Appendix A **Cumulative Impacts Analysis For Avian Resources From Proposed Wind Projects In Sherman County, Washington**

CUMULATIVE IMPACTS ANALYSIS FOR AVIAN RESOURCES FROM PROPOSED WIND PROJECTS IN SHERMAN COUNTY, WASHINGTON

FINAL REPORT

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1.0 INTRODUCTION AND BACKGROUND

In recent years there has been a surge of interest in wind power development in Sherman County, Oregon. A central issue for wind power developments is the potential impacts to avian resources, and in particular direct impacts such as avian fatalities. Wind power proposals are commonly reviewed by natural resource agencies and private conservation groups. Frequently, baseline studies are conducted that are designed to estimate avian use and occurrence at proposed development sites and gather site specific information used in the overall impact assessment and siting of the project.

Currently, at least two different developers have constructed and/or propose construction of several wind projects in Sherman County. The projects include: (1) the Klondike Wind Projects, which include three phases Klondike I, II (KIWP), and III (KIIIWP); and (2) the Biglow Canyon Wind Project (BCWP), which also included study on a Reference Area (BCRA) (Figure 1). Details of the individual wind projects such as the number and size of turbines, turbine locations, roads, and project timing can be found in the various permitting documents. Provided all the proposed projects are constructed, Sherman County could support up to 440 turbines and produce up to 690 MW of energy. The actual number of turbines developed could vary based on a number of factors including turbine model selected, electricity markets, transmission constraints, and results of site surveys and permitting requirements.

The total study area using the lease area boundaries of the three projects is approximately 41,345 acres (64.6 mi^2). The total study area used in the analysis was larger than this due to the Biglow Canyon reference area to the south of the proposed wind projects (see Figure 1). Over the past four to five years the avian resources at each of these sites has been studied using fairly detailed sampling protocols. A one-year baseline study for the KIWP which included the area for Klondike Phase II was completed in April 2002 (Johnson et al. 2002). A one-year fatality monitoring study was conducted at the KIWP turbines in 2002 (Johnson et al. 2003). The KIIIWP site was studied from November 2004 to May 2005 (Mabee et al. 2005). Studies of the BCWP and BCRA sites took place from March 2004 to March 2005 (WEST 2005). While the three studies varied in duration, year, and location, similar field survey methods were used for the avian surveys providing comparable data from each site. Point count stations were established on all four sites from which approximately weekly surveys were conducted during the respective study periods. Detailed descriptions of the methods and data analyses for each project-specific study are reported in the respective baseline study reports (see Johnson et al. 2002, Mabee et al. 2005, and WEST 2005).

To supplement the environmental impact analysis being conducted by BPA for their decisions in the Klondike III and Biglow Canyon projects, it was determined that a cumulative effects analysis that incorporated all the avian survey data conducted for the various projects would be useful. Because all the projects are relatively close together (see Figure 1), it could be reasonably argued that once all the projects are complete, northern Sherman County will host one very large wind project. This cumulative effects analysis takes the general approach of considering the data from the individual projects and combining them as they were one large project. Because the surveyed areas are relatively close together (Figure 1), the predominant vegetation type for all projects was cultivated agriculture (see below), and the avian survey data

was all collected using similar methods, the analysis treats all of the studies as one to estimate impacts and risk to avian resources. This report provides this cumulative effects analysis for avian resources. In addition a summary of impacts to bats from other wind projects that have been monitored is included that provides a basis for a cumulative effects analysis for bats.

2.0 METHODS

This report is intended to provide a broader analysis utilizing the combined data sets from all four project areas and thus provide a cumulative impact analysis of potential impacts to avian resources. This report does not reiterate results from the individual project reports. Additional details about each study, results and methods of the data analyses, and an estimate of potential avian impacts from each individual project are provided in the project specific reports. The data sets analyzed in this report were all collected using similar methods, and were collected from the same general geographical area (northern Sherman County), which provides a useful basis for the cumulative effects analysis presented in this report.

The general approach was to combine the data sets from the individual projects as if the four combined project areas were one large project. The results of this analysis could then be used in the impact assessment for all the projects combined. For this report, when more than one data set existed for a season, each data set was analyzed separately and then averaged for that season. For the flight height and exposure index tables, the four data sets were combined into one database. The overall use estimates and exposure indices are used to estimate potential impacts for all the projects combined based primarily on other monitoring studies within the northeast Oregon and southeast Washington region.

To standardize the data for comparison between sites, points, seasons, and other studies; avian use, frequency of occurrence, and species composition were calculated from observations within 800 m (~1/2 mile) of the survey point. Avian use by species was calculated as the mean number of observations per 20-minute survey[1]. Because individual birds were not marked, counts do not distinguish between individuals; rather, they provide an estimate of avian use of the study area. For example, if one red-tailed hawk was observed during five surveys, it is unknown if this was the same bird seen five times or five different birds seen once. Use estimates provide an index of the relative abundance of a species in the study area and therefore the risk of that species being affected by the proposed project. Because of this, references to abundance are use estimates and are not absolute density or numbers of individuals. Species composition is represented by the mean use for a species divided by the total use for all species and multiplied by 100 to provide percent composition. Frequency of occurrence was calculated as the percent of surveys where a particular species was observed.

[1] Fixed-point surveys at KIWP, BCWP, and BCRA were conducted for 30 minutes. For the purposes of this report and analysis, the surveys were standardized to a 20-minute count for all project sites and only those observations recorded within the first 20 minutes of the observation period were included.

2.1 Study Area

The data included in the analyses were from the following studies:

- Klondike I and II (KIWP): bird surveys conducted from April 2001 to April 2002 (Johnson et al. 2002)
- Klondike III (KIIIWP): bird surveys conducted between November 2004 and May 2005 (Mabee et al. 2005)
- Biglow Canyon (BCWP): bird surveys conducted between March 2004 and March 2005 (WEST 2005)
- Biglow Canyon Reference Area (BCRA): bird surveys conducted between March 2004 and March 2005 (WEST 2005)

For each of the individual study areas the predominant vegetation type was agriculture. The Biglow Canyon project area was described as greater than 90% cultivated agriculture (WEST 2005). The Klondike project areas were also primarily agriculture and described as having very little acreage of native plant communities (Mabee et al. 2005, Johnson et al. 2002). Throughout the entire study area there are some fields of Conservation Reserve Program (CRP) land which are generally previously cultivated areas that have been seeded back to grasslands to minimize soil erosion. For all projects, nearly all the turbines will occur in either cultivate agriculture (mostly wheat) or CRP pastures.

3.0 RESULTS

While the dates of surveys varied among the studies, all of the data sets are fairly contemporary and provide replication for the different seasons within the last five years. In addition, the study areas are located within a contiguous block of land with similar vegetation types and habitat. Over all, the combination of the data sets are believed to provide a reasonable picture of the bird resources throughout the agriculture setting of northern Sherman County.

3.1 Avian Fixed-point Surveys

The KIWP (Klondike I and II) surveys were conducted at 7 fixed-point count stations located within the study area (Figure 1). For the KIIIWP, surveys were conducted at 16 fixed-point stations (Figure 1). For the BCWP and BCRA, surveys were conducted at 22 fixed-point stations, 9 within the study area (BCWP) and 13 south of the study area in the reference area (BCRA) (Figure 1). At each site, each point was surveyed on an approximately weekly basis during the respective study periods but some surveys were missed due to bad weather. For all of the sites, a total of 1,195 individual 20-minute point count surveys were conducted.

For all study areas combined, a total of 75 avian species and an additional 13 unidentified bird types (best possible identification, e.g., unidentified buteo) were observed during the fixed-point surveys (Table 1). Over all studies, 25,262 total observations in 3,612 different groups[2] were recorded during the fixed-point surveys (Table 1). These are raw counts of observations, that are not

[2] Group is defined as an observation of a species of bird regardless of number seen together. For example, a flock of eight American robins flying together is considered a group as well as an individual robin observed by itself.

standardized by the number of hours of observation, but do provide an overall list of what was observed. These counts likely contain duplicate sightings of the same birds. Of the 75 avian species recorded (Table 1), six species were only observed during the last ten minutes of surveys for KIWP, BCWP, or BCRA and, because the analyses are based on a standardized 20-minute point count survey, these six species do not factor into the remainder of the analysis. In most cases, only a few individuals or groups of these species were observed and it is unlikely that they would be at risk due to very low use of the project areas.

Over all three studies, passerines were by far the most numerous group comprising approximately 76.1% of all groups and 66.4% of all birds observed. For all of the study areas, horned lark (*Eremophila alpestris*) was the most numerous passerine observed, followed by unidentified blackbirds, European starling (*Sturnus vulgaris*), and western meadowlark (*Sturnella neglecta*). Raptors comprised approximately 16.1% of all groups but only 2.4% of all birds observed. For all study areas, red-tailed hawk (*Buteo jamaicensis*), rough-legged hawk (*Buteo lagopus*), and northern harrier (*Cyanus circus*) were the most common raptors observed. Waterfowl comprised 2.67% of all groups and 29.1% of all birds observed. Canada goose (*Branta canadensis*) was the most common waterfowl species seen in the fall and winter in large flocks. Upland gamebirds comprised 2.9% of all groups and 0.9% of all birds observed; doves/pigeons comprised 1.5% of all groups and 0.6% of all birds observed; and waterbirds, shorebirds, other birds, unidentified birds, and coots each comprised less than 1% of all groups and all birds observed. Within these groups the more common species seen were ring-necked pheasant, mourning dove, and sandhill crane (Table 1).

3.1.1 Avian Use

Use was calculated by season and over all surveys (Table 2). For spring, based on an average use across the four areas, the five most abundant species in the study area were horned lark (3.223 detections/20-minute survey), western meadowlark (1.308 detections), European starling (0.319 detections), Brewer's blackbird (*Euphagus cyanocephalus*) (0.285 detections), and American goldfinch (*Carduelis tristis*) (0.267 detections). Together these species comprised 76.5% of the total bird use during the spring (Table 3).

During the summer, the five most abundant species were horned lark (2.008 detections/survey), western meadowlark (0.483), barn swallow (*Hirundo rustica*) (0.285), red-winged blackbird (*Agelaius phoeniceus*) (0.248), and European starling (0.175). These species comprised 72.6% of the total bird use during the summer (Table 3).

In the fall, the five most abundant species were horned lark (4.512 detections), American pipit (*Anthus rubescens*) (0.669), western meadowlark (0.611), Brewer's blackbird (0.372), and European starling (0.355). Together these five species comprised 74.3% of the total bird use (Table 3).

Winter was the only season where the top five species were not all passerines. Horned lark (11.496) had the highest used followed by, Canada goose (5.794), European starling (2.184), unidentified blackbird (0.923), and western meadowlark (0.598). These species comprised 84.6% of the total bird use for the winter (Table 3).

Overall seasons, horned lark was the most common bird observed with 7.731 detections per survey, followed by Canada goose (2.474), European starling (0.955), western meadowlark (0.758), and unidentified blackbird (0.627) (Table 2). These five species comprised 81.9% of all bird use of the sites for the study periods (Table 3).

Averaged over all seasons and based on use, passerines were the most abundant group observed followed by waterfowl, raptors, and upland gamebirds (Table 2). Passerines as a group had the highest use in all four seasons. Waterfowl had the second highest use in the winter, raptors had the second highest use estimates in the spring and summer, and upland gamebirds had the second highest use in the fall followed closely by raptors. The high winter waterfowl use was due primarily to large flocks of Canada goose that frequented the study areas during the winter season (see Table 1).

3.1.2 Avian Diversity

Frequency of occurrence and percent composition provide relative estimates of the avian diversity of the study area. For all study areas combined, the overall number of species recorded was relatively high (see Table 1), however, as is expected for predominantly agricultural settings, the majority of avian use for the study area was confined to relatively few species. For example, one species, horned lark was observed in almost three-fourths of all surveys (72.1%) and accounted for slightly more than 50.5% of all bird use recorded during the studies (Tables 3 and 4). Three other species made up approximately 5% or more of the bird use recorded: Canada goose (16.2%), European starling (6.2%), and western meadowlark (5.0%). These four species cumulatively accounted for more than 3/4th of all the bird observations (77.9% of all observations) made during the studies (Table 3). Only seven species were seen in more than 5% of all surveys: horned lark (72.1%), western meadowlark (26.5%), common raven (*Corvus corax*) (12.1%), red-tailed hawk (6.8%), rough-legged hawk (5.9%); European starling (5.2%); and American kestrel (5.2%) (Table 4). The vast majority of species were observed in less than 1% of the surveys (Table 4).

As a group, and due primarily to the abundance of horned lark, western meadowlark, and European starling, passerines comprised 79.3% of the avian use on the sites (Table 3) and were observed in 85.6% of all surveys (Table 4). The influx of large groups of Canada geese in the fall and winter had the relative effect of lowering passerine use and raising waterfowl use in the winter (see Table 3). Raptors as a group comprised 2.0% of the total avian use of the sites (Table 3) and were observed in 22.9% of the surveys (Table 4).

3.1.3 Flight Height Characteristics and Exposure Indices

The proportion of observations of a bird species flying within the area occupied by the turbine rotors provides a rough estimate of risk to that species based on its propensity to fly within the "zone of risk" defined as the rotor swept area (Table 5). Turbines vary in dimensions such as tower height and blade length and it is likely that a variety of turbine types and sizes will be used if all of the projects are built. For this analysis, generic turbine dimensions were used to define the zone of risk that were based on the estimated maximum turbine size and tower height. The maximum tower height and rotor diameters for turbines is likely to be 80 m (262 ft). Provided an 80 m diameter rotor is placed on top of an 80 m tower the maximum height with a blade pointed straight up would be 120 m (~394 feet). A small buffer of approximately 5 m at the top and bottom of the rotor swept

area was added to account for possible variations around these maxima and the zone of risk analyzed in this report was defined as the area from approximately 25 m (~82 ft) to 125 m (~410 ft) above ground level (AGL). This range is a conservative estimate by virtue that it is larger than most turbines so leads to an over estimate of potential bird exposure.

Most of the passerines observed, with the exception of starlings, finches, corvids, warblers, and swallows, were regularly observed flying less than 82 feet (25 m) above the ground (Table 5). Larger birds tended to fly higher, and frequently flew greater than 82 feet (25 m) high, which is within the primary zone of risk for turbine blades used in this analysis. As a group, 62.4% of waterfowl observed flying were observed in the zone of risk. As a group 48.3% of raptors were observed in the rotor swept area. Raptor subgroups observed more often in the zone of risk included buteos (62.7%), eagles (87.5%), and vultures (66.7%). Flying passerines were observed within the zone of risk approximately 21.2 % of the time (Table 5). These estimates are consistent with estimates from other projects, and are an overestimate of exposure, since the zone of risk applied is slightly larger than a typical turbine.

The exposure index is a relative measure of the risk of each species coming in contact with a turbine that factors in the use estimates (measure of abundance) and the flight characteristics observed for that species. Canada goose, horned lark, and unidentified blackbird had the highest exposure indices (Table 6). These three species were commonly observed on site and often observed flying in large flocks which increased exposure indices. Of the raptors, rough-legged hawk and red-tailed hawk had the highest exposure indices. Most of the other raptors were seen less frequently (i.e., use was lower) which reduced their exposure index.

3.2 Bat Surveys

No field surveys or primary field data collection was conducted for bats for the three wind projects considered in this analysis. However, results of the monitoring study at the Klondike 1 project indicate that bats are at risk of collision with the turbines in apparently low numbers (Johnson et al. 2003). Other monitoring studies of wind projects in the Washington/Oregon region have also recorded a level of bat mortality (Table 7). The overall bat mortality estimates that are based on carcass search studies including carcass removal and searcher efficiency bias trials have indicated that approximately 1.62 bats per turbine or 1.59 bats per MW are killed annually at wind turbines in Washington and Oregon (Table 7).

4.0 DISCUSSION

In most cases of wind project development in the Pacific Northwest, baseline or pre-construction avian studies are conducted with two primary objectives: to provide information useful in addressing potential impacts from the project and to provide information that may be helpful in siting the turbines. For each of the wind projects proposed for Sherman County these baseline studies have been conducted. Under the National Environmental Policy Act (NEPA) federal agencies are charged with addressing potential impacts, including cumulative impacts, from projects that they implement, fund, or authorize. Under NEPA, the full build out of potential wind projects in Sherman County would be considered cumulative impacts. It was determined that an analysis of

all the avian survey data collected for the various wind projects in Sherman County would be helpful in analyzing these cumulative impacts. The purpose of this analysis was therefore to determine, based on the cumulative data, what the over all impacts from build out of the proposed wind projects in Sherman County would be. It was determined that combining data from all the projects was a valid approach because: (1) the proposals were all within relatively close proximity to each other; (2) all the projects fall within areas with the primary land use being agriculture; (3) all the avian survey data was collected using similar methods; and (4) the combined data sets provided some replication over years for the project area. The analysis conducted on the combined data set was very similar to that of each individual project.

Over the last five years during the same time frame as the studies in Sherman County, a number of wind projects have been constructed and monitored in the northeast Oregon and southeast Washington region (Columbia Basin Physiographic Province). These projects have been primarily east of Sherman County and include Vansycle, Umatilla County, Oregon; Stateline, Walla Walla County, Washington and Umatilla County, Oregon; Nine Canyon, Benton County Washington; and Combine Hills, Umatilla County, Oregon. In addition to these studies the 16 turbines that comprised the Klondike I project were also monitored for fatalities for a one-year period. These studies provide a regional database of avian use and mortality associated with wind developments that can provide a basis for impact predictions. Another project, the Condon wind project in Gilliam County, Oregon, was also completed in 2002; however, the monitoring effort at this project was ad hoc in nature and not standardized over the study period and the methods used were not similar enough to compare results to the other studies (see Galen 2003).

4.1 Avian Impacts

For the Sherman County projects, several common passerine species comprised the majority of avian use for the area studied. There were a few species - horned lark, western meadowlark, and European starling - that were seen either in large flocks (affecting total numbers seen) and/or observed in most of the surveys. This varied across seasons but had the effect of increasing use estimates for passerines. In contrast, raptors were observed in slightly more than 20% of the surveys but were typically seen individually or in small groups. This resulted in lower use estimates for raptors than passerines and even waterfowl and upland gamebirds. These results are typical of many wind sites studied where passerines have the highest use estimates but where a few raptor species (e.g., red-tailed hawk, American kestrel) are seen regularly. These results are expected given the low diversity of habitats across the three study areas. For most studies that have occurred in agricultural settings, a few common species make up the majority of bird observations at the site, however, a variety of other species are recorded but typically in low numbers and frequency.

4.1.1 Raptors

Based on the estimated levels of raptor use within the study areas, raptor mortality is expected to be similar to other new generation wind projects with similar turbine types located in the Oregon-Washington region. At these other projects, raptor use estimates ranged from approximately 0.2 to 0.6 per 20-minute survey compared to an average estimate of 0.3 raptors/20-minute survey for Sherman County analyzed in this report.

Considering the calculated raptor use estimates developed in each of the baseline studies, it is estimated that potential raptor mortality within the combined study area would be approximately 0.024 raptors per turbine per year. Under the assumption that raptor mortality would be similar in Sherman County as at the other projects where raptor use was similar, we would expect approximately 0.024 raptors per turbine per year or one raptor for every 40 turbines per year. Using this raptor mortality rate, the total annual raptor mortality estimate would be approximately 10-11 raptor fatalities per year for the three projects (KIWP including KIIWP, KIIIWP, and BCWP) combined if 440 turbines are constructed. It should be noted that the fatality estimates may vary from the expected range based on many factors, including the number of occupied raptor nests near the wind projects after construction, turbine size and other site specific and/or weather variables.

Red-tailed hawk, American kestrel, and northern harrier account for most of the raptor use in spring, summer and fall at the four projects areas. In the winter, rough-legged hawk and red-tailed hawk account for majority of the raptor use. These species are expected to be the raptor species with the highest risk of mortality across the projects. The potential exists for other raptor species to collide with turbines, including Swainson's hawk, ferruginous hawk, turkey vulture, golden eagle, Cooper's hawk, sharp-shinned hawk, and prairie falcon. However, the mortality risk associated with these species is expected to be much lower than the risk for red-tailed hawks and American kestrel due to the lower use estimates and exposure indices for these species. Common owl species such as great-horned owls, which are typically not effectively surveyed during the day, may also be at risk of collision. Some raptors such as turkey vultures appear less susceptible to collision than most other raptors (see Orloff and Flannery 1992, Erickson et al. 2001). In addition, there have been very few northern harrier, ferruginous hawk, and rough-legged hawk fatalities recorded at wind plants, based on recent published data (Erickson *et al.* 2002). Golden eagle use of the sites is low relative to other wind sites (e.g., Foote Creek Rim, Young et al. 2003) and mortality for golden eagles is also expected to be very low.

4.1.2 Passerines

Passerines have been the most abundant avian fatality at other wind projects studied (see Johnson *et al.* 2002, Young *et al.* 2003b, Erickson *et al.* 2000, 2001, 2002), often comprising more than 80% of the avian fatalities. Both migrant and resident passerine fatalities have been observed. Given that passerines make up the vast majority of the avian observations at the sites, it is expected passerines will make up the largest proportion of fatalities for all projects combined. Passerine species most common to the project sites will likely be most at risk, including horned lark and western meadowlark. European starling fatalities would also be expected, however, there is little concern over potential mortality of this species, an introduced non-protected species. Horned larks have been the most commonly observed fatality at several wind projects, including Vansycle, Combine Hills, and Stateline (Erickson *et al.* 2003, Young *et al.* 2005, Erickson *et al*. 2004). Nocturnal migrating species may also be affected, but it is not expected that they would be found in large numbers. Estimates for nocturnal migrant mortality at the regional wind projects have been variable and have ranged from 0.27 to 0.55 per turbine per year. Also, there have been only two multiple individual mortality events reported at new generation wind projects in the U.S. based on data collected at other wind plants. For example, at Buffalo Ridge, Minnesota, fourteen migrating passerine fatalities (vireos, warblers, flycatchers) were observed at two turbines during a single night in May 2002 (Johnson *et al*. 2002), while approximately 25 to 30 migrating passerine fatalities

(mostly warblers) were observed near one turbine and a well-lit substation at the Backbone Mountain, West Virginia, wind project (Kerns and Kerlinger 2004).

Mortality rates at other the other region wind projects for all birds combined have ranged from approximately 0.63 birds per turbine per year to 2.56 birds per turbine per year (Table 8). Based on the mortality estimates from the other wind plants studied, it is expected that all bird mortality would fall within the mid range or approximately 1-2 birds per turbine per year. Under the assumption that 440 turbines are constructed for all three projects, the total range of passerine mortality would be 440 to 880 fatalities per year. Because horned lark made up slightly more than 50% of the bird use during the studies, it is expected that approximately 50% of the fatalities would be of this species. This trend has been shown at the other regional projects in agriculture settings. For example, 50% of the fatalities at Nine Canyon; 46% of the fatalities at Stateline; and 41% of the fatalities at Combine Hills were horned larks (see Erickson *et al*. 2003, 2004; Young *et al*. 2005). Under this assumption we would expected approximately 200-400 horned lark fatalities if all the wind turbines were constructed. The level of estimated mortality is not expected to have any population level consequences for individual species, due to the expected low fatality rates for most species and the high population sizes of the common species such as horned lark, western meadowlark, and European starling.

4.2 Bat Impacts

Monitoring studies at other wind projects nationwide have shown consistent trends in impacts to bat. The species at highest risk appear to be foliage dwelling (forest, trees) fall migratory species (Johnson 2005). For the Pacific Northwest region these species are hoary bat (*Lasiurus cinereus*) and silver-haired bat (*Lasionycteris noctivagans*). These two species are by far the most common fatalities found at the regional wind projects monitored comprising more than 90% of all bat fatalities found in the studies (see Erickson *et al*. 2003, 2004; Young *et al*. 2005, Johnson *et al*. 2003). The annual period when most bat fatalities occur is in August and September (Johnson 2005). Hoary and silver-haired bats are wide spread across North America and breed into the boreal forests regions of Canada and migrate south to winter in the southern U.S., Mexico, and potentially further south in Central and South America. Many bats will migrate short distances to suitable hibernacula; however, other species do not appear to be at as great a risk based on the monitoring studies.

Bat foraging areas such as riparian zones, shrublands, streams, and other water sources are limited in the project area. At several wind projects studied in the U.S., bat collision mortality during the breeding season was far less, despite the fact that relatively large populations of resident bats of several species were documented in proximity to the wind plant (see Gruver 2002; Johnson et al., 2003, 2004; Johnson 2005). Based on these studies, it appears that wind projects, especially those in open habitats, pose little risk to non-migratory bat populations.

Based on the available monitoring information and characteristics of the sites, bat mortality at the projects proposed for northern Sherman County is not expected to vary significantly from other regional wind projects (see Table 7). The results of fatality monitoring for the regional

wind projects indicate mortality ranges from less than 1 to slightly over 3 .0 bat per turbine per year or approximately 1 to 2.5 bats per MW per year (see Table 7). Results of the Klondike I monitoring suggest that impacts in Sherman County may be on the lower end of this range.

Although future mortality of migratory bats is difficult to predict in any location, an estimate can be calculated based on levels of mortality documented at other wind projects in similar habitats. Based on these fairly consistent results, and considering the similarities in the characteristics of the project areas and other regional projects, a conservative estimate of bat mortality would fall within the mid range or approximately 1.5-2.5 bats per turbine (or per MW) per year. Provided that 440 turbines are constructed for all three projects, the total range of bat mortality would be from 660 to 1,100 fatalities per year. Actual levels of mortality are unknown and could be lower or higher, depending on factors such as regional migratory patterns of bats, patterns of local movements through the area, and the response of bats to turbines, individually and collectively. Mortality would involve primarily silver-haired and hoary bats, and no impacts to threatened or endangered bat species are anticipated. The significance of this impact on hoary and silver-haired bat populations is hard to predict, as there is very little information available regarding the overall population size and distribution of the bats potentially affected. The other regional monitoring studies suggest resident bats do not appear to be significantly affected by wind turbines and almost all mortality is observed during the fall migration period. Also, hoary bat and sliver-haired bats, which are expected to be the most common fatalities, are widely distributed in North America.

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Table 1. Avian species observed during fixed-point surveys[a] for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Seasons	Spring		Summer		Fall		Winter		Totals	
Group/Species	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**
Waterbirds	**81**	**5**	**1**	**1**	**0**	**0**	**2**	**2**	**84**	**8**
great blue heron	1	1	0	0	0	0	2	2	3	3
ring-billed gull[c]	2	1	0	0	0	0	0	0	2	1
sandhill crane	75	2	0	0	0	0	0	0	75	2
unidentified gull	3	1	1	1	0	0	0	0	4	2
Waterfowl	**60**	**7**	**40**	**1**	**551**	**9**	**6698**	**76**	**7349**	**93**
American wigeon	0	0	0	0	0	0	1	1	1	1
Canada goose	53	4	40	1	551	9	6662	70	7306	84
green-winged teal	0	0	0	0	0	0	1	1	1	1
hooded merganser[b]	2	2	0	0	0	0	0	0	2	2
Mallard	0	0	0	0	0	0	24	2	24	2
trumpeter swan	0	0	0	0	0	0	10	2	10	2
unidentified duck[c]	5	1	0	0	0	0	0	0	5	1
Shorebirds	**15**	**8**	**0**	**0**	**1**	**1**	**8**	**6**	**24**	**15**
Killdeer	7	5	0	0	1	1	8	6	16	12
long-billed curlew	8	3	0	0	0	0	0	0	8	3
Rails/Coots										
American coot[b]	6	1	0	0	0	0	0	0	6	1
Raptors/Vultures	**188**	**178**	**97**	**88**	**62**	**55**	**268**	**262**	**615**	**583**
Accipiters	*1*	*1*	*0*	*0*	*2*	*2*	*0*	*0*	*3*	*3*
Cooper's hawk	0	0	0	0	1	1	0	0	1	1
sharp-shinned hawk	1	1	0	0	1	1	0	0	2	2
Buteos	*109*	*101*	*46*	*41*	*38*	*35*	*181*	*178*	*374*	*355*
Swainson's hawk	23	21	11	10	4	3	0	0	38	34
ferruginous hawk	0	0	1	1	0	0	1	1	2	2
red-tailed hawk	48	45	30	26	21	21	36	35	135	127
rough-legged hawk	14	13	0	0	3	3	117	116	134	132
unidentified buteo	24	22	4	4	10	8	27	26	65	60
Northern Harriers										
northern harrier	39	39	21	21	7	7	38	38	105	105
Eagles	*3*	*3*	*1*	*1*	*0*	*0*	*4*	*4*	*8*	*8*
golden eagle	2	2	1	1	0	0	2	2	5	5
unidentified eagle	1	1	0	0	0	0	2	2	3	3
Falcons	*30*	*29*	*25*	*23*	*15*	*11*	*26*	*25*	*96*	*88*
American kestrel	24	23	24	22	15	11	18	17	81	73
prairie falcon	5	5	1	1	0	0	7	7	13	13
unidentified falcon	1	1	0	0	0	0	1	1	2	2
Other Raptors										
unidentified raptor	3	2	0	0	0	0	19	17	22	19
Vultures										
turkey vulture	3	3	4	2	0	0	0	0	7	5
Passerines	**2428**	**1040**	**595**	**318**	**1465**	**352**	**12298**	**1037**	**16786**	**2747**
American crow	6	1	0	0	1	1	1	1	8	3
American goldfinch	64	5	4	2	56	8	44	7	168	22
American pipit	189	9	0	0	77	9	157	7	423	25
American robin	14	9	3	3	4	3	15	6	36	21
barn swallow	16	11	31	8	9	3	0	0	56	22
black-billed magpie	0	0	1	1	4	2	14	5	19	8
Brewer's blackbird	114	13	7	5	45	7	114	6	280	31

Table 1. Avian species observed during fixed-point surveys[a] for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Seasons	Spring		Summer		Fall		Winter		Totals	
Group/Species	obs	grp	obs	grp	obs	grp	obs	grp	obs	grp
brown-headed cowbird	0	0	8	2	0	0	3	1	11	3
Cassin's finch	0	0	0	0	9	1	0	0	9	1
cliff swallow	10	2	25	9	0	0	0	0	35	11
common raven	88	55	11	9	56	36	152	103	307	203
common redpoll	0	0	0	0	0	0	7	1	7	1
common yellowthroat[b]	0	0	1	1	0	0	0	0	1	1
dark-eyed junco	0	0	0	0	3	2	25	3	28	5
European starling	91	14	18	4	61	8	770	32	940	58
golden-crowned kinglet[b]	0	0	0	0	1	1	0	0	1	1
golden-crowned sparrow	0	0	0	0	1	1	0	0	1	1
grasshopper sparrow	10	10	3	2	0	0	0	0	13	12
horned lark	1144	576	320	188	909	189	8800	656	11173	1609
house finch	8	4	1	1	7	2	75	5	91	12
lapland longspur	0	0	0	0	0	0	53	7	53	7
lark sparrow	2	1	0	0	1	1	0	0	3	2
Lincoln's sparrow	0	0	0	0	1	1	0	0	1	1
loggerhead shrike	1	1	8	7	0	0	1	1	10	9
N .rough-winged swallow	6	4	14	3	1	1	0	0	21	8
northern shrike	0	0	0	0	0	0	3	3	3	3
orange-crowned warbler	0	0	0	0	1	1	0	0	1	1
pine siskin	0	0	0	0	0	0	2	1	2	1
red-breasted nuthatch	0	0	0	0	2	2	0	0	2	2
red-winged blackbird	27	5	36	4	31	6	222	10	316	25
rock wren[b]	0	0	0	0	2	1	0	0	2	1
rusty blackbird	11	2	0	0	0	0	0	0	11	2
savannah sparrow	13	9	4	2	4	2	0	0	21	13
Say's phoebe	37	32	5	4	3	3	13	9	58	48
song sparrow	11	5	6	2	2	2	17	7	36	16
spotted towhee	2	2	0	0	1	1	3	3	6	6
tree swallow	5	2	0	0	0	0	0	0	5	2
unidentified blackbird	1	1	0	0	0	0	1056	6	1057	7
unidentified finch	1	1	0	0	0	0	33	3	34	4
unidentified passerine	48	17	1	1	38	10	352	23	439	51
unidentified shrike	0	0	0	0	0	0	1	1	1	1
unidentified sparrow	2	1	2	2	4	2	1	1	9	6
unidentified swallow	43	3	2	1	8	5	0	0	53	9
varied thrush[b]	0	0	0	0	0	0	1	1	1	1
vesper sparrow	2	2	3	1	1	1	0	0	6	4
violet-green swallow	25	4	0	0	0	0	0	0	25	4
western kingbird	8	5	13	9	3	3	0	0	24	17
western meadowlark	416	231	68	47	95	31	321	121	900	430
white-crowned sparrow	13	3	0	0	11	3	33	5	57	11
yellow-rumped warbler	0	0	0	0	13	3	9	2	22	5
Upland Gamebirds	**75**	**60**	**12**	**12**	**47**	**10**	**104**	**22**	**238**	**104**
California quail	7	3	1	1	4	1	62	5	74	10
Chukar	11	7	0	0	13	2	27	8	51	17
gray partridge	4	2	0	0	0	0	0	0	4	2
ring-necked pheasant	53	48	11	11	30	7	15	9	109	75

Table 1. Avian species observed during fixed-point surveys[a] for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Seasons	Spring		Summer		Fall		Winter		Totals	
Group/Species	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**	**obs**	**grp**
Doves/Pigeons	**30**	**12**	**30**	**14**	**43**	**17**	**47**	**10**	**150**	**53**
mourning dove	23	11	30	14	35	14	25	7	113	46
rock pigeon	7	1	0	0	8	3	22	3	37	7
Other Birds	**0**	**0**	**0**	**0**	**7**	**5**	**2**	**2**	**9**	**7**
Vaux's swift	0	0	0	0	3	1	0	0	3	1
northern flicker	0	0	0	0	4	4	2	2	6	6
Unidentified Birds										
unidentified large bird[c]	0	0	0	0	0	0	1	1	1	1
Overall Total	**2883**	**1311**	**775**	**434**	**2176**	**449**	**19428**	**1418**	**25262**	**3612**

[a] Includes all observations even those in the last ten minutes of surveys.
[b] Only observed in the last ten minutes of either the KIWP, BCWP, or BCRA surveys.
[c] Only observed outside 800m.

Table 2. Estimated mean use (number of observations per 20-minute survey) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Waterbirds	**0.013**	**0.004**	**0.000**	**0.003**	**0.005**
great blue heron	0.002	0.000	0.000	0.003	0.002
sandhill crane	0.011	0.000	0.000	0.000	0.003
unidentified gull	0.000	0.004	0.000	0.000	0.001
Waterfowl	**0.000**	**0.000**	**0.119**	**5.877**	**2.505**
American wigeon	0.000	0.000	0.000	0.003	0.001
Canada goose	0.000	0.000	0.119	5.794	2.474
green-winged teal	0.000	0.000	0.000	0.003	0.001
Mallard	0.000	0.000	0.000	0.073	0.025
trumpeter swan	0.000	0.000	0.000	0.004	0.003
Shorebirds	**0.018**	**0.000**	**0.005**	**0.011**	**0.011**
Killdeer	0.014	0.000	0.005	0.011	0.010
long-billed curlew	0.004	0.000	0.000	0.000	0.001
Raptors/Vultures	**0.354**	**0.392**	**0.232**	**0.309**	**0.306**
Accipiters	*0.000*	*0.019*	*0.000*	*0.000*	*0.003*
Cooper's hawk	0.000	0.000	0.009	0.000	0.001
sharp-shinned hawk	0.000	0.000	0.009	0.000	0.001
Swainson's hawk	0.036	0.018	0.010	0.000	0.016
Buteos	*0.168*	*0.133*	*0.206*	*0.180*	*0.177*
ferruginous hawk	0.000	0.004	0.000	0.000	0.001
red-tailed hawk	0.108	0.139	0.096	0.053	0.083
rough-legged hawk	0.026	0.000	0.013	0.146	0.067
unidentified buteo	0.009	0.007	0.014	0.007	0.010
Harriers					
northern harrier	0.097	0.029	0.014	0.045	0.048
Eagles	*0.004*	*0.000*	*0.003*	*0.002*	*0.003*
golden eagle	0.000	0.004	0.000	0.002	0.002
unidentified eagle	0.002	0.000	0.000	0.002	0.002
Falcons	*0.165*	*0.066*	*0.051*	*0.068*	*0.068*
American kestrel	0.061	0.162	0.066	0.032	0.058
prairie falcon	0.007	0.004	0.000	0.018	0.009
unidentified falcon	0.000	0.000	0.000	0.001	0.001
Other Raptors					
unidentified raptor	0.000	0.000	0.000	0.003	0.002
Vultures					
turkey vulture	0.007	0.026	0.000	0.000	0.005
Passerines	**6.402**	**3.792**	**7.922**	**18.147**	**12.139**
American crow	0.033	0.000	0.000	0.001	0.009
American goldfinch	0.267	0.026	0.285	0.122	0.145
American pipit	0.050	0.000	0.669	0.554	0.314
American robin	0.035	0.011	0.024	0.031	0.025

Table 2. Estimated mean use (number of observations per 20-minute survey) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Brewer's blackbird	0.285	0.049	0.372	0.191	0.230
Cassin's finch	0.000	0.000	0.083	0.000	0.013
European starling	0.319	0.175	0.355	2.184	0.955
Lincoln's sparrow	0.000	0.000	0.006	0.000	0.001
Say's phoebe	0.104	0.018	0.019	0.028	0.046
barn swallow	0.043	0.285	0.028	0.000	0.048
black-billed magpie	0.000	0.004	0.028	0.054	0.025
brown-headed cowbird	0.000	0.000	0.000	0.003	0.002
cliff swallow	0.032	0.018	0.000	0.000	0.009
common raven	0.201	0.042	0.301	0.208	0.192
common redpoll	0.000	0.000	0.000	0.006	0.004
dark-eyed junco	0.000	0.000	0.006	0.001	0.002
golden-crowned sparrow	0.000	0.000	0.006	0.000	0.001
grasshopper sparrow	0.021	0.028	0.000	0.000	0.010
horned lark	3.223	2.008	4.512	11.496	7.731
house finch	0.007	0.009	0.053	0.339	0.135
lapland longspur	0.000	0.000	0.000	0.164	0.059
lark sparrow	0.011	0.000	0.005	0.000	0.004
loggerhead shrike	0.003	0.026	0.000	0.001	0.005
northern rough-winged swallow	0.019	0.115	0.005	0.000	0.018
northern shrike	0.000	0.000	0.000	0.004	0.001
orange-crowned warbler	0.000	0.000	0.006	0.000	0.001
pine siskin	0.000	0.000	0.000	0.008	0.003
red-breasted nuthatch	0.000	0.000	0.016	0.000	0.002
red-winged blackbird	0.098	0.248	0.192	0.535	0.273
rusty blackbird	0.037	0.000	0.000	0.000	0.011
savannah sparrow	0.029	0.050	0.026	0.000	0.019
song sparrow	0.038	0.054	0.006	0.051	0.036
spotted towhee	0.004	0.000	0.006	0.007	0.004
tree swallow	0.020	0.000	0.000	0.000	0.003
unidentified blackbird	0.002	0.000	0.000	0.923	0.627
unidentified finch	0.002	0.000	0.000	0.010	0.007
unidentified passerine	0.063	0.000	0.182	0.496	0.284
unidentified shrike	0.000	0.000	0.000	0.001	0.001
unidentified sparrow	0.000	0.016	0.026	0.005	0.008
unidentified swallow	0.069	0.000	0.019	0.000	0.025
vesper sparrow	0.002	0.048	0.000	0.000	0.006
violet-green swallow	0.006	0.000	0.000	0.000	0.001
western kingbird	0.015	0.079	0.005	0.000	0.015
western meadowlark	1.308	0.483	0.611	0.598	0.758
white-crowned sparrow	0.058	0.000	0.069	0.090	0.058
yellow-rumped warbler	0.000	0.000	0.000	0.036	0.013

Table 2. Estimated mean use (number of observations per 20-minute survey) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Upland Gamebirds	**0.189**	**0.045**	**0.282**	**0.312**	**0.214**
California quail	0.000	0.009	0.026	0.225	0.086
chukar	0.019	0.000	0.071	0.061	0.040
gray partridge	0.022	0.000	0.000	0.000	0.006
ring-necked pheasant	0.147	0.036	0.186	0.027	0.082
Doves/Pigeons	**0.084**	**0.173**	**0.186**	**0.147**	**0.123**
mourning dove	0.084	0.173	0.123	0.070	0.087
rock pigeon	0.000	0.000	0.063	0.077	0.037
Other Birds	**0.000**	**0.000**	**0.030**	**0.004**	**0.006**
Vaux's swift	0.000	0.000	0.019	0.000	0.003
northern flicker	0.000	0.000	0.011	0.004	0.003

Table 3. Estimated percent composition (mean use divided by total use for all species) for each species observed within 800 m of the survey point all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Waterbirds	**0.18**	**0.08**	**0.00**	**0.01**	**0.03**
great blue heron	0.02	0.00	0.00	0.01	0.01
sandhill crane	0.16	0.00	0.00	0.00	0.02
unidentified gull	0.00	0.08	0.00	0.00	0.00
Waterfowl	**0.00**	**0.00**	**1.36**	**23.69**	**16.36**
American wigeon	0.00	0.00	0.00	0.01	0.01
Canada goose	0.00	0.00	1.36	23.35	16.16
green-winged teal	0.00	0.00	0.00	0.01	0.01
mallard	0.00	0.00	0.00	0.29	0.17
trumpeter swan	0.00	0.00	0.00	0.02	0.02
Shorebirds	**0.25**	**0.00**	**0.05**	**0.05**	**0.07**
killdeer	0.20	0.00	0.05	0.05	0.07
long-billed curlew	0.06	0.00	0.00	0.00	0.00
Raptors	**5.01**	**8.89**	**2.64**	**1.24**	**2.00**
Accipiters	*0.00*	*0.00*	*0.21*	*0.00*	*0.02*
Cooper's hawk	0.00	0.00	0.11	0.00	0.01
sharp-shinned hawk	0.00	0.00	0.11	0.00	0.01
Buteos	*2.55*	*3.81*	*1.51*	*0.83*	*1.15*
ferruginous hawk	0.00	0.08	0.00	0.00	0.00
rough-legged hawk	0.37	0.00	0.15	0.59	0.44
red-tailed hawk	1.53	3.15	1.10	0.22	0.54
Swainson's hawk	0.52	0.42	0.11	0.00	0.11
unidentified buteo	0.13	0.17	0.16	0.03	0.06
Northern Harrier					
northern harrier	1.37	0.67	0.16	0.18	0.32
Eagles	*0.02*	*0.08*	*0.00*	*0.01*	*0.02*
golden eagle	0.00	0.08	0.00	0.01	0.01
unidentified eagle	0.02	0.00	0.00	0.01	0.01
Falcon	*0.96*	*3.75*	*0.75*	*0.21*	*0.44*
American kestrel	0.87	3.67	0.75	0.13	0.38
prairie falcon	0.10	0.08	0.00	0.07	0.06
unidentified falcon	0.00	0.00	0.00	0.00	0.00
Other Raptors					
unidentified raptor	0.00	0.00	0.00	0.01	0.01
Vultures					
turkey vulture	0.10	0.58	0.00	0.00	0.03
Passerines	**90.69**	**86.06**	**90.27**	**73.14**	**79.29**
American crow	0.47	0.00	0.00	0.00	0.06
American goldfinch	3.79	0.59	3.25	0.49	0.95
American pipit	0.71	0.00	7.63	2.23	2.05
American robin	0.50	0.25	0.27	0.13	0.17

Table 3. Estimated percent composition (mean use divided by total use for all species) for each species observed within 800 m of the survey point all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
barn swallow	0.60	6.48	0.32	0.00	0.31
black-billed magpie	0.00	0.08	0.32	0.22	0.16
brown-headed cowbird	0.00	0.00	0.00	0.01	0.01
Brewer's blackbird	4.03	1.12	4.24	0.77	1.50
Cassin's finch	0.00	0.00	0.95	0.00	0.09
cliff swallow	0.45	0.42	0.00	0.00	0.06
common raven	2.84	0.94	3.43	0.84	1.26
common redpoll	0.00	0.00	0.00	0.02	0.03
dark-eyed junco	0.00	0.00	0.07	0.00	0.01
European starling	4.52	3.96	4.05	8.80	6.24
golden-crowned sparrow	0.00	0.00	0.07	0.00	0.01
grasshopper sparrow	0.29	0.63	0.00	0.00	0.06
house finch	0.11	0.21	0.61	1.37	0.88
horned lark	45.66	45.58	51.42	46.34	50.50
lapland longspur	0.00	0.00	0.00	0.66	0.38
lark sparrow	0.16	0.00	0.05	0.00	0.02
Lincoln's sparrow	0.00	0.00	0.07	0.00	0.01
loggerhead shrike	0.05	0.60	0.00	0.00	0.03
northern rough-winged swallow	0.27	2.62	0.05	0.00	0.11
northern shrike	0.00	0.00	0.00	0.02	0.01
orange-crowned warbler	0.00	0.00	0.07	0.00	0.01
pine siskin	0.00	0.00	0.00	0.03	0.02
red-breasted nuthatch	0.00	0.00	0.18	0.00	0.02
rusty blackbird	0.52	0.00	0.00	0.00	0.07
red-winged blackbird	1.38	5.63	2.19	2.16	1.78
Say's phoebe	1.47	0.40	0.21	0.11	0.30
savannah sparrow	0.41	1.14	0.29	0.00	0.12
song sparrow	0.54	1.23	0.07	0.20	0.24
spotted towhee	0.06	0.00	0.07	0.03	0.03
tree swallow	0.28	0.00	0.00	0.00	0.02
unidentified blackbird	0.02	0.00	0.00	3.72	4.10
unidentified finch	0.02	0.00	0.00	0.04	0.05
unidentified passerine	0.89	0.00	2.08	2.00	1.86
unidentified shrike	0.00	0.00	0.00	0.00	0.00
unidentified sparrow	0.00	0.36	0.29	0.02	0.05
unidentified swallow	0.98	0.00	0.22	0.00	0.16
vesper sparrow	0.02	1.08	0.00	0.00	0.04
violet-green swallow	0.08	0.00	0.00	0.00	0.01
white-crowned sparrow	0.82	0.00	0.78	0.36	0.38
western kingbird	0.21	1.78	0.05	0.00	0.10
western meadowlark	18.53	10.96	6.96	2.41	4.95
yellow-rumped warbler	0.00	0.00	0.00	0.14	0.09

Table 3. Estimated percent composition (mean use divided by total use for all species) for each species observed within 800 m of the survey point all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Upland Gamebirds	**2.68**	**1.03**	**3.21**	**1.26**	**1.40**
California quail	0.00	0.21	0.29	0.91	0.56
chukar	0.28	0.00	0.80	0.24	0.26
gray partridge	0.31	0.00	0.00	0.00	0.04
ring-necked pheasant	2.09	0.82	2.12	0.11	0.54
Doves/Pigeons	**1.19**	**3.93**	**2.11**	**0.59**	**0.80**
mourning dove	1.19	3.93	1.40	0.28	0.57
rock pigeon	0.00	0.00	0.71	0.31	0.24
Other Birds	**0.00**	**0.00**	**0.35**	**0.02**	**0.04**
northern flicker	0.00	0.00	0.13	0.02	0.02
Vaux's swift	0.00	0.00	0.22	0.00	0.02

Table 4. Estimated frequency of occurrence (average percent of surveys species/group is recorded) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Waterbirds	**0.73**	**0.37**	**0.00**	**0.30**	**0.37**
great blue heron	0.17	0.00	0.00	0.30	0.16
sandhill crane	0.56	0.00	0.00	0.00	0.15
unidentified gull	0.00	0.37	0.00	0.00	0.07
Waterfowl	**0.00**	**0.00**	**0.48**	**5.91**	**2.52**
American wigeon	0.00	0.00	0.00	0.30	0.10
Canada goose	0.00	0.00	0.48	4.87	2.12
green-winged teal	0.00	0.00	0.00	0.30	0.10
mallard	0.00	0.00	0.00	0.65	0.23
trumpeter swan	0.00	0.00	0.00	0.09	0.06
Shorebirds	**1.26**	**0.00**	**0.48**	**0.78**	**0.78**
killdeer	0.87	0.00	0.48	0.78	0.71
long-billed curlew	0.40	0.00	0.00	0.00	0.07
Raptors/Vultures	**27.57**	**25.88**	**16.69**	**23.58**	**22.94**
Accipiters	*0.00*	*0.00*	*1.85*	*0.00*	*0.29*
Cooper's hawk	0.00	0.00	0.93	0.00	0.15
sharp-shinned hawk	0.00	0.00	0.93	0.00	0.15
Buteos	*14.28*	*11.21*	*10.58*	*16.95*	*13.99*
ferruginous hawk	0.00	0.37	0.00	0.00	0.07
rough-legged hawk	2.25	0.00	1.28	12.72	5.90
red-tailed hawk	8.82	9.01	8.35	5.04	6.78
Swainson's hawk	2.60	1.47	0.95	0.00	1.23
unidentified buteo	0.95	0.73	0.95	0.59	0.86
Northern Harrier					
northern harrier	8.59	2.56	1.43	4.12	4.37
Eagles	*0.17*	*0.37*	*0.00*	*0.33*	*0.35*
golden eagle	0.00	0.37	0.00	0.16	0.18
unidentified eagle	0.17	0.00	0.00	0.16	0.17
Falcon	*6.80*	*13.59*	*5.19*	*4.73*	*6.06*
American kestrel	6.11	13.22	5.19	3.17	5.16
prairie falcon	0.69	0.37	0.00	1.78	0.95
unidentified falcon	0.00	0.00	0.00	0.08	0.06
Other Raptors					
unidentified raptor	0.00	0.00	0.00	0.33	0.23
Vultures					
turkey vulture	0.52	0.85	0.00	0.00	0.26
Passerines	**92.71**	**79.30**	**86.18**	**83.31**	**85.59**
American crow	0.56	0.00	0.00	0.08	0.20
American goldfinch	1.90	1.29	2.35	2.04	1.74
American pipit	0.56	0.00	5.82	2.12	1.80
American robin	1.97	1.10	1.88	1.22	1.38
barn swallow	2.78	6.31	1.40	0.00	1.66
black-billed magpie	0.00	0.37	0.93	1.70	0.84
brown-headed cowbird	0.00	0.00	0.00	0.09	0.06

Table 4. Estimated frequency of occurrence (average percent of surveys species/group is recorded) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
Brewer's blackbird	2.58	4.01	4.06	0.74	2.10
Cassin's finch	0.00	0.00	0.93	0.00	0.15
cliff swallow	0.40	1.47	0.00	0.00	0.34
common raven	12.02	3.30	18.86	13.56	12.15
common redpoll	0.00	0.00	0.00	0.08	0.06
dark-eyed junco	0.00	0.00	0.64	0.08	0.15
European starling	5.30	3.44	3.13	7.50	5.21
golden-crowned sparrow	0.00	0.00	0.64	0.00	0.10
grasshopper sparrow	1.57	0.93	0.00	0.00	0.59
house finch	0.57	0.93	1.57	2.00	1.20
horned lark	80.74	58.16	68.95	69.71	72.10
lapland longspur	0.00	0.00	0.00	2.10	0.75
lark sparrow	0.56	0.00	0.48	0.00	0.21
Lincoln's sparrow	0.00	0.00	0.64	0.00	0.10
loggerhead shrike	0.35	1.78	0.00	0.09	0.36
northern rough-winged swallow	0.97	1.78	0.48	0.00	0.46
northern shrike	0.00	0.00	0.00	0.40	0.15
orange-crowned warbler	0.00	0.00	0.64	0.00	0.10
pine siskin	0.00	0.00	0.00	0.40	0.15
red-breasted nuthatch	0.00	0.00	1.57	0.00	0.24
rusty blackbird	0.67	0.00	0.00	0.00	0.20
red-winged blackbird	1.90	2.71	3.21	1.91	1.95
Say's phoebe	9.43	1.78	1.85	1.92	3.89
savannah sparrow	1.57	2.51	1.28	0.00	0.97
song sparrow	1.77	1.78	0.64	1.61	1.39
spotted towhee	0.40	0.00	0.64	0.74	0.45
tree swallow	0.79	0.00	0.00	0.00	0.14
unidentified blackbird	0.17	0.00	0.00	0.42	0.34
unidentified finch	0.17	0.00	0.00	0.08	0.11
unidentified passerine	1.91	0.00	5.18	3.17	2.86
unidentified shrike	0.00	0.00	0.00	0.08	0.06
unidentified sparrow	0.00	1.60	1.28	0.51	0.60
unidentified swallow	0.35	0.00	1.43	0.00	0.32
vesper sparrow	0.17	1.59	0.00	0.00	0.24
violet-green swallow	0.57	0.00	0.00	0.00	0.12
white-crowned sparrow	1.20	0.00	1.76	1.23	1.04
western kingbird	0.73	4.67	0.48	0.00	0.86
western meadowlark	49.30	23.29	16.23	18.35	26.51
yellow-rumped warbler	0.00	0.00	0.00	0.79	0.29
Upland Gamebirds	**13.41**	**4.54**	**3.97**	**4.66**	**6.46**
California quail	0.00	0.93	0.64	1.82	0.86
chukar	1.25	0.00	0.64	1.50	1.07
gray partridge	1.11	0.00	0.00	0.00	0.29

Table 4. Estimated frequency of occurrence (average percent of surveys species/group is recorded) for each species observed within 800 m of the survey point for all projects combined (KIWP, KIIIWP, BCWP, BCRA).

Group/Species	Spring	Summer	Fall	Winter	Overall
ring-necked pheasant	11.61	3.61	3.33	1.33	4.48
Doves/Pigeons	**3.59**	**4.17**	**6.68**	**2.44**	**3.33**
mourning dove	3.59	4.17	4.47	1.79	2.76
rock pigeon	0.00	0.00	2.21	0.65	0.57
Other Birds	**0.00**	**0.00**	**1.76**	**0.38**	**0.42**
northern flicker	0.00	0.00	1.12	0.38	0.32
Vaux's swift	0.00	0.00	0.64	0.00	0.10

Table 5. Flight height characteristics of bird species and groups observed during the fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

				% w/i Height Categories		
Group/Species	**Number groups flying**	**Number birds flying**	**Percent of birds flying**	**<25 m**	**25-125m**	**> 125 m**
Waterbirds	**2**	**2**	**25.00**	**50.00**	**50.00**	**0.00**
great blue heron	1	1	50.00	0.00	100.00	0.00
sandhill crane	0	0	0.00	N/A	N/A	N/A
unidentified gull	1	1	25.00	100.00	0.00	0.00
Waterfowl	**54**	**4847**	**86.54**	**32.14**	**62.41**	**5.45**
American wigeon	0	0	0.00	N/A	N/A	N/A
Canada goose	52	4837	87.00	32.21	62.33	5.46
green-winged teal	0	0	0.00	N/A	N/A	N/A
mallard	0	0	0.00	N/A	N/A	N/A
trumpeter swan	2	10	100.00	0.00	100.00	0.00
unidentified duck	0	0	0.00	N/A	N/A	N/A
Shorebirds	**10**	**18**	**78.26**	**83.33**	**16.67**	**0.00**
killdeer	8	11	73.33	81.82	18.18	0.00
long-billed curlew	2	7	87.50	85.71	14.29	0.00
Raptors/Vultures	**359**	**383**	**81.14**	**41.78**	**48.30**	**9.92**
Accipiters	*2*	*2*	*100.00*	*100.00*	*0.00*	*0.00*
Cooper's hawk	1	1	100.00	100.00	0.00	0.00
sharp-shinned hawk	1	1	100.00	100.00	0.00	0.00
Buteos	*219*	*233*	*78.72*	*25.75*	*62.66*	*11.59*
Swainson's hawk	20	22	73.33	22.73	50.00	27.27
ferruginous hawk	1	1	100.00	0.00	0.00	100.00
red-tailed hawk	72	79	73.15	32.91	51.90	15.19
rough-legged hawk	86	88	83.81	25.00	72.73	2.27
unidentified buteo	40	43	82.69	16.28	69.77	13.95
Northern Harriers						
northern harrier	63	63	94.03	87.30	11.11	1.59
Eagles	*8*	*8*	*100.00*	*0.00*	*87.50*	*12.50*
golden eagle	5	5	100.00	0.00	100.00	0.00
unidentified eagle	3	3	100.00	0.00	66.67	33.33
Falcons	*44*	*49*	*69.01*	*73.47*	*24.49*	*2.04*
American kestrel	31	36	62.07	77.78	22.22	0.00
prairie falcon	11	11	100.00	63.64	27.27	9.09
unidentified falcon	2	2	100.00	50.00	50.00	0.00
Other Raptors						
unidentified raptor	19	22	100.00	22.73	40.91	36.36
Vultures						
turkey vulture	4	6	100.00	33.33	66.67	0.00
Passerines	**1609**	**13107**	**85.64**	**78.70**	**21.16**	**0.14**
American crow	1	1	14.29	0.00	100.00	0.00

Table 5. Flight height characteristics of bird species and groups observed during the fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

				% w/i Height Categories		
Group/Species	Number groups flying	Number birds flying	Percent of birds flying	<25 m	25-125m	> 125 m
American goldfinch	12	124	86.11	50.81	49.19	0.00
American pipit	11	226	94.17	99.56	0.44	0.00
American robin	9	15	48.39	80.00	20.00	0.00
Brewer's blackbird	20	200	75.47	60.50	39.50	0.00
Cassin's finch	1	9	100.00	0.00	100.00	0.00
European starling	38	691	78.52	45.88	54.12	0.00
Lincoln's sparrow	1	1	100.00	100.00	0.00	0.00
Say's phoebe	18	24	57.14	100.00	0.00	0.00
barn swallow	18	46	100.00	97.83	2.17	0.00
black-billed magpie	4	14	82.35	50.00	50.00	0.00
brown-headed cowbird	1	3	100.00	100.00	0.00	0.00
cliff swallow	5	13	100.00	100.00	0.00	0.00
common raven	129	197	85.28	56.35	37.06	6.60
common redpoll	1	7	100.00	100.00	0.00	0.00
dark-eyed junco	2	2	100.00	100.00	0.00	0.00
golden-crowned sparrow	0	0	0.00	N/A	N/A	N/A
grasshopper sparrow	2	2	16.67	100.00	0.00	0.00
horned lark	1037	9315	89.49	88.32	11.68	0.00
house finch	9	82	95.35	95.12	4.88	0.00
lapland longspur	2	34	70.83	50.00	50.00	0.00
lark sparrow	2	3	100.00	100.00	0.00	0.00
loggerhead shrike	5	5	100.00	100.00	0.00	0.00
northern rough-winged swallow	7	20	100.00	60.00	40.00	0.00
northern shrike	0	0	0.00	N/A	N/A	N/A
orange-crowned warbler	0	0	0.00	N/A	N/A	N/A
pine siskin	1	2	100.00	100.00	0.00	0.00
red-breasted nuthatch	0	0	0.00	N/A	N/A	N/A
red-winged blackbird	8	46	17.16	100.00	0.00	0.00
rusty blackbird	0	0	0.00	N/A	N/A	N/A
savannah sparrow	8	15	75.00	100.00	0.00	0.00
song sparrow	4	8	23.53	100.00	0.00	0.00
spotted towhee	2	2	40.00	100.00	0.00	0.00
tree swallow	2	5	100.00	20.00	80.00	0.00
unidentified blackbird	7	1057	100.00	5.39	94.61	0.00
unidentified finch	2	13	100.00	100.00	0.00	0.00
unidentified passerine	37	406	99.27	90.64	7.88	1.48
unidentified shrike	1	1	100.00	100.00	0.00	0.00
unidentified sparrow	3	5	71.43	100.00	0.00	0.00
unidentified swallow	5	44	100.00	97.73	2.27	0.00
vesper sparrow	1	3	75.00	100.00	0.00	0.00
violet-green swallow	2	2	100.00	50.00	50.00	0.00

Table 5. Flight height characteristics of bird species and groups observed during the fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

				% w/i Height Categories		
Group/Species	**Number groups flying**	**Number birds flying**	**Percent of birds flying**	**<25 m**	**25-125m**	**> 125 m**
western kingbird	10	15	93.75	100.00	0.00	0.00
western meadowlark	174	405	49.33	99.01	0.99	0.00
white-crowned sparrow	5	35	70.00	100.00	0.00	0.00
yellow-rumped warbler	2	9	100.00	44.44	55.56	0.00
Upland Gamebirds	**25**	**101**	**49.75**	**100.00**	**0.00**	**0.00**
California quail	2	48	71.64	100.00	0.00	0.00
chukar	6	13	30.23	100.00	0.00	0.00
gray partridge	1	2	50.00	100.00	0.00	0.00
ring-necked pheasant	16	38	42.70	100.00	0.00	0.00
Doves/Pigeons	**38**	**102**	**82.93**	**62.75**	**37.25**	**0.00**
mourning dove	32	72	77.42	88.89	11.11	0.00
rock pigeon	6	30	100.00	0.00	100.00	0.00
Other Birds	**4**	**6**	**85.71**	**33.33**	**66.67**	**0.00**
Vaux's swift	1	3	100.00	0.00	100.00	0.00
northern flicker	3	3	75.00	66.67	33.33	0.00
Unidentified Birds						
unidentified large bird	1	1	100.00	100.00	0.00	0.00
Overall	2102	18567	85.40	65.80	32.47	1.73

Table 6. Exposure indices calculated for species observed during fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

Group/Species	Mean use	Percent flying	Percent flying within RSA	Exposure Index
Waterbirds	**0.005**	**25.00**	**50.00**	**0.001**
great blue heron	0.002	50.00	100.00	0.001
sandhill crane	0.003	0.00	N/A	N/A
unidentified gull	0.001	25.00	0.00	0.000
Waterfowl	**2.505**	**86.54**	**62.41**	**1.353**
American wigeon	0.001	0.00	N/A	N/A
Canada goose	2.474	87.00	62.33	1.342
green-winged teal	0.001	0.00	N/A	N/A
mallard	0.025	0.00	N/A	N/A
trumpeter swan	0.003	100.00	100.00	0.003
unidentified duck	N/A	0.00	N/A	N/A
Shorebirds	**0.011**	**78.26**	**16.67**	**0.001**
killdeer	0.010	73.33	18.18	0.001
long-billed curlew	0.001	87.50	14.29	0.000
Raptors	**0.306**	**81.14**	**48.30**	**0.120**
Accipiters	*0.003*	*100.00*	*0.00*	*0.000*
Cooper's hawk	0.001	100.00	0.00	0.000
sharp-shinned hawk	0.001	100.00	0.00	0.000
Buteos	*0.177*	*78.72*	*62.66*	*0.087*
Swainson's hawk	0.016	73.33	50.00	0.006
ferruginous hawk	0.001	100.00	0.00	0.000
red-tailed hawk	0.083	73.15	51.90	0.031
rough-legged hawk	0.067	83.81	72.73	0.041
unidentified buteo	0.010	82.69	69.77	0.006
Northern Harriers				
northern harrier	0.048	94.03	11.11	0.005
Eagles	*0.003*	*100.00*	*87.50*	*0.003*
golden eagle	0.002	100.00	100.00	0.002
unidentified eagle	0.002	100.00	66.67	0.001
Falcon	*0.068*	*69.01*	*24.49*	*0.011*
American kestrel	0.058	62.07	22.22	0.008
prairie falcon	0.009	100.00	27.27	0.003
unidentified falcon	0.001	100.00	50.00	0.000
Other Raptors				
unidentified raptor	0.002	100.00	40.91	0.001
Vultures				
turkey vulture	0.005	100.00	66.67	0.003
Passerines	**12.139**	**85.64**	**21.16**	**2.200**
American crow	0.009	14.29	100.00	0.001
American goldfinch	0.145	86.11	49.19	0.062

Table 6. Exposure indices calculated for species observed during fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

Group/Species	Mean use	Percent flying	Percent flying within RSA	Exposure Index
American pipit	0.314	94.17	0.44	0.001
American robin	0.025	48.39	20.00	0.002
Brewer's blackbird	0.230	75.47	39.50	0.069
Cassin's finch	0.013	100.00	100.00	0.013
European starling	0.955	78.52	54.12	0.406
Lincoln's sparrow	0.001	100.00	0.00	0.000
Say's phoebe	0.046	57.14	0.00	0.000
barn swallow	0.048	100.00	2.17	0.001
black-billed magpie	0.025	82.35	50.00	0.010
brown-headed cowbird	0.002	100.00	0.00	0.000
cliff swallow	0.009	100.00	0.00	0.000
common raven	0.192	85.28	37.06	0.061
common redpoll	0.004	100.00	0.00	0.000
dark-eyed junco	0.002	100.00	0.00	0.000
golden-crowned sparrow	0.001	0.00	N/A	N/A
grasshopper sparrow	0.010	16.67	0.00	0.000
horned lark	7.731	89.49	11.68	0.808
house finch	0.135	95.35	4.88	0.006
lapland longspur	0.059	70.83	50.00	0.021
lark sparrow	0.004	100.00	0.00	0.000
loggerhead shrike	0.005	100.00	0.00	0.000
northern rough-winged swallow	0.018	100.00	40.00	0.007
northern shrike	0.001	0.00	N/A	N/A
orange-crowned warbler	0.001	0.00	N/A	N/A
pine siskin	0.003	100.00	0.00	0.000
red-breasted nuthatch	0.002	0.00	N/A	N/A
red-winged blackbird	0.273	17.16	0.00	0.000
rusty blackbird	0.011	0.00	N/A	N/A
savannah sparrow	0.019	75.00	0.00	0.000
song sparrow	0.036	23.53	0.00	0.000
spotted towhee	0.004	40.00	0.00	0.000
tree swallow	0.003	100.00	80.00	0.003
unidentified blackbird	0.627	100.00	94.61	0.593
unidentified finch	0.007	100.00	0.00	0.000
unidentified passerine	0.284	99.27	7.88	0.022
unidentified shrike	0.001	100.00	0.00	0.000
unidentified sparrow	0.008	71.43	0.00	0.000
unidentified swallow	0.025	100.00	2.27	0.001
vesper sparrow	0.006	75.00	0.00	0.000
violet-green swallow	0.001	100.00	50.00	0.001
western kingbird	0.015	93.75	0.00	0.000
western meadowlark	0.758	49.33	0.99	0.004

Table 6. Exposure indices calculated for species observed during fixed-point surveys at KIWP, KIIIWP, BCWP, and BCRA.

Group/Species	Mean use	Percent flying	Percent flying within RSA	Exposure Index
white-crowned sparrow	0.058	70.00	0.00	0.000
yellow-rumped warbler	0.013	100.00	55.56	0.007
Upland Gamebirds	**0.214**	**49.75**	**0.00**	**0.000**
California quail	0.086	71.64	0.00	0.000
chukar	0.040	30.23	0.00	0.000
gray partridge	0.006	50.00	0.00	0.000
ring-necked pheasant	0.082	42.70	0.00	0.000
Doves/Pigeons	**0.123**	**82.93**	**37.25**	**0.038**
mourning dove	0.087	77.42	11.11	0.007
rock pigeon	0.037	100.00	100.00	0.037
Other Birds	**0.006**	**85.71**	**66.67**	**0.004**
Vaux's swift	0.003	100.00	100.00	0.003
northern flicker	0.003	75.00	33.33	0.001
Unidentified Birds				
unidentified large bird	N/A	100.00	0.00	N/A

Table 7. Summary of Bat Mortality for Newer Generation Wind Plant Monitoring Studies in the Western U.S.

Project Name [state]	No. Bats /turbine/year	Approx. Bats per MW[1]	Reference
Washington/Oregon Sites			
Stateline [OR/WA]	1.12	1.70	Erickson et al. 2003
Vansycle [OR]	0.74	1.12	Erickson et al. 2000
Klondike [OR]	1.16	0.77	Johnson et al. 2003
Nine Canyon [WA]	3.21	2.46	Erickson et al. 2003
Combine Hills [OR]	1.88	1.88	Young et al. 2006
Average	1.62	1.59	
Other West and Midwest Sites			
Foote Creek Rim I [WY]	1.34	2.23	Young et al. 2003a
Foote Creek Rim II [WY]	0.79	1.05	Young et al. 2003b
Buffalo Ridge [MN]	2.05	3.10	Johnson et al. 2000
Wisconsin [WI]	4.30	6.51	Howe et al. 2002
Overall Average	1.84	2.31	

[1] Most reports do not provide number of birds per MW of energy produced so this number was calculated based on the mortality per turbine and capacity of turbines studied.

Table 8. Mean raptor use estimates standardized to 20-min surveys and raptor mortality estimates based on fatality studies at region wind projects.

Project	Raptor Use Estimate (#/20-min survey)	Raptor Mortality (#/turbine/year)	References
Vansycle, OR	0.51	0	URS&WEST 2001; Erickson et al. 2000
Stateline, OR	0.41	0.053	URS&WEST 2001; Erickson et al. 2004
Combine Hills, OR	0.61	0	Young et al. 2003 Young et al. 2005
Nine Canyon, WA	0.27	0.065	Erickson et al. 2001 Erickson et al. 2003
Klondike I, OR	0.42	0	Johnson et al. 2002; Johnson et al. 2003
Average	0.44	0.024	

Table 9. Mean bird use estimates standardized to 20-min surveys and all bird mortality estimates based on fatality studies at region wind projects.

Project	All Bird Use Estimate (#/20-min survey)	All Bird Mortality (#/turbine/year)	References
Vansycle, OR	7.06	0.63	URS&WEST 2001; Erickson et al. 2000
Stateline, OR	8.77	1.93	URS&WEST 2001; Erickson et al. 2004
Combine Hills, OR	4.11	2.56	Young et al. 2003 Young et al. 2005
Nine Canyon, WA	6.28	3.59	Erickson et al. 2001 Erickson et al. 2003
Klondike I, OR	9.34	1.42	Johnson et al. 2002; Johnson et al. 2003
Average		2.03	

Figure 1. Region map of wind projects proposed for Sherman County.