Appendix E:
Pre-Construction Avian Surveys and Risk Assessment Haxtun Wind Project Logan and Phillips Counties, Colorado

PRE-CONSTRUCTION AVIAN SURVEY AND RISK ASSESSMENT

Haxtun Wind Project

Logan and Phillips Counties, Colorado
August 30, 2011

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1.0 EXECUTIVE SUMMARY

National Wind retained Westwood Professional Services (Westwood) to conduct a pre-construction avian survey and risk assessment for the Haxtun Wind Project (Haxtun) proposed in Logan and Phillips Counties, Colorado. This work is being completed as part of a federal Environmental Assessment (EA) process. An avian survey was conducted at 16 point count locations to characterize avian community and assess potential risks to recorded species based on flight heights relative to proposed turbines during fall migration, winter, spring migration, and breeding seasons (2010 – 2011). Raptor nests were surveyed and mapped concurrent with the avian survey.

Westwood observed a total of 2,444 birds of 35 species at Haxtun during 12 surveys over four seasons. Generally, species observed are common in distribution and/or abundance. Overall mean use was 12.73 birds per 5 minutes. The most frequently seen species was the Horned Lark. The only species with conservation status that was observed was Burrowing Owl, which was recorded once as an incidental observation. No other species with conservation status were observed, including federal candidate or proposed species, federal and state threatened and endangered species, or state-listed special concern species. The project area lacks habitats that typically support rare species.

The bird species observed at Haxtun showed substantial overlap with the species reported for the nearest and most recent North American Breeding Bird Survey route. Passerines (songbirds) accounted for 90% of the individual birds observed. Most passerines were generalist species that are adapted to the agricultural landscape. Waterfowl and waterbirds were notably scarce in the avian community, presumably due to the lack of suitable migration stopover and breeding habitat (i.e., wetlands, lakes, and rivers). Haxtun lacks prominent migration stopover habitat for many species of birds. Observations of large flocks of migrating birds, such as warblers, sparrows, and ducks and geese, were fewer than expected. Of 748 avian observations recorded, only 41 (5.5%) involved groups of more than 10 birds, and only nine involved more than 25 birds.

There were 33 species of birds observed in flight, and only four of these species had a measurable index of collision hazard ($I \geq 0.001$). These species include Horned Lark, Swainson's Hawk, Killdeer, and Mourning Dove. Overall, the risk for avian fatality at Haxtun is considered to be low, as only 10% of flights were within the rotor-swept height (RSH). Passerines typically account for most of the bird fatalities at wind energy facilities, but there is no clear correlation between high passerine use and fatality rates. Raptor fatality is likely to be low at Haxtun despite relatively high raptor use because the project will integrate mitigation measures into turbine design and siting.

One raptor nest was recorded during the avian surveys – Great Horned Owl. This nest occurs in the southeastern portion of the project area and is more than 0.6 miles from proposed turbines, including alternates, The distance from the nest to proposed turbines exceeds the most restrictive Colorado Division of Wildlife guidance on raptor nest setbacks, which recommends half mile setback from Ferruginous Hawk nests. Additionally, an unverified nest observed by Westwood during a site visit in May 2010 was confirmed inactive in 2011 during the spring and summer surveys. One Burrowing Owl with fledglings was incidentally observed during the spring

surveys. A burrow or breeding colony was not detected as this family group was in a ditch. It is unknown where this group of owls dispersed from.

Seasonal avian use at Haxtun Wind Project was variable among seasons and bird groups. Additionally, migration patterns were not evident based on mean use. For example, spring and fall mean use numbers would be expected to be higher than wintering and breeding seasons because of migratory species moving through the area. This was not the case at Haxtun as wintering mean use for all birds was higher than fall mean use. Similar patterns were evident within the bird groups amongst seasons. This may be a function of the weekly survey timing in each season – perhaps major migration events occurred on days that did not coincide with the survey. Alternatively, it may indicate a lack of migration stopover habitat and/or routes through the area and that this portion of northeast Colorado may be more important to wintering species.

The risk of avian fatality can be reduced with project design strategies that minimize effects on avian habitats such as woodland, grassland, and pasture. Haxtun turbines are sited responsibly to minimize impacts on wildlife and habitats. Most proposed turbines (83%) are sited in cultivated fields to minimize the fragmentation of the remaining non-native grassland remnants. Although some habitat impacts are unavoidable, the proposed turbine locations minimize encroachment on potentially sensitive habitats, principally grassland areas. The risk to birds from the Haxtun Wind Project is expected to be low.

2.0 INTRODUCTION

Westwood Professional Services began assisting the U. S. Department of Energy (DOE) and NECO Wind, LLC with a federal Environmental Assessment (EA) for the proposed 30-MW Haxtun Wind Project in April 2010 by initiating coordination with the U.S. Fish and Wildlife Service (USFWS) under the Fish and Wildlife Coordination Act of 1934 (as amended) and the Endangered Species Act of 1973 (as amended). The Haxtun Wind Project was previously known as the NECO Wind Project. The DOE has awarded Phillips County a grant pursuant to the American Recovery and Reinvestment Act (ARRA) and determined that an EA is required under DOE National Environmental Policy Act (NEPA) regulations. Coordination with U.S Fish and Wildlife Service (USFWS) and Colorado Division of Wildlife (CDOW) suggested avian migration surveys be conducted to assess risk to birds and their habitats. Accordingly, a 4-week avian migration survey was conducted during fall 2010 to address these potential concerns. After the fall migration surveys were completed, further agency coordination resulted in additional surveys during the wintering, spring migration, and breeding seasons using CDOW approved methods. This report describes the methods and results amongst all four surveyed seasons.

The Haxtun Wind Project covers 9,271 acres (14.5 square miles) of land in Logan and Phillips Counties of northeastern Colorado, approximately 110 miles northeast of Denver and immediately southwest of the city of Haxtun (Exhibit 1). This study was undertaken to address the risk of avian impacts at Haxtun Wind Project. The objectives of the study were to: (1) characterize the avian community using the study area during each of the four seasons; (2) quantify flight patterns and avian/turbine collision risk relative to turbine height; and (3) map the locations of observed raptor stick nests. An understanding of the composition and behavior of

the avian community throughout the year provides an opportunity to assess the risk of avian impacts caused by collisions, electrocutions, and habitat disruption, and to consider measures that reduce and mitigate this risk.

3.0 PROJECT DESCRIPTION AND STUDY AREA

3.1 Project Description

The 30-MW Haxtun Wind Project will consist of 18 proposed 1.6-MW turbines and the project design includes five alternative turbine locations in case one or more of the 18 preferred locations are deemed infeasible for any reason. The northeastern part of the project area includes land for a transmission line to link to the Haxtun Wind Project to the interconnection point at the Haxtun substation. Exhibit 2 depicts the preliminary project layout, including alternative turbine and substation locations and alternative alignments for roads, crane paths, collector cables and the interconnection transmission line.

3.2 Study Area and Habitat

Based U.S. Geological Survey National Land Cover Dataset mapping (USGS 2000), 76% of the 9,271-acre project area consists of cultivated cropland. The predominant cultivated crop is dry land winter wheat. Six and one-half quarter sections are under irrigation with center pivots and most such areas are planted to corn.

Non-native grasslands cover approximately 22% of the project area. No native grasslands were observed within the project area during a site visit on May 27, 2010 where observed grasslands were mapped on aerial photography at a scale of 1inch = 1, 000 feet. No detailed vegetation species lists were prepared, but where grasslands were observed, they were characterized as either native plant communities or introduced, non-native species. Most grasslands lie on steeper hillsides or ridge tops within crop fields. A small portion of the mapped grassland encompasses wildlife shrub plantings. Grassland areas within the Haxtun project area average 53.68 acres in size and the largest contiguous grassland area (currently used as pasture) covers about 963 acres. Most grasslands are grazed or hayed and all appear to be planted to introduced forage species such as smooth brome (*Bromus inermis*) and timothy (*Phleum pratense*). Many of the grasslands are heavily invaded by cheatgrass (*Bromus tectorum*). Table 2-1 summarizes and Exhibit 3 depicts the cover types within the Haxtun Wind Project area.

The project area does not include any publicly owned or leased land. The nearest such land is a Colorado Division of Wildlife (CDOW) walk-in hunting area 1,201 feet (0.22 mile) east of the nearest proposed turbine location (including alternates) within the Haxtun project area.

4.0 METHODS

4.1 Field Surveys

4.1.1 Point Counts

Westwood conducted point counts along roadside transects, recorded incidental observations, and documented the location of raptor stick nests visible from the survey route (Exhibit 4). These methods, and the specific location of point counts, were selected to provide comprehensive coverage of the study area. Point count locations were established at approximately 1-mile intervals throughout the project area in representative habitats and specifically in areas with proposed turbines. Point count locations were established prior to the fall 2010 surveys and were consistent amongst all four seasons. In May 2011, the project area was expanded to the south to include four square miles and move turbines out of the 963 acre block of non-native grassland in the northwest portion of the project area.

For all birds observed, the following data was recorded: species; number of individuals; movement status (perched or in flight); observation method (visual, auditory, or both); and altitude of flight, if applicable. Our three altitude categories were based on the height and diameter of the rotation of wind turbine blades (127.1 ft to 397.8 ft, or 38.75 m to 121.25 m) 121.25 meters (397.8 feet) that Haxtun Wind intends to install (Table 3-1). Estimates of flight altitude were field-calibrated using the known height of two cell towers in the study area (262.5 ft and 278.9 ft or 80 m and 85 m, respectively). Observations were not limited by distance; however, observations were only recorded for birds that could be identified at least to taxonomic family. Weather data (cloud cover, visibility, temperature, wind speed) were also recorded for each survey day. Birds observed outside of point counts were recorded as incidental observations if the observation involved a raptor, a species not previously observed, and/or a species with conservation status. Tables 5-1 through 5-6 summarize the avian community, their risk of collision hazard, and are located at the end of this report.

Surveys took place during fall, winter, spring, and summer to record seasonal avian use of the project area (Table 3-2). Survey days were selected on a weekly basis to coincide with optimal weather conditions for that season whenever possible (i.e., favorable migration winds or non-stormy days). If optimal conditions did not exist, the weekly survey day was selected for favorable weather conditions. Visibility was good (at least 10 miles) on all survey days. The entire survey was generally completed between 7:00 a.m. and 4:00 p.m., and each point count lasted 5 minutes. Five surveys were conducted in the morning and seven surveys were conducted in the afternoon. The route direction varied each week to allow temporal variation for each point count location.

4.1.2 Raptor Nests

Raptor stick nests, which tend to be large and elevated in trees, were inventoried because some raptors tend to fly within the rotor-swept-height. Raptor stick nests are quite visible in seasons without deciduous trees leaves. Other raptor nests may exist within the study area because raptors also nest on the ground, in cavities, and in abandoned structures, but these nests could not be located from roadside transects. Stick nests were located by scanning the surroundings from point count locations and the survey route. Potential raptor stick-nests were identified during leaf-off period and subsequently monitored during the spring survey to confirm nesting status. To the extent allowed by visibility, identified nests were observed until they could be verified as active based on raptor nesting behavior (i.e., material carries, incubation, or nest/territory defense). All documented raptor nest locations (those observed in any season) were then mapped using aerial photograph interpretation and buffered by 0.25 mile (400 m) during site design. This distance is sometimes used as a seasonal construction setback during the raptor breeding season to minimize disturbance to breeding raptors (El Dorado County 2006, CDOW 2008).

4.1.3 Mountain Plovers

The Mountain Plover is a bird of interest on the site due to the USFWS review for potential listing under the Endangered Species Act. This species generally arrives in the breeding areas in eastern Colorado beginning mid-March extending into April, with breeding activity occurring in late April and May (Andres and Stone 2010). Westwood conducted presence/absence surveys for this species, with the survey protocol adapted from the "Mountain Plover Survey Guidelines" published by the USFWS in March 2002 (USFWS 2002).

Westwood conducted three surveys during May and June with a minimum spacing of 14 days. Surveys were conducted between sunrise and 10:00a.m., when the horizontal light provides optimum light to detect these secretive birds. Forty survey points were established at approximately half-mile intervals along the existing road network (Exhibit 5). Surveys were conducted at these 40 locations for 5 minutes each by scanning up to quarter mile with binoculars from the vehicle or next to the vehicle. Detected plovers were confirmed with a spotting scope and documented with specific notes on behavior and location.

In addition to the presence/absence of Mountain Plover at each point count location, Westwood also recorded the presence and absence of general habitat indicators of this species (Table 4-3). While these habitat indicators do not denote presence or absence of the bird, they are clues that will aid in the detection of this secretive bird, and also help to provide a probability of this species being present.

4.2 Analysis

4.2.1 Community Composition

Animal communities are typically characterized by measuring the diversity and abundance of different species. We calculated the relative abundance of each bird species recorded during point counts by dividing the number of individuals observed per species by the total number of individuals observed. Although relative abundance is a conventional metric of species abundance, it often results in many zero values because communities commonly contain a few species that are very numerous and many species that are rare.

In order to have a secondary indicator of avian species abundance at Haxtun Wind Project, we calculated mean use (i.e., number of birds/number of point counts/number of survey days) for each species. As with relative abundance, mean use is derived from the number of individuals, but it is calculated as a function of survey effort rather than the abundance of other species and is therefore less likely to skew rankings excessively. Mean use, when calculated for groups of species, is also a common metric for comparing avian communities among different wind farm studies. "Standardizing" mean use values to account for different methodologies (e.g., multiplying our mean use values by four to make our 5-minute point count results comparable to studies using 20-minute point counts) does not eliminate biases, however (Erickson et al. 2002). In our case, multiplying mean use by four is extremely likely to result in overestimates of bird abundance, because all birds at a point count location could routinely be counted within 5 minutes. An additional 15 minutes would be unlikely to produce new observations and would increase the probability of counting the same individuals twice. To allow comparisons with other studies and minimize overestimation of mean use, we give both "actual" (# birds/5 min) and "standardized" (# birds/20 min) mean use values when comparing mean use of groups at Haxtun Wind Project to other wind farm sites.

In addition to quantifying species abundance, characterizing a bird community involves quantifying the frequency with which species are observed. Some species are not naturally abundant but may be considered "common" because they are frequently observed in the community. We calculated the relative frequency of each bird species seen during point counts by dividing the number of observations of each species by the total number of observations. Birds seen during incidental observations (i.e., outside of a 5-minute point count or at a non-point count location) were not included in relative frequency calculations or any other analysis due to the non-systematic nature of these observations. Additionally, "unidentified species" (unidentified sparrow and unidentified warbler) were not included in the total species count because these "species" could only be identified to genus and potentially represent more than 2 species.

As a tool for interpreting the tables in this report and also to provide a simplified summary of diversity, we grouped observed species into categories. Birds were grouped according to taxonomic order (Table 5-1). While these groups are generally

broad, they keep the number of categories manageable and taxonomically defined. The passerine order (songbirds) is the largest category and represents species that inhabit a variety of habitats (woodland, grassland, and wetland/ditch). Some categories of birds typically inhabit one habitat. Grouping birds on the basis of taxonomy helps us understand the potential impacts of wind energy development.

4.2.2 Flight Patterns and Collision Risk

For birds that were observed in flight, we summarized the number of observations per species for which birds were flying in the height categories of below, within, and above the RSH. We then calculated an index of collision hazard for each species. The index is a function of species abundance, how often individuals of the species are seen in flight, and how often those flights occur at a height that overlaps the RSH. In our index calculation, we also included how frequently the species was observed as an indicator of detection probability. The index (I) was based on Erickson et al. (2000), as follows:

I = M*R*Pf*Pt, where

M = mean use, as calculated above;
R = relative frequency, as calculated above;
Pf = proportion of observations where flight occurred; and
Pt = proportion of flight observations where flight was within the RSH.

4.2.3 Conservation Status

The status of bird populations for species observed at Haxtun Wind Project was examined by consulting federal and state endangered and threatened species lists (USFWS 2011 and CDOW 2010). These lists were obtained from federal and state websites and cross referenced with the birds recorded during the avian surveys. Additionally, Colorado's Comprehensive Wildlife Conservation Strategy and Wildlife Action Plans was referenced to determine Species in Greatest Conservation Need (SGCN) – those that are state-listed as well as many others that merit conservation attention, but are not yet listed as threatened or endangered (CDOW 2006).

5.0 RESULTS

5.1 Overall

We observed 35 species of birds using the study area during point counts amongst all four seasons. There were 20 species categorized as passerines, 10 species of raptors, two dove and pigeons, and one each of gamebird, hummingbird, and waterbird (Table 5-2). We recorded nine notable species during incidental observations, including seven raptors and two species that are generally common in abundance and distribution (Mallard and Yellow-headed Blackbird). We observed two additional "unidentified species" that could not be identified to species due to distance or visibility; both were raptor observations.

The most abundant species was Horned Lark (Table 5-2). Observations of Horned Larks were recorded throughout the project area and duration of the avian surveys, as this species is generally common and abundant in Colorado during all four seasons. Common species ranked highly in either relative abundance or mean use because they were so frequently seen (e.g., Western Meadowlark, Lark Bunting, Red-winged Blackbird). Overall mean use was 12.73 birds/5 min. In general, the ranking of species according to relative abundance and mean use was weighted to the passerine group, as would be expected because the passerine taxonomic order has more species than other groups (Table 5-2).

The most frequently seen species was also Horned Lark (Table 5-2). A few species were similar to the Horned Lark in having both high relative abundance and high relative frequency (e.g., Western Meadowlark, Lark Bunting, Red-winged Blackbird). Other species were commonly seen, but never in large numbers (e.g., Northern Harrier and Mourning Dove). Overall, the ranking of species according to relative frequency was weighted mostly to the passerine group (Table 5-2). Similar to relative abundance, passerines generally had the highest relative frequency, due at least partially to the number of species in the passerine group.

Of 748 total observations, 298 observations (40%) involved birds in flight. Most flying birds (89%) were observed below the RSH. Of the remaining observations, approximately 10% of the flights were within the RSH for a portion of the flight, and 1% were above the RSH. Raptors were the only bird group observed above the RSH and were observed within the RSH more often than birds in general (Table 5-2). Passerines were almost exclusively observed below the RSH.

There were 33 species (including the unidentified species) observed in flight at least once, and only four of these species had a measurable index of collision hazard (i.e., $I \geq 0.001$) (Table 5-2). These species include Horned Lark, Swainson's Hawk, Killdeer, and Mourning Dove. Although most of the flight observations of Horned Lark and Mourning Dove were below the RSH, its high relative abundance contributed to its measurable index of collision hazard. Conversely, although Swainson's Hawk and Killdeer had a much lower relative abundance, most observed flights were within the RSH for at least a portion of their flight, which contributed to its measurable index of collision hazard. Other species observed in flight had immeasurable index of collision hazard, due at least partially to low relative abundance, few flights within the RSH, or both (Table 5-2).

Observations of large flocks of migrating birds, such as warblers, sparrows, and ducks and geese, were fewer than expected. Of 748 avian observations recorded, only 41 (5.5%) involved groups of more than 10 birds, and only nine involved more than 25 birds. Most of these groups (88%) were social species including Brown-headed Cowbirds, European Starling, Tree Swallows, and House Sparrows. Only one flock of waterbirds was observed, a small flock of 14 Killdeer, and all other flocks were passerines. These numbers suggest that the project area does not provide prominent stopover habitat for migratory birds.

5.2 Fall Migration

There were 223 observations of 688 birds during the fall 2010 migration. Most of the observed birds, 89%, were passerines of 14 species. Overall mean use during the fall migration was 10.75 birds/5-minutes. The most frequently observed and abundant species were Horned Lark and Western Meadowlark, with Savannah Sparrow being the third most frequently observed and House Sparrow being the third most abundant (Table 5-3). Mean use for passerines during fall 2010 was 9.6 birds/5-minutes.

Raptors were the second most observed guild of birds (6%); however, as expected, they were observed less frequently and abundantly than passerines. Raptor species observed during the fall include Swainson's Hawk, Red-tailed Hawk, Turkey Vulture, Northern Harrier, Cooper's Hawk, Prairie Falcon, and two observations that could not be identified to species due to distance and/or visibility. Raptor mean use during fall 2010 was 0.6/5-minute point count.

The species with the highest index of collision hazard during fall 2010 was Horned Lark ($I = 0.029$), which is a function of its high relative frequency and abundance. Swainson's Hawk and Red-tailed Hawk ranked second and third, with indices of collision hazard of $I = 0.006$ and $I = 0.004$, respectively. Taken together, there were 11 observations of 25 birds of these two species in flight, most of which were within the RSH for at least a portion of their flight (96%). These flight altitudes combined with field observations indicate that these two raptors were utilizing thermals and soaring. Only two other species had a measurable index of collision hazard ($I \geq 0.001$) – Savannah Sparrow and Killdeer.

5.3 Wintering Community

The wintering avian community observed at Haxtun Wind Project was comprised of only 11 species, based on 79 observations of 415 birds (Table 5-4). Similar to the fall, Horned Lark had the highest relative frequency and abundance. Western Meadowlark and House Sparrow ranked second and third, respectively, in relative frequency, while House Sparrow and European Starling ranked second and third, respectively, in relative abundance. Passerines accounted for 98% of wintering observations and had a mean use of 12.5 birds/5-minute point count. Overall mean use of the wintering community was 12.97 birds/5-minutes.

Three raptor species were observed during the wintering surveys: Rough-legged Hawk, Northern Harrier, and American Kestrel. Raptors accounted for almost two percent of the wintering observations, with nine observations of nine birds and a mean use of 0.3 birds/5-minute point count. There were four observations of either Harriers or Kestrels in flight and all flights for these species were below the RSH (there was an additional observation of a perched Kestrel). Rough-legged Hawks were observed flying 75% of the time (3 out of 4 observations), and all observed flights for this species were within the RSH.

Only two species had a measurable index of collision hazard during winter – Horned Lark ($I = 0.055$) and Rough-legged Hawk ($I = 0.005$). Similar to the fall, Horned Lark's risk of

collision hazard was a function of its relative frequency and abundance as well as the proportion of time it spent flying. Most (98.5 %) observations of Horned Lark flights were below the RSH. As described above, all Rough-legged Hawk flight observations occurred within the RSH, thus contributing to its measurable risk of collision hazard. Other species had a risk of collision hazard that was lower than expected due to few observations of flying birds (i.e., Western Meadowlark and Robin) or flights were consistently below the RSH (i.e., Northern Harrier and House Sparrow).

5.4 Spring Migration

The spring migration thru Haxtun Wind Project included 291 observations of 1,007 birds and 22 species (Table 5-5). Most of these birds were passerines (87%). Horned Lark ranked first in both relative abundance and frequency. Western Meadowlark and Ring-necked Pheasant ranked second and third respectively in relative frequency, while Lark Bunting and Western Meadowlark ranked second and third in relative abundance. Overall mean use during spring migration was 15.7 birds/5-minutes and passerine mean use was 13.7 birds/5-minute point count.

Four raptor species were observed during the spring migration – Swainson's Hawk, Red-tailed Hawk, Golden Eagle, and Great Horned Owl. These included nine observations of ten birds and a mean use of 0.5 birds/5-minute point count. During this season, raptors ranked third in mean use, behind passerines and dove/pigeons. Owls were never recorded in flight, and the other three raptor species were only observed in flight.

Three species had a measureable index of collision hazard – Mourning Dove (I = 0.003), Lark Bunting (I = 0.001), and Swainson's Hawk (I = 0.001). Both Mourning Dove and Lark Bunting ranked in the top six species in relative frequency and abundance and were observed flying within the RSH more than once. Swainson's Hawks were only observed flying (5 observations) and two of those flights occurred within the RSH for at least a portion of the flight. Most other species were observed in flight; however, all flights were below the RSH.

5.5 Breeding Community

The breeding community at Haxtun Wind Project was comprised of 20 species, based on 146 observations of 334 birds (Table 5-6). Similar to other seasons, passerines made up 89% of the breeding observations. Lark Bunting, Western Meadowlark, and Horned Lark had the highest relative frequency while House Sparrow, Lark Bunting, and Horned Lark ranked the highest in relative abundance. Passerine mean use during the breeding season was 9.3 birds/5-minute point count.

The only raptor observed during the breeding season was Great Horned Owl, which was observed once perched in its nest tree (see Section 5.6). Accordingly, raptor mean use and index of collision hazard were very low to non-existent during this season. Only one species had a measurable index of collision hazard – Red-winged Blackbird (I = 0.003).

Other species were either not observed in flight or had a large proportion of their flights below the RSH.

5.6 Raptor Nests

Westwood recorded one raptor nest during the Haxtun avian surveys – a Great Horned Owl nest in the south central portion of the project area (Exhibit 4). Additionally, an unverified nest observed by Westwood during a site visit in May 2010 was confirmed inactive in 2011 during the spring and summer surveys. One Burrowing Owl with fledglings was incidentally observed during the spring surveys. A burrow or breeding colony was not detected as this family group was in a ditch. It is unknown where this group of owls dispersed from.

5.7 Conservation Status

We observed one federal or state listed species during the 2010-2011 avian surveys, including federal candidate or proposed species, federal and state threatened and endangered species, and state-listed special concern species. Burrowing Owl, which is state-listed as threatened, was recorded as an incidental observation in early May 2011. As mentioned in Section 5.6, it is unknown where this bird and its fledglings dispersed from.

The Colorado Division of Wildlife Comprehensive Wildlife Conservation Strategy lists 48 Tier 1 and 39 Tier 2 avian Species of Greatest Conservation Need. What separates Tier 1 from Tier 2 primarily is the species' status in a declining trend as designated by federal or state listing designation, CDOW's perceived ability to effectively implement conservation/recovery actions on the ground, and the agency's ability to contribute to a meaningful change in federal status through actions in Colorado (CDOW 2006).

Six Tier 1 species were observed at Haxtun Wind Project: Golden Eagle, Lark Bunting, Loggerhead Shrike, Prairie Falcon, Swainson's Hawk, and Western Burrowing Owl. Golden Eagle, Loggerhead Shrike, and Western Burrowing Owl were each observed only once and all observations occurred during a migration season. Lark Buntings were routinely observed during the migrations and breeding seasons, Prairie Falcons were observed during the migrations (one observation during the survey and two incidental observations), and Swainson's Hawks were also routinely seen during the migrations. The Tier 2 species observed at Haxtun include Northern Harrier, generally observed during the fall and winter surveys, and Vesper Sparrow, commonly observed during the migrations and breeding seasons. As previously mentioned, observed species are generally common and abundant in northeastern Colorado.

No Mountain Plovers were detected during the species specific survey or the general avian survey. Mountain Plover specific surveys were only conducted once because the petition to list the species was withdrawn by the USFWS. On May 12, 2011, the USFWS withdrew their petition for the Mountain Plover to be listed as threatened under the Endangered Species Act. After a thorough review, the federal agency determined threats to this species

are not as significant as previously believed. Accordingly, the final two Mountain Plover surveys were deemed unnecessary.

6.0 DISCUSSION

6.1 Community Composition

Predominant groups of birds at Haxtun Wind Project during the survey period included passerines such as sparrows and blackbirds; raptors; and few waterbirds, game birds, or other guilds. Passerines accounted for 90% of the birds observed. This avian community reflects the agricultural landscape of the study area, which is about 76% cropland and 22% non-native grassland, interspersed with limited woodlands and water features. Waterbirds (ducks, geese, shorebirds, wading birds) were noticeably scarce in the avian community, presumably due to the lack of suitable wetland habitat for migration stopover.

The bird species observed at Haxtun Wind Project showed substantial overlap with the species reported for the nearest and most recent North American Breeding Bird Survey (BBS) route (Sauer et al. 2008). The BBS, conducted by the U.S. Geological Survey's Patuxent Wildlife Research Center, provides a long-term database for monitoring bird populations. Roadside survey routes are covered during June of each year, using methodology similar to our study (each route is 24.5 miles long, with stops at 0.5-mile intervals for auditory and visual counts within a 0.25-mile radius). The nearest BBS route is approximately 2 miles north of the project area and runs primarily east and west. This route, called the Fleming BBS route, has been surveyed regularly since 1968. While these BBS data represent the breeding community, they also provide an indication of migratory species as the breeding season overlaps with both the spring and fall migration within in the avian community. Depending on climatic conditions, species observed during the spring migration could also be observed during the breeding season and species observed during the breeding season could also be observed during the early fall migration period.

In 2007 there were 61 species reported for the Fleming BBS route (Sauer et al. 2008), 26 of which were also seen during our survey period (26 of the 35 identified species at Haxtun are known to breed in the project vicinity). Notable species from the BBS data that were not recorded on our surveys included several waterbirds (ten waterfowl species and five shorebird species), raptors (Ferruginous Hawk), and several grassland specialists (Short-eared Owl, Lark Sparrow, Dickcissel). Overall, however, the overlap of the lists suggests that the birds observed during our survey at Haxtun Wind Project were representative of the breeding bird community in this portion of Colorado, with some additional migratory and wintering species because of the timing and duration of our study periods. It should be noted, however, that while species observed at Haxtun are known to breed in the project vicinity, the individuals of those species observed may have been migrating from another area.

Seasonal avian use at Haxtun Wind Project was variable among seasons and bird groups (Table 6-1). Additionally, migration patterns were not evident based on mean use. For example, spring and fall mean use numbers would be expected to be higher than wintering

and breeding seasons because of migratory species moving through the area. This was not the case at Haxtun as wintering mean use for all birds was higher than fall mean use. Similar patterns were evident within the bird groups amongst seasons. This is may be a function of the weekly survey timing in each season – perhaps major migration events occurred on days that did not coincide with the survey. Alternatively, it may indicate a lack of migration stopover habitat and/or routes through the area and that this portion of northeast Colorado may be more important to wintering species.

Pre-construction avian use estimates for wind projects are typically unavailable until a project is fully permitted and/or post-construction avian monitoring is completed (if necessary). These pre-construction avian reports usually support a Site Permit Application and are submitted to wildlife agencies and the state, but do not necessarily become part of the wind/wildlife literature until after construction, if at all. Such studies are considered "gray literature" because they are not usually available for comparison. However, Western EcoSystems Technology, Inc. (WEST) created a synthesis document comparing mean use at various wind projects across the country for specific species groups that may be more susceptible to wind impacts (raptors, waterfowl/waterbirds) or more meaningful than such a global measure like overall mean use (Erickson et al. 2002). While several wind projects and associated avian studies have been completed since Erickson et al. (2002), it provides the most comprehensive list of standardized and comparable data amongst wind projects.

Comparison of mean use at Haxtun Wind Project to other wind farms indicates that waterfowl/waterbird use at Haxtun was low. Erickson et al. (2002) compiled mean use values for several wind farms and standardized them to # birds/20 min. According to their Table 21, the mean waterfowl/waterbird use estimates is 4.5 birds/20 minutes at wind projects sited in an agricultural landscape averaged across all seasons, with a range of 0.079 at Stateline (Washington/Oregon) to 13.2 birds/20 min at Zintel Canyon (Washington). Mean waterbird use at Haxtun across all four seasons was 0.125 birds/5 minutes and 0.5 birds/20 minutes. Several wind farms in the analysis had a mean use of less than 1.0 bird/20 min for waterfowl/waterbirds across all four seasons, likely due to their location in the Pacific Northwest and unsuitable water based habitat. One Colorado project was referenced in the synthesis document; however, diurnal avian use surveys were not conducted at this wind project (Ponnequin Wind Project in Weld County). Waterfowl use at Haxtun was consistent with mean use reports during fall for waterfowl/waterbirds at four Wyoming wind resource areas sited in native landscapes. It is likely that the Haxtun estimate is even less than those reported in Wyoming, because of overestimating from standardization (Erickson et al. 2002).

According to Table 7 in Erickson et al. (2002), the highest mean use by raptors across four seasons of data occurred at Altamont Pass WRA in California (2.4 birds/20 min). All other wind farms in the analysis had a mean use of less than 1.0 bird/20 min for raptors across seasons. Standardized mean use for raptors at Haxtun was at the upper end of those reported in the synthesis document, with overall mean use estimates at 1.2 raptors/20 min. Based on these mean use raptor data compared to other wind resource areas, there is potentially an increased risk to raptors at Haxtun. Erickson et al. (2002) acknowledged the biases of comparing sites using standardized estimates of mean use. The Haxtun avian

surveys used 5-minute point counts. Standardizing 5-minute point count data to 20-minutes for comparison purposes can lead to overestimates because the number of birds observed tends to decline after the first 5 minutes. Alternatively, use of 20-minute point counts can lead to double counting (Jones et al. 2008). Regardless, available data suggest that raptor use at Haxtun was relatively high compared to those reported at other wind project areas.

Erickson et al. (2002) did not report mean use for passerines (songbirds). Songbirds are North America's most abundant bird group and the group includes hundreds of species. Sub-dividing this group into meaningful categories can be difficult without creating too many categories (taxonomically based, i.e., families or subjectively by habitat preferences). It is clear that the community composition at Haxtun is predominately passerines with several taxonomic families and habitat preferences represented, reflecting the available habitats in the project area: cropland and non-native grassland.

6.2 Flight Patterns and Collision Risk

Migratory behavior was not frequently observed at Haxtun Wind Project. Only about 1% of flights were above the RSH where migratory flights typically occur, few flocks were observed, and few species known to breed further north were recorded. High flights were of unidentified raptors (too high to distinguish). However, high raptor flights do not necessarily indicate migratory behavior because raptors soar on thermals or hot air pockets that facilitate effortless flight, even in their daily movements. While some observations of flights above the RSH likely represented migratory behavior due to their seasonality, flights below the RSH – where most flight observations occurred – are more difficult to interpret. Bird flights below the RSH could represent foraging activity, other local movements, or migratory birds that have stopped to feed and rest. Almost 2% of observations involving flight below the RSH also involved flight within or above the RSH (i.e., the same birds sometimes flew in different height categories). Thus, some birds flying below the RSH could still be at risk of collision with turbines, though the overall prevalence of low-altitude flight suggests the risk is small.

The level of raptor use and the index of collision hazard suggest a risk of raptor fatality at Haxtun, but the risk is likely to be low. Raptor fatality due to turbine collisions has been very low to non-existent at other wind farms studied in the U.S. (Erickson et al. 2002). Although high raptor use at Haxtun merits attention to potential raptor impacts, abundance alone does not necessarily predict fatality rates. For example, de Lucas et al. (2008) showed that raptor fatality was a function of species-specific flight behavior and turbine layout, but was not related to raptor abundance. Based on seasonal mean use estimates, raptors likely experience the highest risk during the wintering period and to a lesser degree, migration seasons.

Passerines (songbirds) have been the most abundant bird fatality at wind-energy facilities, excluding facilities in California, often accounting for more than 80% of the bird fatalities (Erickson et al. 2002, NWCC Wildlife Workgroup 2010). Both migrant and resident passerine fatalities have been observed. Given that passerines made up a large proportion

of the birds observed during the pre-construction avian survey, passerines would be expected to make up the largest proportion of fatalities at Haxtun Wind Project. However, there has not been a clearly demonstrated correlation between high passerine use and high mortality (Erickson et al. 2002). Collision risk indices indicate that Horned Lark is the most likely passerine to be exposed to collision from wind turbines at Haxtun (i.e., the only passerine with $I \geq 0.001$). Most passerines had relatively low risk exposures indices due to the majority of individuals flying below the RSH.

Passerines are generally expected to be observed below the RSH during avian surveys. This group of birds is known to migrate in large flocks at night to minimize predation. Therefore, passerines observed during migration surveys are likely utilizing the project area as a stopover or they breed/winter in the project vicinity during the summer/winter and have not initiated their migration. The small number of passerine flocks observed at Haxtun suggests that the habitats in the project area are not prominent migration stopover locations for this group. While we did not specifically assess nocturnal migration, wind energy projects typically kill an extremely small proportion of nocturnal migrants. Radar studies at Buffalo Ridge indicate that as many as 3.5 million birds per year may migrate over the wind development area (Johnson et al. 2000). The largest single fatality event reported at a U.S. wind plant was 14 nocturnal migrating passerines at two turbines at Buffalo Ridge during spring migration (Erickson et al. 2002). The mediocre migration stopover habitat at Haxtun further decreases the nocturnal migrant collision risk because large passerine flocks are likely to select more suitable stopover locations in adjacent counties rather than descend through the RSH in the project area.

6.3 Raptor Nests

The raptor nest confirmed at Haxtun Wind Project occurs in a tree associated with the edge of a farmstead in the southeastern portion of the project area. While woodlots are limited in the project area, raptors may utilize solitary trees or those associated with farmsteads if they are an adequate distance from human disturbance. In addition to Great Horned Owl, other raptors potentially breeding within the study area include Northern Harriers. Northern Harriers were routinely observed in the study site, but their habit of ground nesting makes nests difficult to observe from roadside surveys.

Buffers from active raptor nests are becoming an industry standard. The active Great Horned Owl nest is located more than quarter mile from preliminary infrastructure, including turbines and access roads. The nearest potential raptor nest is outside the project area and 3,245 ft (0.61 miles) away from the nearest proposed turbine location (including alternates). This exceeds the most restrictive CDOW guidance on raptor nest setbacks, which recommends 2,640 ft (0.5 mile) setback from Ferruginous Hawk nests (CDOW 2008). Erickson et al. (2002) cautioned that there are currently not enough data on turbines within 0.5 mile of raptor nests to determine potential impacts. The most tangible mitigation measure to reduce the risk of raptor fatality is minimizing proximity of turbines to wooded areas that provide nesting habitat.

6.4 Conservation Status

The lack of rare species observations in the project area is likely related to the agricultural landscape at Haxtun. Most species observed are generally common or abundant and are typical of agricultural landscapes. The project area generally lacks habitats that typically support rare species (i.e., managed wildlife lands, large blocks of CRP, water features). The higher concentration of these habitats in the central portion of Logan County associated with the Platte River highlights a focus on wildlife conservation that lies outside the project area.

7.0 CONCLUSIONS

This study provided a pre-construction assessment of migrating, breeding, and wintering birds at the Haxtun Wind Project. We characterized the avian community, quantified flight patterns and associated collision risks, and examined potential avian impacts throughout all four seasons. The community was dominated by passerines, most of which are common or abundant in an agricultural landscape during migration, breeding, and wintering seasons. Waterfowl/waterbirds were notably scarce at Haxtun, presumably due to the lack of water features that these birds characteristically utilize during migration and breeding.

One state listed threatened species was recorded as an incidental observation during Spring 2011 – Burrowing Owl. One adult and fledglings were observed in a ditch, however it is unknown where they dispersed from. There was no evidence of any other federal or state listed species using the site, including federal candidate or proposed species, federal and state threatened and endangered species, and state-listed special concern species. Eight species listed on Colorado's CWCS Wildlife Action Plan were observed during the surveys. However, the project area generally lacks habitats that typically support rare species (i.e., managed lands, large blocks of CRP, water features). It also lacks prominent migration stopover habitat for birds, as few flocks of migrating birds were recorded.

The agricultural landscape at Haxtun contains some non-native grassland and pasture with few water features and woodlots/trees. These habitats typically support relatively more diverse avian communities than tilled agricultural lands. However, fifteen out of eighteen (83 percent) of the proposed turbines and four out of five alternates (80 percent) have been preliminarily sited in cultivated fields to minimize the fragmentation of the remaining non-native grassland remnants. Although some habitat impacts are unavoidable due to the interconnected design of wind energy projects, proposed turbine locations minimize encroachment on relatively sensitive habitats, including grasslands, pastures, woodlands, and wetlands.

A habitat-based approach to mitigating avian impacts has the benefit of reducing potential impacts related to habitat disruption while also reducing fatality risk. Raptor use of the study area was relatively high compared to other wind farms that have been studied. The risk of raptor fatality is expected to be low overall, based on mitigation measures that are integral to turbine design and siting. The index of collision hazard was highly variable for raptors, suggesting that species-specific behavior plays an important role in fatality risk. This risk can be reduced by

siting most turbines away from woodlands and minimizing turbines in grassland, which together provide nesting habitat for most raptors.

One season of baseline avian use data has been shown to allow for accurate prediction of avian impacts, especially as they relate to raptors (Erickson et al. 2002). The four seasons of baseline surveys should adequately predict avian impacts and help identify specific cost-effective mitigation practices. The layout at Haxtun Wind Project is considered to be responsibly sited and helps achieve minimization of avian impacts by:

1. Siting turbines and other facilities predominantly in agricultural areas.
2. Avoiding turbine placement in wetlands.
3. Minimizing the effects of turbines and related infrastructure on grasslands.
4. Siting turbines at least 0.25 mile from identified active raptor nest locations.

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Tables

Haxtun Wind Project
Logan and Phillips Counties, Colorado

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Table 2-1: Cover Types in Haxtun Wind Project Area

Land Cover	Acres	Percent
Cropland	7,002	75.53
Non-Native Grassland	2,064	22.26
Developed	70	0.76
Private Road	5	0.05
Intermittent Stream	48	0.52
Pond	2	0.02
Public Road	68	0.73
Woodland	12	0.13
Totals	9,271	100.00

Table 4-1: Flight Height Categories for Flying Birds

Altitude Category	Flight Height (meters)	Flight Height (feet)
Below	< 39	< 127
Within	39 to 121	127 to 398
Above	> 121	> 398

Table 4-2: Seasonal Timing of Avian Surveys

Season	Date Range	Number of Surveys
Fall Migration	Sept 5 – Oct 2, 2010	4
Wintering Community	Jan 5 – Mar 5, 2011	2
Spring Migration	Apr 1 – May 31, 2011	4
Breeding Community	Jun 3 – Jun 21, 2011	2

Table 4-3: General Habitat Indicators for Mountain Plovers

Positive Habitat Images	Negative Habitat Images
Non-leaking Stock Tank	Leaky Stock Tank
Flat Terrain (level or "titled")	Hillsides or steep slopes
Burned field/prairie/pasture	Vegetation greater than 4 inches in height in short-grass prairie habitat
Bare ground (> 30 percent)	Increasing presence of tall shrubs
"Spaced" grass plants	Matted grass (i.e., minimal bare ground)
Prairie dog colonies	Prominent, obvious low ridge
Horned Lark	Lark Bunting
Cattle	Killdeer
Heavily grazed pastures	
Opuntia pads visible	

Table 5-1: Key to Avian Groups Observed at Haxtun Wind Project (2010-2011)

Group Name	Taxonomic Group(s)
Doves & Pigeons	Columbiformes (Doves, Pigeons)
Gamebirds	Galliformes (Pheasants, Grouse, Turkeys)
Passerines	Passeriformes (Songbirds) and Apodiformes (Hummingbirds)
Raptors	Falconiformes (Vultures, Hawks, Eagles, Falcons)
Waterbirds	Anseriformes (Ducks, Geese, Swans), Ciconiiformes (Herons), Charadriiformes (Shorebirds)

Table 5-2: Summary of the Overall Avian Community Observed at Haxtun Wind Project across Four Seasons (2010-2011)[1]

Group	Common Name	Scientific Name	Status[2]	# Individuals	# Obs	Rel Freq	Rel Abund	Mean Use	Index	% fly	% L	% M	%H
Passerines	Horned Lark	*Eremophila alpestris*		754	221	0.30	0.31	3.93	0.012	57.2	98.1	1.9	0.0
Raptors	Swainson's Hawk	*Buteo swainsoni*	Tier 1	19	11	0.01	0.01	0.10	0.001	100.0	15.8	84.2	0.0
Water Birds	Killdeer	*Charadrius vociferus*		24	10	0.01	0.01	0.13	0.001	75.0	22.2	77.8	0.0
Doves, Pigeons	Mourning Dove	*Zenaida macroura*		96	37	0.05	0.04	0.50	0.001	30.2	89.7	10.3	0.0
Raptors	Red-tailed Hawk	*Buteo jamaicensis*		13	7	0.01	0.01	0.07	0.000	92.3	16.7	83.3	0.0
Passerines	Lark Bunting	*Calamospiza melanocorys*	Tier 1	252	63	0.08	0.10	1.31	0.000	20.2	98.0	2.0	0.0
Passerines	Red-winged Blackbird	*Agelaius phoeniceus*		159	40	0.05	0.07	0.83	0.000	25.2	97.5	2.5	0.0
Passerines	Savannah Sparrow	*Passerculus sandwichensis*		39	15	0.02	0.02	0.20	0.000	56.4	90.9	9.1	0.0
Passerines	American Robin	*Turdus migratorius*		47	16	0.02	0.02	0.24	0.000	25.5	91.7	8.3	0.0
Raptors	Rough-legged Hawk	*Buteo lagopus*		4	4	0.01	0.00	0.02	0.000	75.0	0.0	100.0	0.0
Passerines	Western Kingbird	*Tyrannus verticalis*		23	10	0.01	0.01	0.12	0.000	13.0	66.7	33.3	0.0
Raptors	Golden Eagle	*Aquila chrysaetos*	Tier 1	1	1	0.00	0.00	0.01	0.000	100.0	0.0	100.0	0.0
Raptors	Turkey Vulture	*Cathartes aura*		1	1	0.00	0.00	0.01	0.000	100.0	0.0	100.0	0.0
Doves, Pigeons	Rock Pigeon	*Columba livia*	Introduced	20	5	0.01	0.01	0.10	0.000	60.0	100.0	0.0	0.0
Gamebirds	Ring-necked Pheasant	*Phasianus colchicus*	Introduced	54	37	0.05	0.02	0.28	0.000	5.6	100.0	0.0	0.0
Passerines	Chimney Swift	*Chaetura pelagica*		1	1	0.00	0.00	0.01	0.000	100.0	100.0	0.0	0.0
Raptors	Great Horned Owl	*Bubo virginianus*		4	3	0.00	0.00	0.02	0.000	25.0	100.0	0.0	0.0
Passerines	American Pipit	*Anthus rubescens*		1	1	0.00	0.00	0.01	0.000	0.0	0.0	0.0	0.0
Passerines	Barn Swallow	*Hirundo rustica*		9	8	0.01	0.00	0.05	0.000	88.9	100.0	0.0	0.0
Passerines	Brown-headed Cowbird	*Molothrus ater*		108	14	0.02	0.04	0.56	0.000	86.1	100.0	0.0	0.0
Passerines	Brown Thrasher	*Toxostoma rufum*		2	2	0.00	0.00	0.01	0.000	100.0	100.0	0.0	0.0
Passerines	Common Grackle	*Quiscalus quiscula*		26	9	0.01	0.01	0.14	0.000	80.8	100.0	0.0	0.0
Passerines	European Starling	*Sturnus vulgaris*	Introduced	57	5	0.01	0.02	0.30	0.000	29.8	100.0	0.0	0.0
Passerines	Grasshopper Sparrow	*Ammodramus savannarum*		11	7	0.01	0.00	0.06	0.000	0.0	0.0	0.0	0.0
Passerines	Great-tailed Grackle	*Quiscalus mexicanus*		3	2	0.00	0.00	0.02	0.000	0.0	0.0	0.0	0.0
Passerines	House Sparrow	*Passer domesticus*	Introduced	323	19	0.03	0.13	1.68	0.000	7.4	100.0	0.0	0.0
Passerines	Lapland Longspur	*Calcarius lapponicus*		1	1	0.00	0.00	0.01	0.000	0.0	0.0	0.0	0.0
Passerines	Loggerhead Shrike	*Lanius ludovicianus*	Tier 1	1	1	0.00	0.00	0.01	0.000	100.0	100.0	0.0	0.0
Passerines	Tree Swallow	*Tachycineta bicolor*		38	6	0.01	0.02	0.20	0.000	100.0	100.0	0.0	0.0
Passerines	Vesper Sparrow	*Pooecetes gramineus*	Tier 2	50	15	0.02	0.02	0.26	0.000	64.0	100.0	0.0	0.0
Passerines	Western Meadowlark	*Sturnella neglecta*		284	149	0.20	0.12	1.48	0.000	31.7	100.0	0.0	0.0
Raptors	American Kestrel	*Falco sparverius*		2	2	0.00	0.00	0.01	0.000	50.0	100.0	0.0	0.0
Raptors	Cooper's Hawk	*Accipiter cooperii*		1	1	0.00	0.00	0.01	0.000	100.0	100.0	0.0	0.0
Raptors	Northern Harrier	*Circus cyaneus*	Tier 2	10	10	0.01	0.00	0.05	0.000	100.0	100.0	0.0	0.0
Raptors	Prairie Falcon	*Falco mexicanus*	Tier 1	2	1	0.00	0.00	0.01	0.000	100.0	100.0	0.0	0.0
Raptors	Unidentified Buteo Hawk	Buteo (sp)		3	3	0.00	0.00	0.02	0.000	66.7	0.0	0.0	100.0
Raptors	Unidentified Hawk	Accipitridae (gen, sp)		1	1	0.00	0.00	0.01	0.000	100.0	0.0	0.0	100.0

[1] Species recorded only as incidental observations include Burrowing Owl, Yellow-headed Blackbird, and Mallard. Each species were observed once during spring migration. Burrowing Owl is state listed threatened (CDOW 2010).

[2] Status according to Colorado Division of Wildlife Comprehensive Wildlife Conservation Strategy Wildlife Action Plan - Tier 1 and Tier 2 Species of Greatest Conservation Need (SGCN) - (CDOW 2006) and Introduced Species (i.e., non-native) - (Banks et al. 2005).

Table 5-3: Summary of the Migration Avian Community Observed at Haxtun Wind Project during Fall 2010

Group	Common Name	Scientific Name	Status[1]	# Individuals	# Obs	Rel Freq	Rel Abund	Mean Use	Index	% fly	% L	% M	%H
Passerines	Horned Lark	*Eremophila alpestris*		234	85	0.38	0.34	3.66	0.029	64.5	96.7	3.3	0.0
Raptors	Swainson's Hawk	*Buteo swainsoni*	Tier 1	14	6	0.03	0.02	0.22	0.006	100.0	0.0	100.0	0.0
Raptors	Red-tailed Hawk	*Buteo jamaicensis*		12	6	0.03	0.02	0.19	0.004	91.7	9.1	90.9	0.0
Passerines	Savannah Sparrow	*Passerculus sandwichensis*		36	13	0.06	0.05	0.56	0.002	61.1	90.9	9.1	0.0
Water Birds	Killdeer	*Charadrius vociferus*		14	1	0.00	0.02	0.22	0.001	100.0	0.0	100.0	0.0
Raptors	Turkey Vulture	*Cathartes aura*		1	1	0.00	0.00	0.02	0.000	100.0	0.0	100.0	0.0
Doves, Pigeons	Mourning Dove	*Zenaida macroura*		8	6	0.03	0.01	0.13	0.000	62.5	100.0	0.0	0.0
Gamebirds	Ring-necked Pheasant	*Phasianus colchicus*	Introduced	12	3	0.01	0.02	0.19	0.000	0.0	0.0	0.0	0.0
Passerines	American Pipit	*Anthus rubescens*		1	1	0.00	0.00	0.02	0.000	0.0	0.0	0.0	0.0
Passerines	American Robin	*Turdus migratorius*		7	4	0.02	0.01	0.11	0.000	85.7	100.0	0.0	0.0
Passerines	Brown-headed Cowbird	*Molothrus ater*		49	3	0.01	0.07	0.77	0.000	100.0	100.0	0.0	0.0
Passerines	European Starling	*Sturnus vulgaris*	Introduced	19	3	0.01	0.03	0.30	0.000	89.5	100.0	0.0	0.0
Passerines	Grasshopper Sparrow	*Ammodramus savannarum*		1	1	0.00	0.00	0.02	0.000	0.0	0.0	0.0	0.0
Passerines	House Sparrow	*Passer domesticus*	Introduced	75	2	0.01	0.11	1.17	0.000	0.0	0.0	0.0	0.0
Passerines	Lark Bunting	*Calamospiza melanocorys*	Tier 1	25	10	0.04	0.04	0.39	0.000	72.0	100.0	0.0	0.0
Passerines	Loggerhead Shrike	*Lanius ludovicianus*	Tier 1	1	1	0.00	0.00	0.02	0.000	100.0	100.0	0.0	0.0
Passerines	Tree Swallow	*Tachycineta bicolor*		38	6	0.03	0.06	0.59	0.000	100.0	100.0	0.0	0.0
Passerines	Vesper Sparrow	*Pooecetes gramineus*	Tier 2	36	8	0.04	0.05	0.56	0.000	88.9	100.0	0.0	0.0
Passerines	Western Kingbird	*Tyrannus verticalis*		2	1	0.00	0.00	0.03	0.000	0.0	0.0	0.0	0.0
Passerines	Western Meadowlark	*Sturnella neglecta*		89	49	0.22	0.13	1.39	0.000	57.3	100.0	0.0	0.0
Raptors	Cooper's Hawk	*Accipiter cooperii*		1	1	0.00	0.00	0.02	0.000	100.0	100.0	0.0	0.0
Raptors	Northern Harrier	*Circus cyaneus*	Tier 2	7	7	0.03	0.01	0.11	0.000	100.0	100.0	0.0	0.0
Raptors	Prairie Falcon	*Falco mexicanus*	Tier 1	2	1	0.00	0.00	0.03	0.000	100.0	100.0	0.0	0.0
Raptors	Unidentified Buteo Hawk	Buteo (sp)		3	3	0.01	0.00	0.05	0.000	66.7	0.0	0.0	100.0
Raptors	Unidentified Hawk	Accipitridae (gen, sp)		1	1	0.00	0.00	0.02	0.000	100.0	0.0	0.0	100.0

[1] Status according to Colorado Division of Wildlife Comprehensive Wildlife Conservation Strategy Wildlife Action Plan - Tier 1 and Tier 2 Species of Greatest Conservation Need (SGCN) - (CDOW 2006) and Introduced Species (i.e., non-native) - (Banks et al. 2005).

Table 5-4: Summary of the Wintering Avian Community Observed at Haxtun Wind Project duing Winter 2011

Group	Common Name	Scientific Name	Status[1]	# Individuals	# Obs	Rel Freq	Rel Abund	Mean Use	Index	% fly	% L	% M	%H
Passerines	Horned Lark	*Eremophila alpestris*		283	48	0.59	0.68	8.84	0.055	70.7	98.5	1.5	0.0
Raptors	Rough-legged Hawk	*Buteo lagopus*		4	4	0.05	0.01	0.13	0.005	75.0	0.0	100.0	0.0
Doves, Pigeons	Rock Pigeon	*Columba livia*	Introduced	7	2	0.02	0.02	0.22	0.000	100.0	100.0	0.0	0.0
Passerines	American Robin	*Turdus migratorius*		2	2	0.02	0.00	0.06	0.000	0.0	0.0	0.0	0.0
Passerines	European Starling	*Sturnus vulgaris*	Introduced	36	1	0.01	0.09	1.13	0.000	0.0	0.0	0.0	0.0
Passerines	House Sparrow	*Passer domesticus*	Introduced	60	4	0.05	0.14	1.88	0.000	40.0	100.0	0.0	0.0
Passerines	Lapland Longspur	*Calcarius lapponicus*		1	1	0.01	0.00	0.03	0.000	0.0	0.0	0.0	0.0
Passerines	Red-winged Blackbird	*Agelaius phoeniceus*		5	2	0.02	0.01	0.16	0.000	0.0	0.0	0.0	0.0
Passerines	Western Meadowlark	*Sturnella neglecta*		12	10	0.12	0.03	0.38	0.000	0.0	0.0	0.0	0.0
Raptors	American Kestrel	*Falco sparverius*		2	2	0.02	0.00	0.06	0.000	50.0	100.0	0.0	0.0
Raptors	Northern Harrier	*Circus cyaneus*	Tier 2	3	3	0.04	0.01	0.09	0.000	100.0	100.0	0.0	0.0

[1] Status according to Colorado Division of Wildlife Comprehensive Wildlife Conservation Strategy Wildlife Action Plan - Tier 1 and Tier 2 Species of Greatest Conservation Need (SGCN) - (CDOW 2006) and Introduced Species (i.e., non-native) - (Banks et al. 2005).

Table 5-5: Summary of the Migration Community Observed at Haxtun Wind Project during Spring 2011

Group	Common Name	Scientific name	Status[1]	# Individuals	# Obs	Rel Freq	Rel Abund	Mean Use	Index	% fly	% L	% M	%H
Doves, Pigeons	Mourning Dove	*Zenaida macroura*		68	17	0.06	0.07	1.06	0.003	14.7	70.0	30.0	0.0
Passerines	Lark Bunting	*Calamospiza melanocorys*	Tier 1	163	26	0.09	0.16	2.55	0.001	10.4	94.1	5.9	0.0
Raptors	Swainson's Hawk	*Buteo swainsoni*	Tier 1	5	5	0.02	0.00	0.08	0.001	100.0	60.0	40.0	0.0
Passerines	Western Kingbird	*Tyrannus verticalis*		9	4	0.01	0.01	0.14	0.000	11.1	0.0	100.0	0.0
Raptors	Golden Eagle	*Aquila chrysaetos*	Tier 1	1	1	0.00	0.00	0.02	0.000	100.0	0.0	100.0	0.0
Doves, Pigeons	Rock Pigeon	*Columba livia*	Introduced	5	1	0.00	0.00	0.08	0.000	0.0	0.0	0.0	0.0
Gamebirds	Ring-necked Pheasant	*Phasianus colchicus*	Introduced	36	28	0.10	0.04	0.56	0.000	8.3	100.0	0.0	0.0
Passerines	Chimney Swift	*Chaetura pelagica*		1	1	0.00	0.00	0.02	0.000	100.0	100.0	0.0	0.0
Raptors	Great Horned Owl	*Bubo virginianus*		3	2	0.01	0.00	0.05	0.000	0.0	0.0	0.0	0.0
Passerines	American Robin	*Turdus migratorius*		35	8	0.03	0.03	0.55	0.000	8.6	100.0	0.0	0.0
Passerines	Barn Swallow	*Hirundo rustica*		4	3	0.01	0.00	0.06	0.000	100.0	100.0	0.0	0.0
Passerines	Brown-headed Cowbird	*Molothrus ater*		49	9	0.03	0.05	0.77	0.000	81.6	100.0	0.0	0.0
Passerines	Common Grackle	*Quiscalus quiscula*		23	7	0.02	0.02	0.36	0.000	78.3	100.0	0.0	0.0
Passerines	Grasshopper Sparrow	*Ammodramus savannarum*		6	3	0.01	0.01	0.09	0.000	0.0	0.0	0.0	0.0
Passerines	Great-tailed Grackle	*Quiscalus mexicanus*		3	2	0.01	0.00	0.05	0.000	0.0	0.0	0.0	0.0
Passerines	Horned Lark	*Eremophila alpestris*		196	65	0.22	0.19	3.06	0.000	37.2	100.0	0.0	0.0
Passerines	House Sparrow	*Passer domesticus*	Introduced	116	8	0.03	0.12	1.81	0.000	0.0	0.0	0.0	0.0
Passerines	Red-winged Blackbird	*Agelaius phoeniceus*		120	24	0.08	0.12	1.88	0.000	20.0	100.0	0.0	0.0
Passerines	Vesper Sparrow	*Pooecetes gramineus*	Tier 2	9	4	0.01	0.01	0.14	0.000	0.0	0.0	0.0	0.0
Passerines	Western Meadowlark	*Sturnella neglecta*		146	65	0.22	0.14	2.28	0.000	22.6	100.0	0.0	0.0
Raptors	Red-tailed Hawk	*Buteo jamaicensis*		1	1	0.00	0.00	0.02	0.000	100.0	100.0	0.0	0.0
Water Birds	Killdeer	*Charadrius vociferus*		8	7	0.02	0.01	0.13	0.000	37.5	100.0	0.0	0.0

[1] Status according to Colorado Division of Wildlife Comprehensive Wildlife Conservation Strategy Wildlife Action Plan - Tier 1 and Tier 2 Species of Greatest Conservation Need (SGCN) - (CDOW 2006) and Introduced Species (i.e., non-native) - (Banks et al. 2005).

Table 5-6: Summary of the Breeding Avian Community Observed at Haxtun Wind Project during Summer 2011

Group	Common Name	Scientific Name	Status[1]	# Individuals	# Species	Rel Freq	Rel Abund	Mean Use	Index	% fly	% L	% M	%H
Passerines	Red-winged Blackbird	*Agelaius phoeniceus*		34	14	0.10	0.10	1.06	0.003	47.1	93.8	6.3	0.0
Passerines	American Robin	*Turdus migratorius*		3	2	0.01	0.01	0.09	0.000	100.0	66.7	33.3	0.0
Doves, Pigeons	Mourning Dove	*Zenaida macroura*		20	14	0.10	0.06	0.63	0.000	70.0	100.0	0.0	0.0
Doves, Pigeons	Rock Pigeon	*Columba livia*	Introduced	8	2	0.01	0.02	0.25	0.000	62.5	100.0	0.0	0.0
Gamebirds	Ring-necked Pheasant	*Phasianus colchicus*	Introduced	6	6	0.04	0.02	0.19	0.000	0.0	0.0	0.0	0.0
Raptors	Great Horned Owl	*Bubo virginianus*		1	1	0.01	0.00	0.03	0.000	100.0	100.0	0.0	0.0
Passerines	Barn Swallow	*Hirundo rustica*		5	5	0.03	0.01	0.16	0.000	80.0	100.0	0.0	0.0
Passerines	Brown Thrasher	*Toxostoma rufum*		2	2	0.01	0.01	0.06	0.000	100.0	100.0	0.0	0.0
Passerines	Brown-headed Cowbird	*Molothrus ater*		10	2	0.01	0.03	0.31	0.000	40.0	100.0	0.0	0.0
Passerines	Common Grackle	*Quiscalus quiscula*		3	2	0.01	0.01	0.09	0.000	100.0	100.0	0.0	0.0
Passerines	European Starling	*Sturnus vulgaris*	Introduced	2	1	0.01	0.01	0.06	0.000	0.0	0.0	0.0	0.0
Passerines	Grasshopper Sparrow	*Ammodramus savannarum*		4	3	0.02	0.01	0.13	0.000	0.0	0.0	0.0	0.0
Passerines	Horned Lark	*Eremophila alpestris*		41	23	0.16	0.12	1.28	0.000	17.1	100.0	0.0	0.0
Passerines	House Sparrow	*Passer domesticus*	Introduced	72	5	0.03	0.22	2.25	0.000	0.0	0.0	0.0	0.0
Passerines	Lark Bunting	*Calamospiza melanocorys*	Tier 1	64	27	0.18	0.19	2.00	0.000	25.0	100.0	0.0	0.0
Passerines	Savannah Sparrow	*Passerculus sandwichensis*		3	2	0.01	0.01	0.09	0.000	0.0	0.0	0.0	0.0
Passerines	Vesper Sparrow	*Pooecetes gramineus*	Tier 2	5	3	0.02	0.01	0.16	0.000	0.0	0.0	0.0	0.0
Passerines	Western Kingbird	*Tyrannus verticalis*		12	5	0.03	0.04	0.38	0.000	16.7	100.0	0.0	0.0
Passerines	Western Meadowlark	*Sturnella neglecta*		37	25	0.17	0.11	1.16	0.000	16.2	100.0	0.0	0.0
Water Birds	Killdeer	*Charadrius vociferus*		2	2	0.01	0.01	0.06	0.000	50.0	100.0	0.0	0.0

[1] Status according to Colorado Division of Wildlife Comprehensive Wildlife Conservation Strategy Wildlife Action Plan - Tier 1 and Tier 2 Species of Greatest Conservation Need (SGCN) - (CDOW 2006) and Introduced Species (i.e., non-native) - (Banks et al. 2005).

Table 6-1: Summary of Avian Use across Four Seasons at Haxtun Wind Project (2010 – 2011)[1]

	All Birds	Passerines	Raptors	Waterbirds
Overall	12.7	11.4	0.3	0.1
Fall	10.8	9.6	0.6	0.2
Winter	13.0	12.5	0.3	None Observed
Spring	15.7	13.7	0.2	0.1
Summer	10.4	9.3	0.0	0.1

[1] Mean use per 5-minute point count and rounded to the nearest tenth.

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Exhibits

Haxtun Wind Project
Logan and Phillips Counties, Colorado

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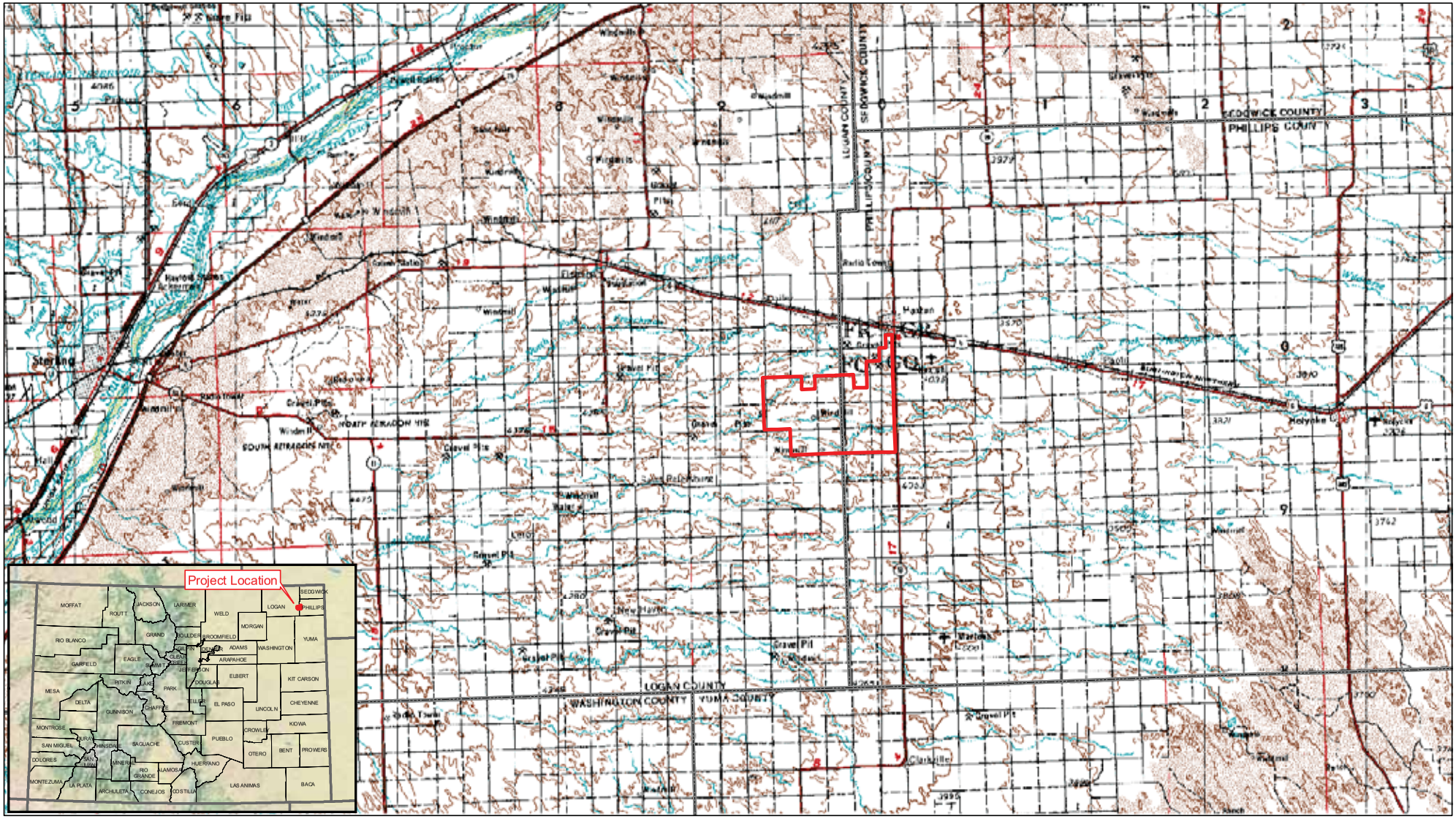

Data Source(s): Westwood (2010); 250K Seamless USGS DRG downloaded from (http://seamless.usgs.gov/) (2010); County Boundary from Colorado Division of Local Government (2000); State Boundary from ESRI and Tele Atlas North America, Inc. (2008); ESRI WMS Server US National Parks, World Physical Map (accessed 2010).

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Legend

- Project Boundary
- County Boundary

N

0 3.5 Miles

Haxtun Wind Project

Logan and Phillips Counties, CO

Project Location

EXHIBIT 1

Map Document: (P:\2010\103\gis\Avian\2011 final report\2010103arrg01B.mxd)
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Data Source(s): DATA ARE APPROXIMATE. Westwood (2011); National Wind (2011); U.S. Department of Commerce, U.S. Census Bureau, Geography Division (2009); World Imagery from WMS Server ESRI, i-cubed, USDA FSA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGP (accessed 2010); Colorado Division of Local Government (2000); GeoCommunicator (2009); Nav Air (2010); Ventyx Velocity Suite (2010).

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- County Boundary
- Township and Range
- Primary Turbine Locations
- Alternate Turbine Locations
- Primary Access Roads
- Alternative Access Roads
- Primary Crane Paths
- Alternative Crane Paths
- Primary Cable Routes
- Alternative Cable Routes
- Transmission Line Primary
- Transmission Line Alternative
- Substation Primary
- Substation Alternative

Haxtun Wind Project

Logan and Phillips Counties, Colorado

Preliminary Project Layout

EXHIBIT 2

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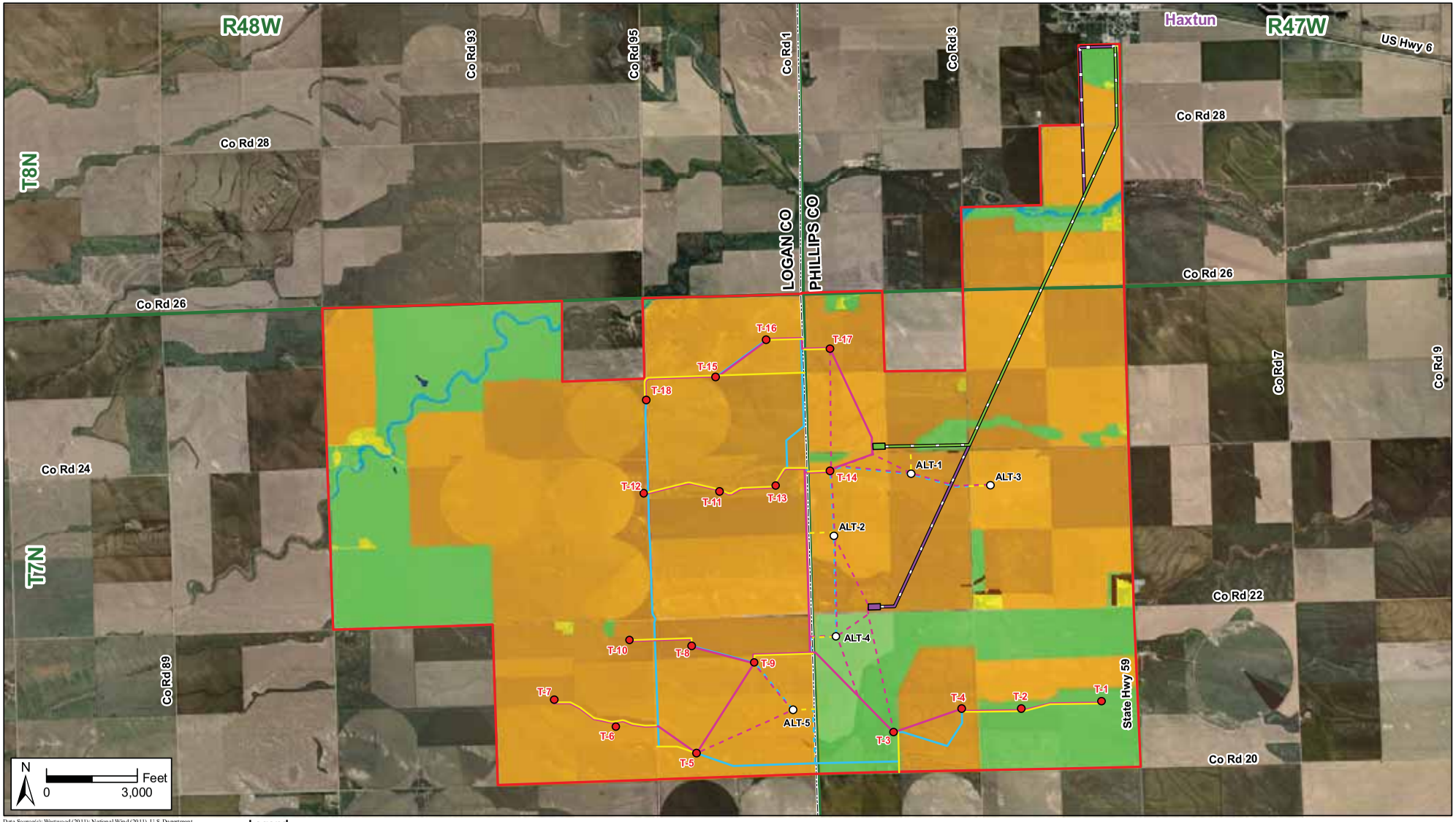

Data Source(s): Westwood (2011); National Wind (2011). U.S. Department of Commerce, U.S. Census Bureau, Geography Division (2009); World Imagery from WMS Server ESRI, i-cubed, USDA FSA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGP (accessed 2010).

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- Primary Cable Routes
- Alternative Cable Routes
- Transmission Line Primary
- Transmission Line Alternative
- Substation Alternative
- Substation Primary

Land Cover (Percent of Project Area)

- Cropland (76%)
- Non-Native Grassland (22%)
- Public Road (<1%)
- Developed (<1%)
- Intermittent Stream (<1%)
- Woodland (<1%)
- Private Road (<1%)
- Pond (<1%)

Haxtun Wind Project

Logan and Phillips Counties, Colorado

Land Cover

EXHIBIT 3

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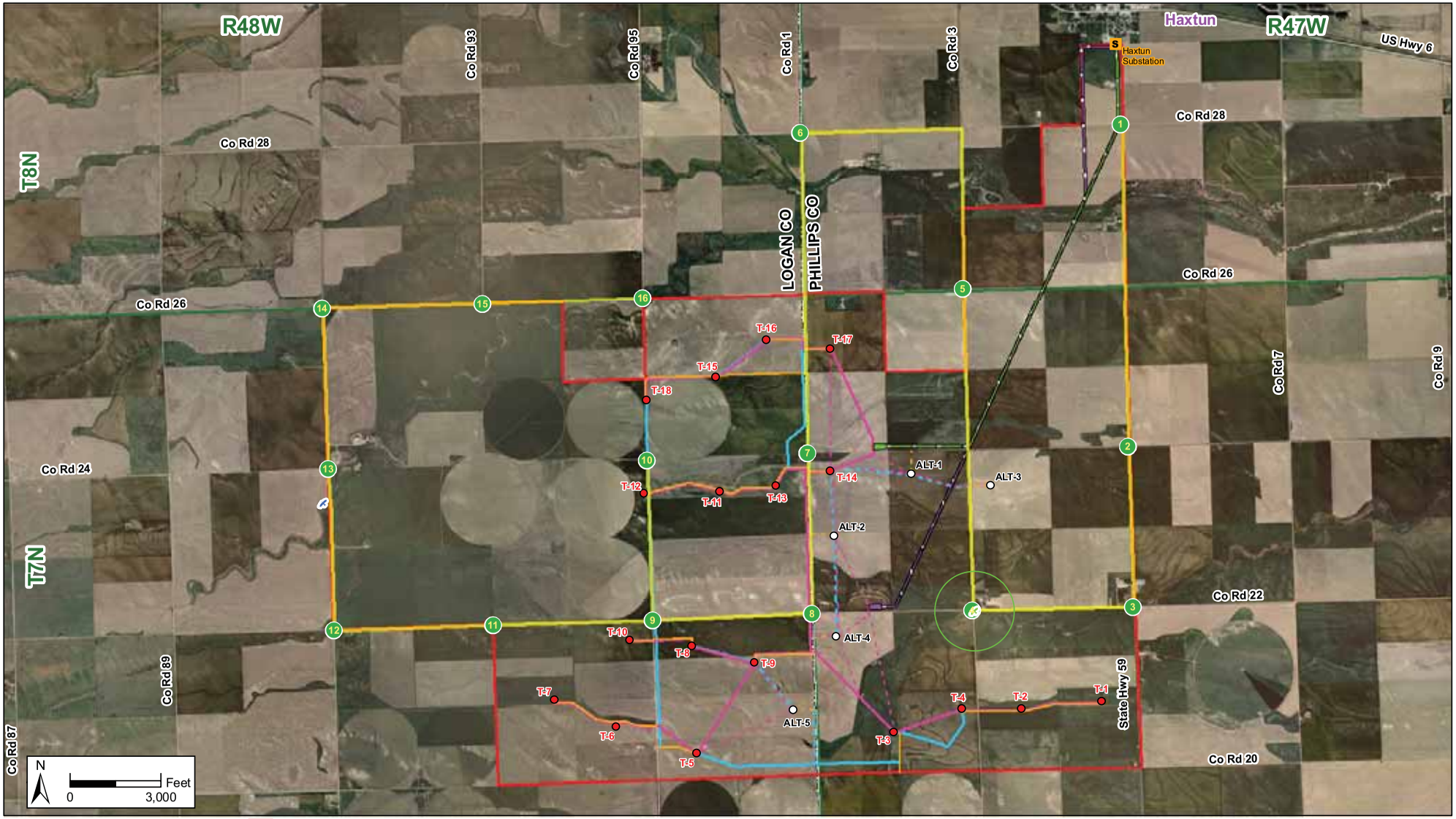

Data Source(s): DATA ARE APPROXIMATE. Westwood (2011); National Wind (2011); U.S. Department of Commerce, U.S. Census Bureau, Geography Division (2009); World Imagery from WMS Server ESRI, i-cubed, USDA FSA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGP (accessed 2010); Colorado Division of Local Government (2000); GeoCommunicator (2009); Nav Air (2010); Ventyx Velocity Suite (2010).

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- Alternative Access Roads
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- Alternative Crane Paths
- Primary Cable Routes
- Alternative Cable Routes
- Transmission Line Primary
- Transmission Line Alternative
- Substation Primary
- Substation Alternative

Raptor Nests

- Verified Raptor Nest
- Verified Inactive Raptor Nest
- Point Count Location
- Avian Survey Route
- 0.25-mile Buffer of Active Raptor Nests

Haxtun Wind Project

Logan and Phillips Counties, Colorado

Avian Survey Route and Raptor Nests

EXHIBIT 4

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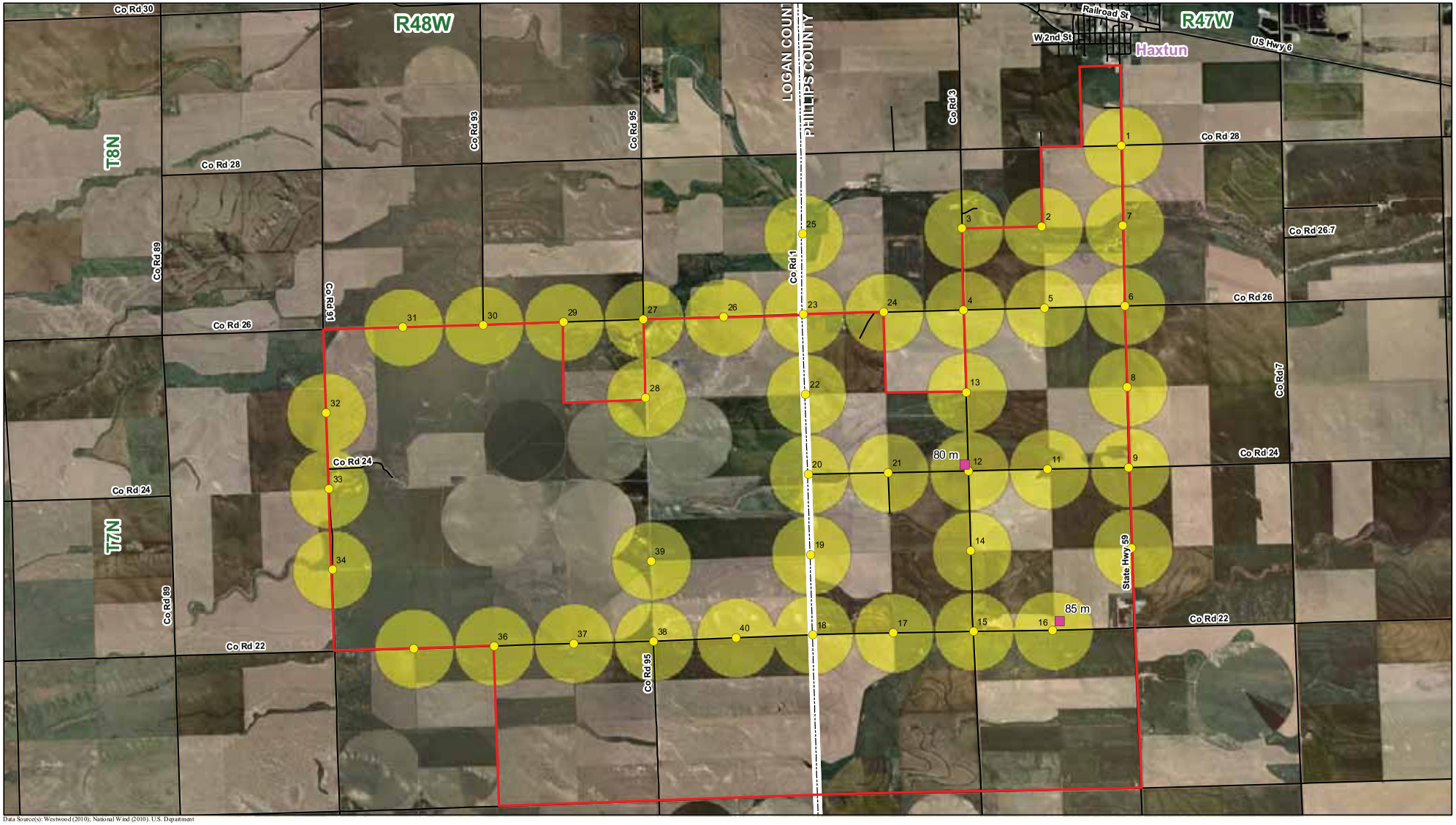

Data Source(s): Westwood (2010); National Wind (2010). U.S. Department of Commerce, U.S. Census Bureau, Geography Division (2009); World Imagery from WMS Server ESRI, i-cubed, USDA FSA, USGS, AEX, GeoEye, Getmapping, Aerogrid, IGP (accessed 2010).

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N

0 3,000 Feet

Project Boundary
County Boundary
Roads
Cell Tower
Mountain Plover Survey Location
Mountain Plover Survey Area

Haxtun Wind Project

Logan and Phillips Counties, CO

Mountian Plover Survey Locations

EXHIBIT 5

Map Document: (P:\2010\1033\gis\Avian\20101033bird03B_MOPL.mxd)
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