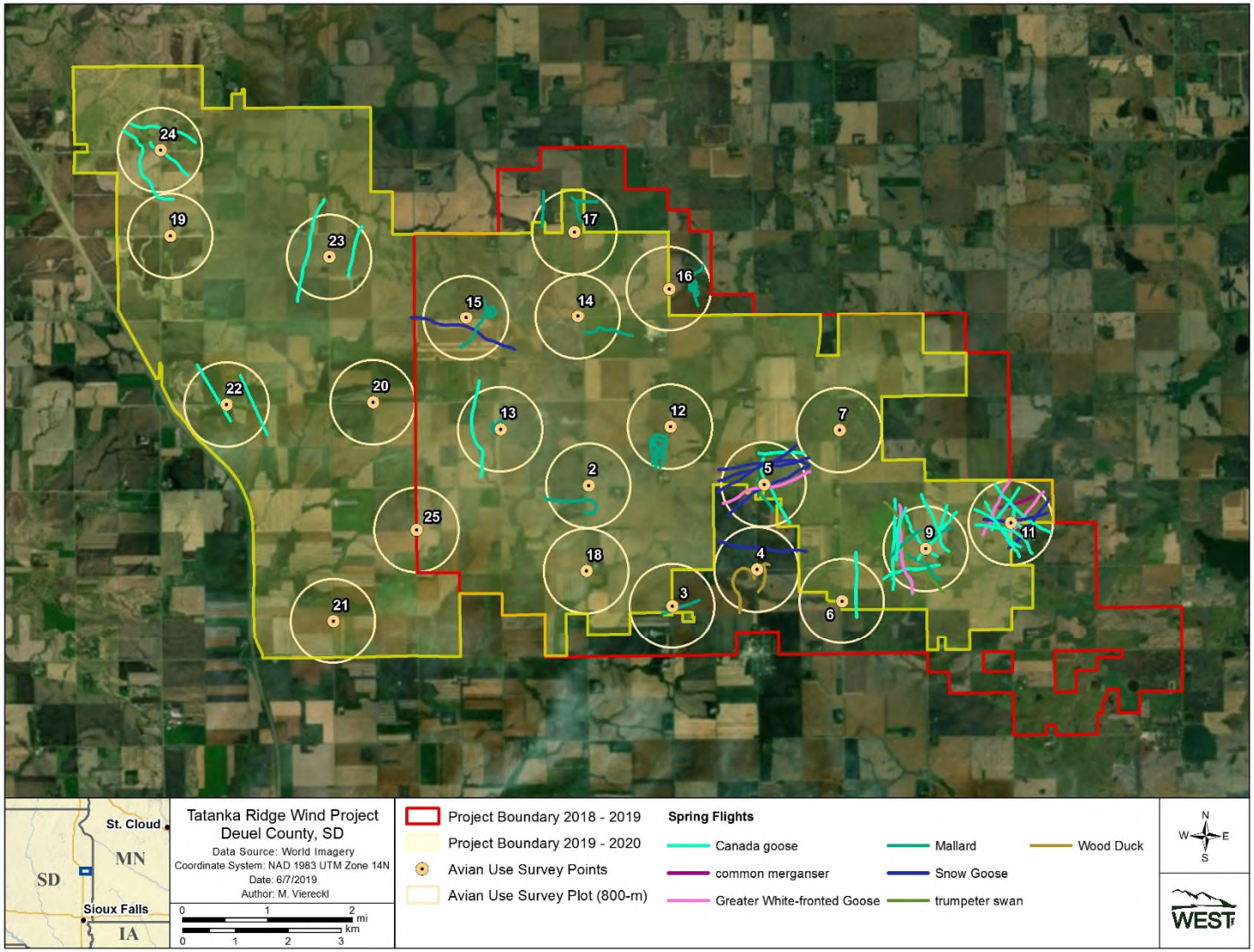
Appendix D1 (*continued*). Mean use (number of observations/800-meter plot/60-minute survey) by point for all large birds, major bird types, and diurnal raptor subtypes observed at the Tatanka Ridge Wind Project from April 20, 2018 − March 26, 2019. Points 19-25 were added in February 2019

	Survey Point										
Bird Type	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
Waterbirds	**6.25**	**0**	**0.42**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Waterfowl	**10.00**	**1.30**	**0.42**	**0**	**0**	**0**	**0**	**4.50**	**5.00**	**12.50**	**0**
Shorebirds	**0.50**	**0.70**	**0.83**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.50**
Gulls/Terns	**0**	**5.00**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Diurnal Raptors	**0.50**	**0.50**	**0.33**	**0**	**0**	**0.50**	**0**	**0**	**0**	**0**	**0.50**
Accipiters	0	0.10	0	0	0	0	0	0	0	0	0
Buteos	0.12	0.30	0.33	0	0	0.50	0	0	0	0	0
Northern Harrier	0.38	0	0	0	0	0	0	0	0	0	0
Eagles	0	0.10	0	0	0	0	0	0	0	0	0.50
Falcons	0	0	0	0	0	0	0	0	0	0	0
Other Raptors	0	0	0	0	0	0	0	0	0	0	0
Vultures	**0**	**0.50**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Upland Game Birds	**0.75**	**0.40**	**0.58**	**0**	**0**	**20.00**	**0**	**0**	**0**	**0**	**2.50**
Doves/Pigeons	**0.12**	**2.60**	**1.92**	**2.67**	**0**	**0**	**0**	**0**	**0**	**1.50**	**0**
Large Corvids	**1.38**	**0.20**	**1.17**	**0**	**0**	**10.00**	**1.00**	**0**	**1.00**	**7.00**	**0**
All Large Birds	**19.50**	**11.20**	**5.67**	**2.67**	**0**	**30.50**	**1.00**	**4.50**	**6.00**	**21.00**	**3.50**

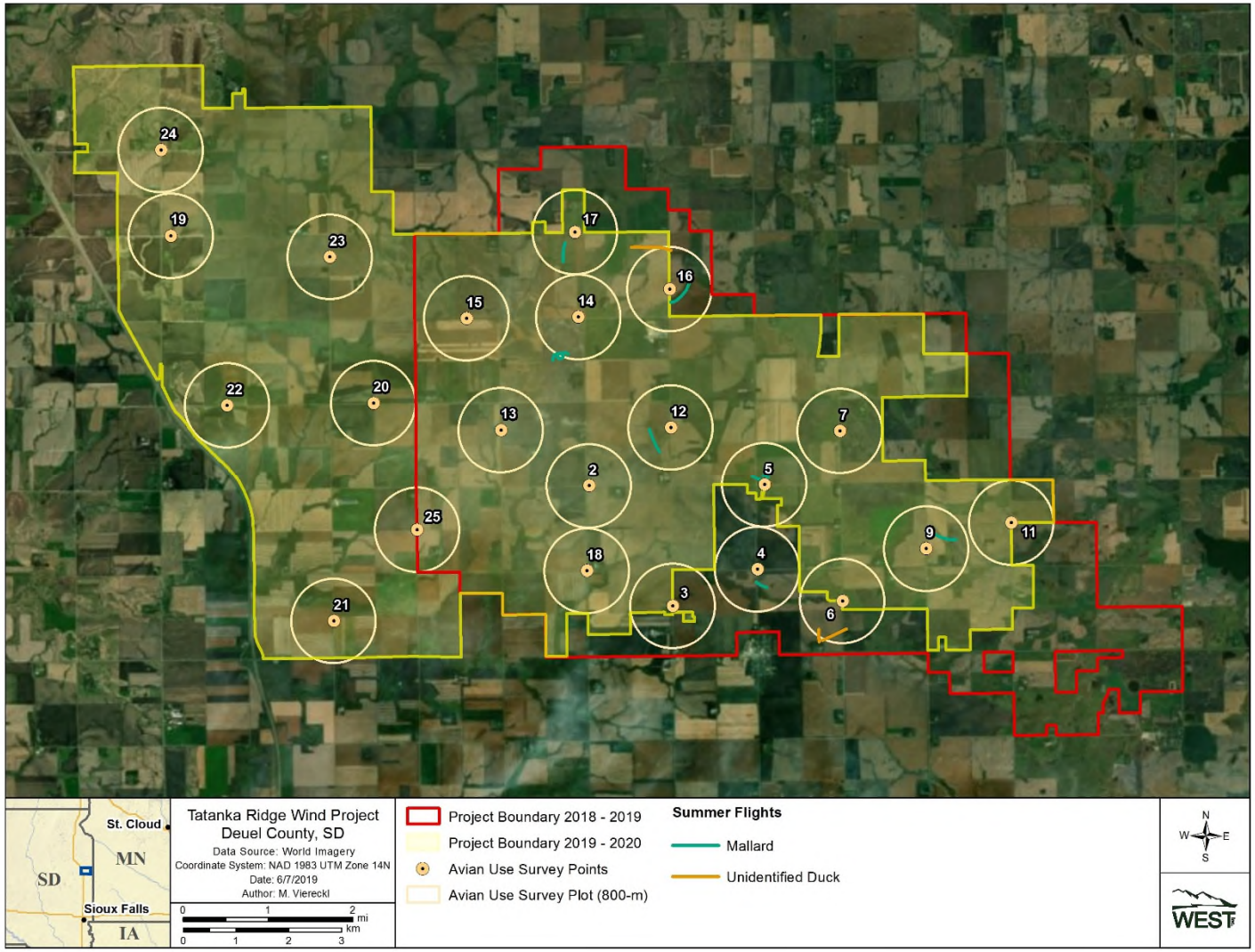
Sums may not equal total values shown due to rounding.



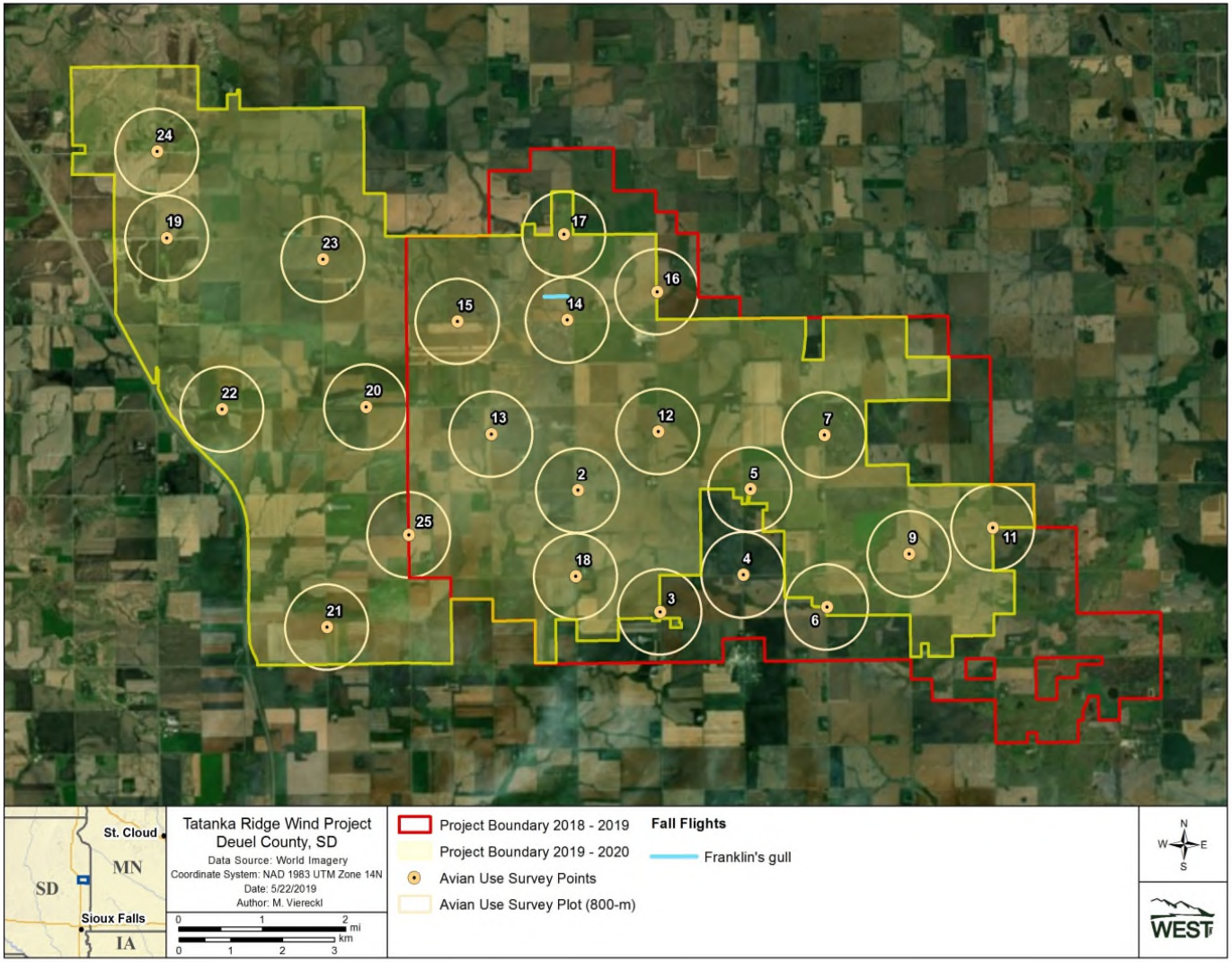
Appendix D2. Waterfowl flight paths recorded during the fall season during 60-minute fixed-point large bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019.



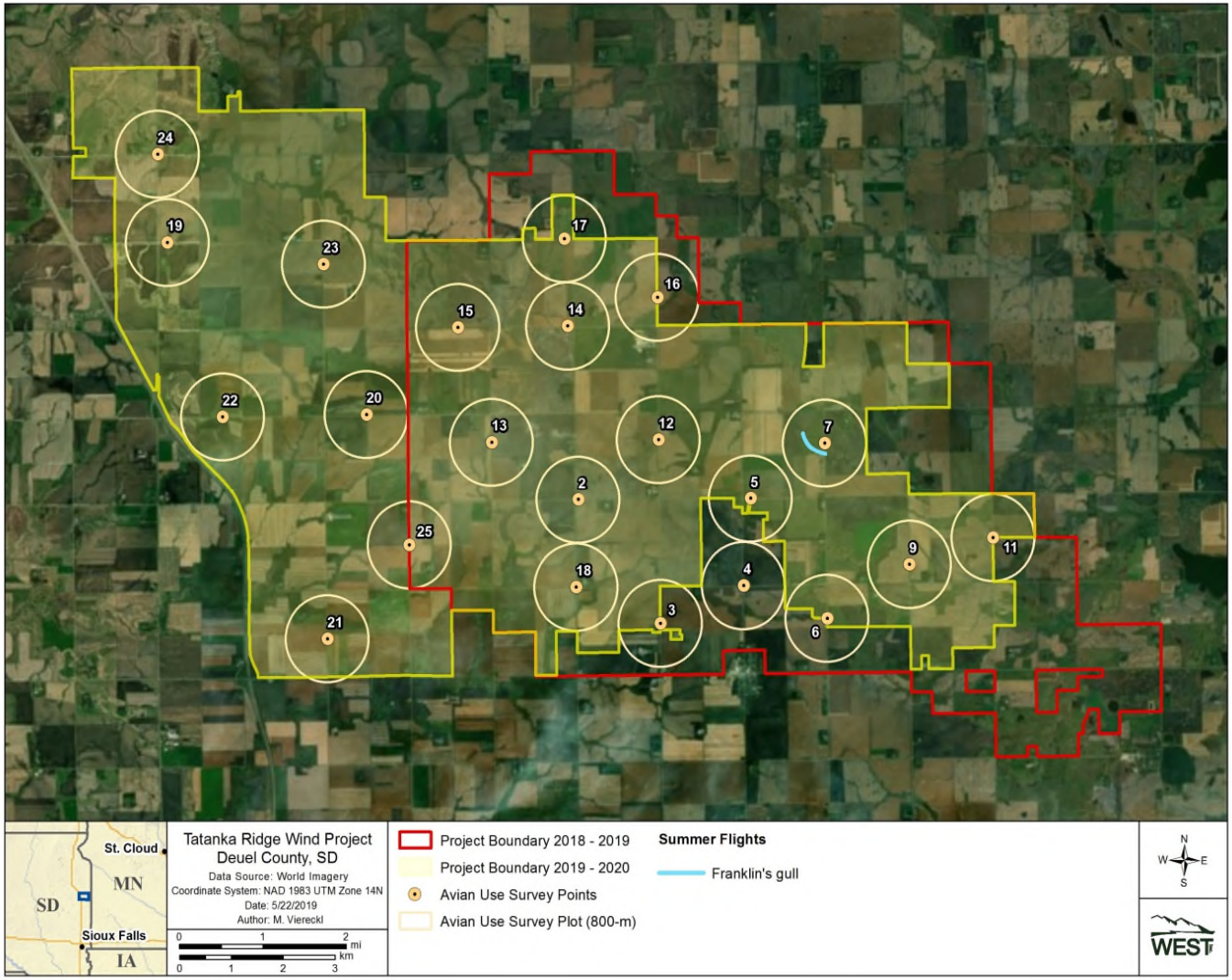
Appendix D2 (*continued*). Waterfowl flight paths recorded during the spring season during 60-minute fixed-point bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019.



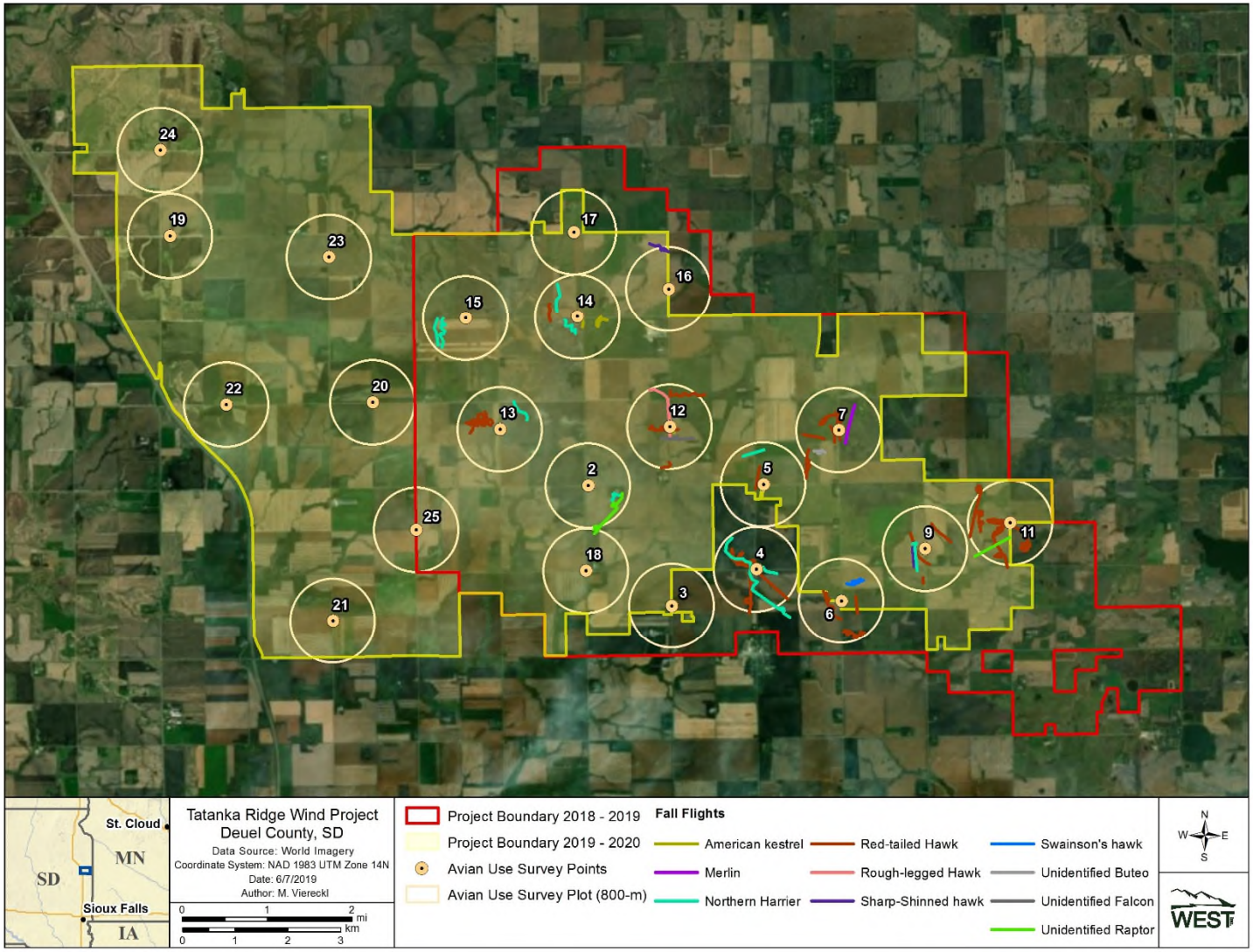
Appendix D2 (*continued*). Waterfowl flight paths recorded during the summer season during 60-minute fixed-point bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019



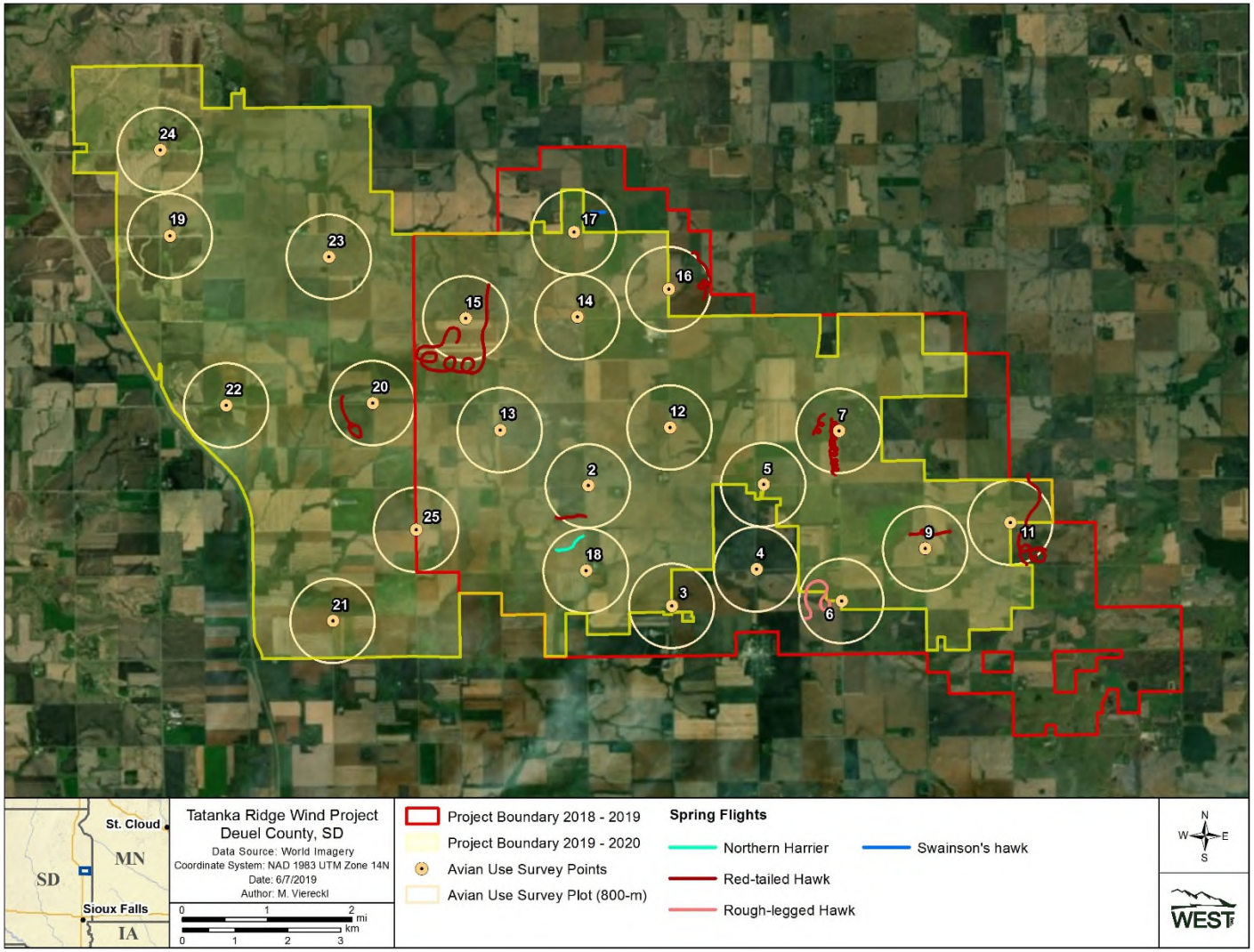
Appendix D2 (*continued*). Gull and tern flight paths recorded during the fall season during 60-minute fixed-point bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019.



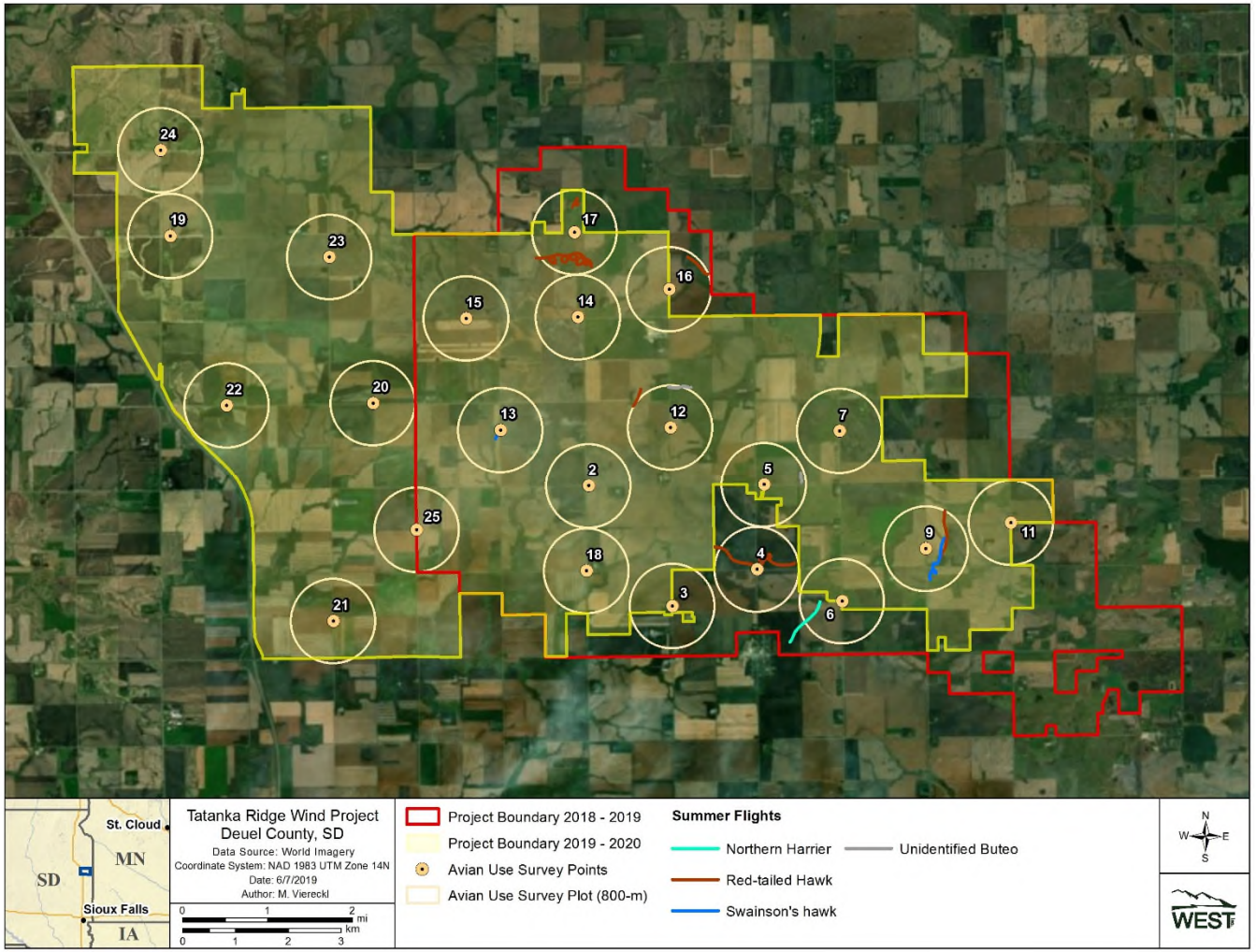
Appendix D2 (*continued*). Gulls and terns flight paths recorded during the summer season during 60-minute fixed-point bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019.



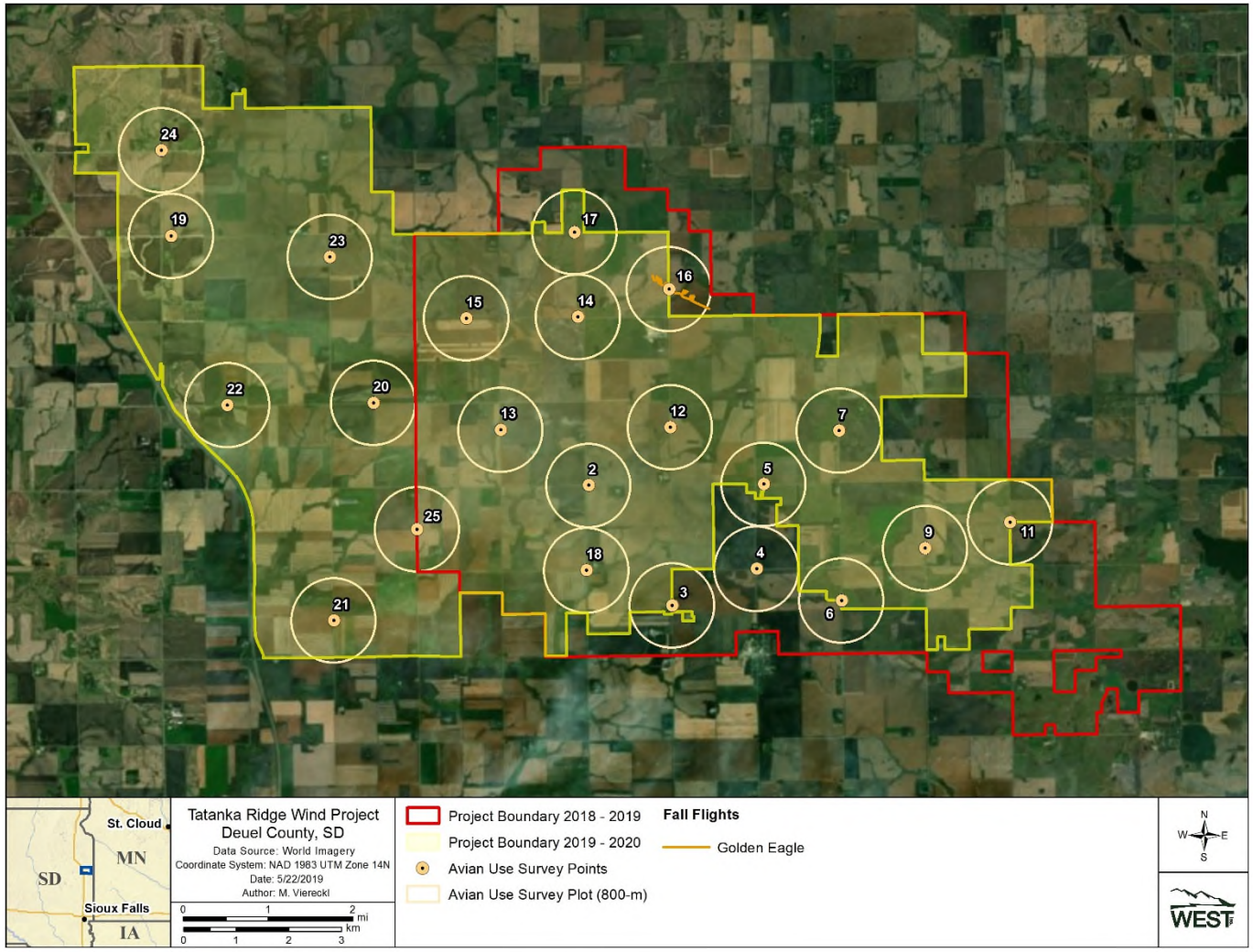
Appendix D2 (*continued*). Diurnal raptor flight paths recorded during the fall season during 60-minute fixed-point bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019.



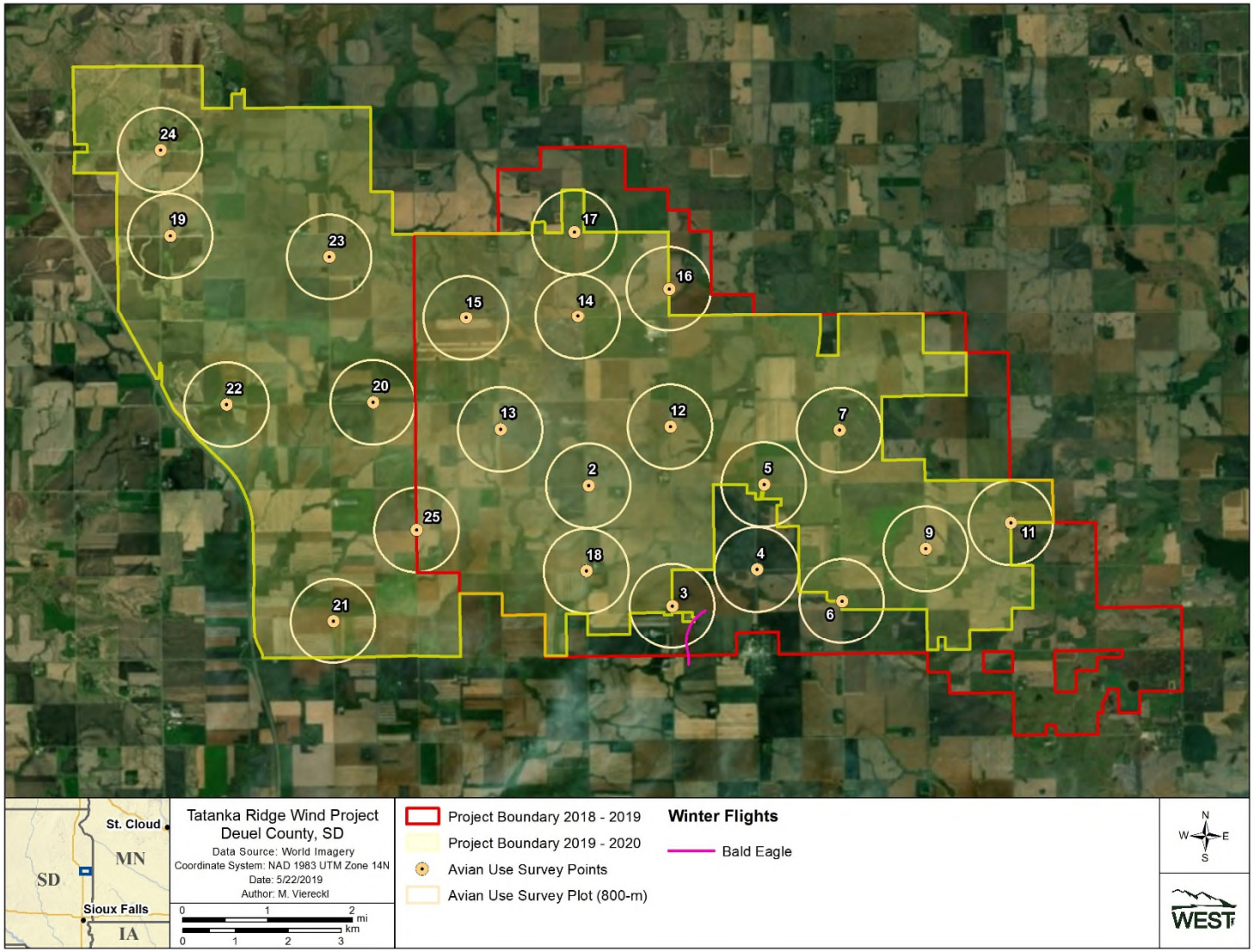
Appendix D2 (*continued*). Diurnal raptor flight paths recorded during the spring season during 60-minute fixed-point bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019.



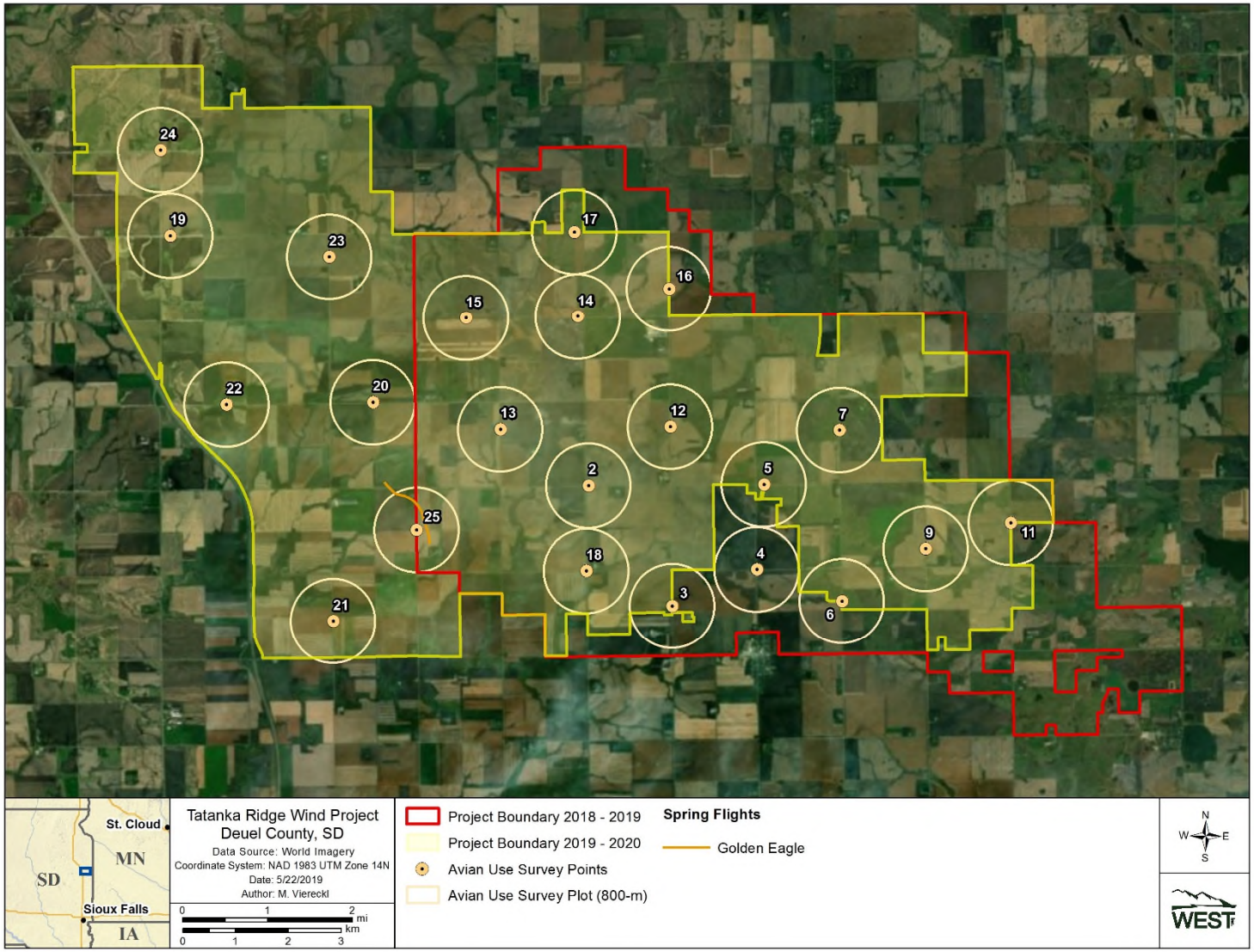
Appendix D2 (*continued*). Diurnal raptor flight paths recorded during the summer season during 60-minute fixed-point bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019.



Appendix D2 (*continued*). Eagle flight paths recorded during the fall season during 60-minute fixed-point large bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019.



Appendix D2 (*continued*). Eagle flight paths recorded during the winter season during 60-minute fixed-point large bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019.



Appendix D2 (*continued*). Eagle flight paths recorded during the spring season during 60-minute fixed-point large bird use surveys at the Tatanka Ridge Wind Project, Deuel County, South Dakota from April 20, 2018 − March 26, 2019. Points 19–25 were added in February 2019.

Appendix D3. Mean use (number of observations/100-meter plot/10-minute survey) by point for all small birds observed at the Tatanka Ridge Wind Project in Deuel County, South Dakota from April 20, 2018 to March 26, 2019.

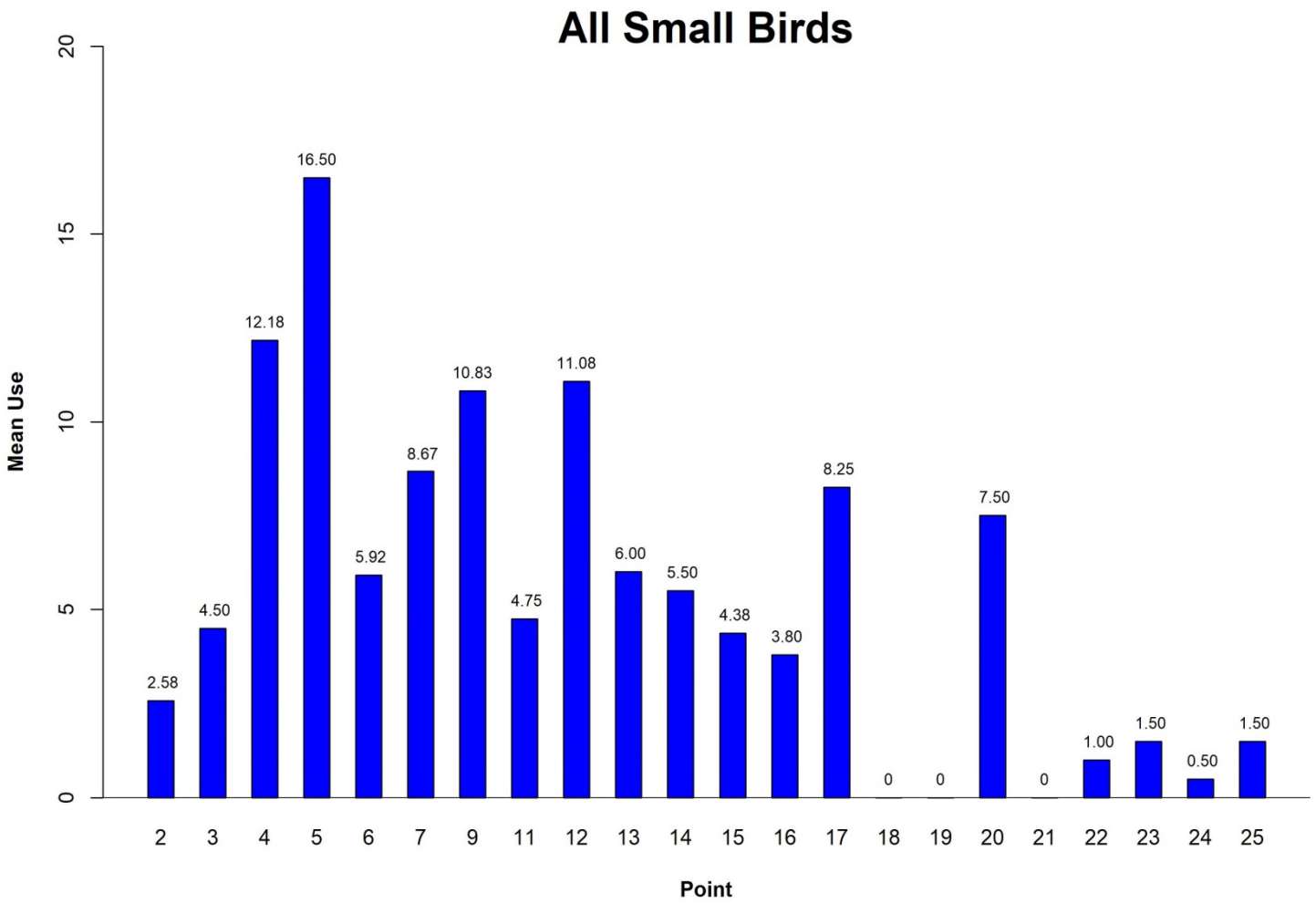
Bird Type	Survey Point										
	2	**3**	**4**	**5**	**6**	**7**	**9**	**11**	**12**	**13**	**14**
Passerines	2.50	4.33	12.18	16.50	5.92	8.67	10.83	4.67	11.08	6.00	5.50
Woodpeckers	0.08	0.17	0	0	0	0	0	0.08	0	0	0
All Small Birds	**2.58**	**4.50**	**12.18**	**16.50**	**5.92**	**8.67**	**10.83**	**4.75**	**11.08**	**6.00**	**5.50**

Sums may not equal total values shown due to rounding.

Appendix D3 (*continued*). Mean use (number of observations/100-meter plot/10-minute survey) by point for all small birds observed at the Tatanka Ridge Wind Project in Deuel County, South Dakota from April 20, 2018 − March 26, 2019.

	Survey Point										
Bird Type	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
Passerines	4.25	3.80	8.25	0	0	7.50	0	1.00	1.50	0.50	1.50
Woodpeckers	0.12	0	0	0	0	0	0	0	0	0	0
All Small Birds	**4.38**	**3.80**	**8.25**	**0**	**0**	**7.50**	**0**	**1.00**	**1.50**	**0.50**	**1.50**

Sums may not equal total values shown due to rounding.



Appendix D4. Relative small bird use by observation point during 10-minute fixed-point small bird use surveys at the Tatanka Ridge Wind Project in Deuel County, South Dakota from April 20, 2018 − March 26, 2019

Appendix E: Midwestern Cumulative Fatalities Summary Table

Appendix E1. Wind energy facilities in the Midwest region of North America with publicly available cumulative fatality data on for all bird species.

Bird Type	Reported Fatalities	Percent Composition
Passerines	993	54.8
Unidentified Birds	133	7.3
Waterfowl	125	6.9
Upland Game Birds	111	6.1
Diurnal Raptors	107	5.9
Shorebirds	93	5.1
Doves/Pigeons	89	4.9
Rails/Coots	39	2.1
Vultures	29	1.6
Swifts/Hummingbirds	19	1.0
Cuckoos	18	0.9
Gulls/Terns	18	0.9
Loons/Grebes	16	0.9
Woodpeckers	10	0.6
Waterbirds	4	0.2
Owls	4	0.2
Large Corvids	2	0.1
Goatsuckers	1	<0.1
Total[a]	**1,811**	**100**

[a] Sums of values may not add to total value shown due to rounding.

Appendix E1 (*continued*). Wind energy facilities in the Midwest region of North America with publicly available cumulative fatality data on for all bird species.

Wind Energy Facility	Source	Wind Energy Facility	Source
Barton I & II, IA (2010-2011)	Derby et al. 2011b	Grand Ridge I, IL (2009-2010)	Derby et al. 2010a
Big Blue, MN (2013)	Fagen Engineering 2014	Harrow, ON (2010)	Natural Resource Solutions 2011
Big Blue, MN (2014)	Fagen Engineering 2015	Heritage Garden, MI (2012-2013)	Kerlinger et al. 2014
Bishop Hill (2012)	Good et al. 2014	Kewaunee County, WI (1999-2001)	Howe et al. 2002
Blue Sky Green Field, WI (2008; 2009)	Gruver et al. 2009	Lakefield Wind, MN (2012)	Minnesota Public Utilities Commission (MPUC) 2012
Buffalo Ridge, MN (1994-1995)	Osborn et al. 1996, 2000	Melancthon, ON (Phase I; 2007)	Stantec Ltd. 2008
Buffalo Ridge, MN (2000)	Krenz and McMillan 2000	Moraine II, MN (2009)	Derby et al. 2010h
Buffalo Ridge, MN (Phase I; 1996)	Johnson et al. 2000a	NPPD Ainsworth, NE (2006)	Derby et al. 2007
Buffalo Ridge, MN (Phase I; 1997)	Johnson et al. 2000a	Odell, MN (2016-2017)	Chodachek and Gustafson 2018
Buffalo Ridge, MN (Phase I; 1998)	Johnson et al. 2000a	Pioneer Prairie I, IA (Phase II; 2011-2012)	Chodachek et al. 2012
Buffalo Ridge, MN (Phase I; 1999)	Johnson et al. 2000a	Pioneer Prairie II, IA (2013)	Chodachek et al. 2014b
Buffalo Ridge, MN (Phase II; 1998)	Johnson et al. 2000a	Pioneer Trail, IL (2012-2013)	ARCADIS U.S. 2013
Buffalo Ridge, MN (Phase II; 1999)	Johnson et al. 2000a	Pleasant Valley, MN (2016-2017)	Tetra Tech 2017b
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	Johnson et al. 2004	Prairie Rose, MN (2014)	Chodachek et al. 2015

Appendix E1 (*continued*). Wind energy facilities in the Midwest region of North America with publicly available cumulative fatality data on for all bird species.

Wind Energy Facility	Source	Wind Energy Facility	Source
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	Johnson et al. 2004	PrairieWinds ND1 (Minot), ND (2010)	Derby et al. 2011d
Buffalo Ridge, MN (Phase III; 1999)	Johnson et al. 2000a	PrairieWinds ND1 (Minot), ND (2011)	Derby et al. 2012d
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	Johnson et al. 2004	PrairieWinds SD1, SD (2011-2012)	Derby et al. 2012c
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	Johnson et al. 2004	PrairieWinds SD1, SD (2012-2013)	Derby et al. 2013
Buffalo Ridge I, SD (2009-2010)	Derby et al. 2010e	PrairieWinds SD1, SD (2013-2014)	Derby et al. 2014b
Buffalo Ridge II, SD (2011-2012)	Derby et al. 2012a	Prince Wind Farm, ON (2006)	NRSI 2009
Cedar Ridge, WI (2009)	BHE Environmental 2010	Prince Wind Farm, ON (2007)	NRSI 2009
Cedar Ridge, WI (2010)	BHE Environmental 2011a	Prince Wind Farm, ON (2008)	NRSI 2009
Crescent Ridge, IL (2005-2006)	Kerlinger et al. 2007	Rail Splitter, IL (2012-2013)	Good et al. 2013b
Crystal Lake II, IA (2009)	Kerlinger et al. 2007	Ripley, ON (2008)	Jacques Whitford 2009
Elm Creek, MN (2009-2010)	Derby et al. 2010g	Ripley, ON (2008-2009)	Golder Associates 2010
Elm Creek II, MN (2011-2012)	Derby et al. 2012b	Rugby, ND (2010-2011)	Derby et al. 2011c
Forward Energy Center, WI (2008-2010)	Grodsky and Drake 2011	Thunder Spirit, ND (2016-2017)	Derby et al. 2018
Fowler I, IN (2009)	Johnson et al. 2010a	Top Crop I & II, IL (2012-2013)	Good et al. 2013c
Fowler III, IN (2009)	Johnson et al. 2010b	Top of Iowa, IA (2003)	Jain 2005
Fowler I, II, III, IN (2010)	Good et al. 2011	Top of Iowa, IA (2004)	Jain 2005
Fowler I, II, III, IN (2011)	Good et al. 2012	Waverly Wind, KS (2016-2017)	Tetra Tech 2017a
Fowler I, II, III, IN (2012)	Good et al. 2013a	Wessington Springs, SD (2009)	Derby et al. 2010d
Fowler, IN (2015)	Good et al. 2016	Wessington Springs, SD (2010)	Derby et al. 2011a
Fowler, IN (2016)	Good et al. 2017	Winnebago, IA (2009-2010)	Derby et al. 2010i
Fowler, IN (2017)	Good et al. 2018		

Appendix E2. Publicly available and comparable all bird and diurnal raptor fatality rate estimates and habitat types from wind energy facilities in the Midwest region of North America.

Project	Bird Fatalities (birds/MW/year)	Raptor Fatalities (raptors/MW/year)	Predominant Habitat Type	Citation
Wessington Springs, SD (2009)	8.25	0.06	grassland	Derby et al. 2010d
Blue Sky Green Field, WI (2008; 2009)	7.17	0	agriculture	Gruver et al. 2009
Cedar Ridge, WI (2009)	6.55	0.18	agriculture	BHE Environ-mental 2010
Buffalo Ridge, MN (Phase III; 1999)	5.93	0	agriculture	Johnson et al. 2000a
Moraine II, MN (2009)	5.59	0.37	agriculture/grassland	Derby et al. 2010h
Barton I & II, IA (2010-2011)	5.5	0	agriculture	Derby et al. 2011b
Buffalo Ridge I, SD (2009-2010)	5.06	0.2	agriculture/grassland	Derby et al. 2010e
Odell, MN (2016-2017)	4.69	NA	agriculture	Chodachek and Gustafson 2018
Buffalo Ridge, MN (Phase I; 1996)	4.14	0	agriculture	Johnson et al. 2000a
Winnebago, IA (2009-2010)	3.88	0.27	agriculture/grassland	Derby et al. 2010i
Cedar Ridge, WI (2010)	3.72	0.13	agriculture	BHE Environ-mental 2011b
Elm Creek II, MN (2011-2012)	3.64	0	agriculture, grassland	Derby et al. 2012b
Buffalo Ridge, MN (Phase II; 1999)	3.57	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1998)	3.14	0	agriculture	Johnson et al. 2000a
Lakefield Wind, MN (2012)	2.75	0	agriculture	Minnesota Public Utilities Commission 2012
Buffalo Ridge, MN (Phase I; 1997)	2.51	0	agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1998)	2.47	0	agriculture	Johnson et al. 2000a
Heritage Garden, MI (2013-2014)	2.4	NA	agriculture	Kerlinger et al. 2014
PrairieWinds SD1, SD (2012-2013)	2.01	0.03	grassland	Derby et al. 2013
Buffalo Ridge II, SD (2011-2012)	1.99	0	agriculture, grassland	Derby et al. 2012a
Kewaunee County, WI (1999-2001)	1.95	0	agriculture	Howe et al. 2002
PrairieWinds SD1, SD (2013-2014)	1.66	0.17	grassland	Derby et al. 2014b
Elm Creek, MN (2009-2010)	1.55	0	agriculture	Derby et al. 2010f
Buffalo Ridge, MN (Phase I; 1999)	1.43	0.47	agriculture	Johnson et al. 2000a
PrairieWinds SD1, SD (2011-2012)	1.41	0	grassland	Derby et al. 2012c
Top Crop I & II (2012-2013)	1.35	NA	agriculture	Good et al. 2013c
Heritage Garden, MI (2012-2013)	1.3	NA	agriculture	Kerlinger et al. 2014
Wessington Springs, SD (2010)	0.89	0.07	grassland	Derby et al. 2011a
Rail Splitter, IL (2012-2013)	0.84	0	agriculture	Good et al. 2013b
Top of Iowa, IA (2004)	0.81	0.17	agriculture	Jain 2005
Pleasant Valley, MN (2016-2017)	0.68	NA	agriculture; grassland; wetlands	Tetra Tech 2017b
Big Blue, MN (2013)	0.6	0	agriculture	Fagen Engineering 2014
Grand Ridge I, IL (2009-2010)	0.48	0	agriculture	Derby et al. 2010a

Appendix E2. Publicly available and comparable all bird and diurnal raptor fatality rate estimates and habitat types from wind energy facilities in the Midwest region of North America.

Project	Bird Fatalities (birds/MW/year)	Raptor Fatalities (raptors/MW/year)	Predominant Habitat Type	Citation
Prairie Rose, MN (2014)	0.44	0.08	agriculture; grassland	Chodachek et al. 2015
Top of Iowa, IA (2003)	0.42	0	agriculture	Jain 2005
Big Blue, MN (2014)	0.37	0	agriculture	Fagen Engineering 2015
Pioneer Prairie I, IA (Phase II; 2011-2012)	0.27	0	agriculture, grassland	Chodachek et al. 2012