Wildlife Baseline Study for the Kittitas Valley Wind Project

Summary of Results from 2002 Wildlife Surveys

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Prepared for:

Zilkha Renewable Energy
210 SW Morrison, Suite 310
Portland, OR 97204

Prepared by:

Wallace Erickson
Jay Jeffrey
David Young
Kimberly Bay
Rhett Good
Karyn Sernka

WEST, Inc.
2003 Central Avenue
Cheyenne, WY 82001

And

Karen Kronner
Northwest Wildlife Consultants, Inc.
815 NW 4th St.
Pendleton, OR 97801

EXECUTIVE SUMMARY

Zilkha Renewable Energy (Applicant) proposes to construct and operate 100 to 150 wind turbines in the Kittitas Valley northwest of Ellensburg, Washington. The Kittitas Valley Wind Power Project (the Project) is anticipated to provide up to 173 megawatts (MW) of generating capacity. It would be constructed on privately owned land and public land administered by the Washington Department of Natural Resources (WDNR). The project area is bisected by five Bonneville Power Administration (BPA) and one Puget Sound Energy (PSE) high-voltage transmission lines. A project substation, which would connect the project's output to the regional transmission grid, would be constructed near the center of the project site, adjacent to the BPA or PSE lines. The output of the project would be sold under contract to one or more regional utilities for transmission to regional electricity consumers.

The Applicant has contracted with CH2MHILL, Western Ecosystems Technology, Inc. (WEST), and Northwest Wildlife Consultants, Inc. (NWC) to develop and implement a survey protocol for a baseline study of wildlife, habitat and plants in the project area. The protocol for the ecological baseline study is similar to protocols used at the Vansycle, Klondike, Stateline, Maiden, Condon and Nine Canyon wind projects in Oregon and Washington, the Buffalo Ridge wind project in southwest Minnesota, and the Foote Creek Rim wind project in Wyoming.

This report summarizes the results of the ecological baseline studies conducted from February 2002 through early November 2002. The wildlife portion of the ecological baseline study consists of 1) point count and in-transit surveys for wildlife species, 2) two aerial surveys within approximately two miles of the project boundary for visible raptor nests in the spring of 2002 and 3) nine driving transect surveys along Highway 10, Highway 97, Bettas Road, and Hayward Road to estimate the number of wintering bald eagles in the project vicinity. Rare plant surveys and habitat mapping were also conducted and has been summarized in a separate report (Eagle Cap and CH2M HILL 2002). Information on sensitive plant and wildlife species within the vicinity of the project was requested from the U.S. Fish and Wildlife Service (USFWS), Washington Department of Fish and Wildlife (WDFW), and the Washington Natural Heritage Program (WNHP). The recent synthesis of baseline and operational monitoring studies at wind developments by Erickson *et al.* (2002), as well as other relevant information has been reviewed and will be utilized for predicting impacts from the Kittitas Valley Project. A general wildlife review was conducted by NWC during the fall of 2001. Agency personnel and local bird specialists were contacted at that time for readily available information on wildlife of the general project area.

A total of 97 species were identified during the point count, in-transit, and/or bald eagle surveys at the Project. The mean number of species observed per survey (20-minute point count) was 3.63 with an average of 12.05 bird observations per survey. Higher overall avian-use occurred in the spring (15.14/survey) and fall (12.20/survey) compared with the summer (9.16/survey). The higher use in spring was primarily due to observations of relatively large flocks of birds (e.g., 520 American pipits, 141 Canada geese).

Passerines were the most abundant avian group observed in all seasons. The majority of bird observations were of American pipits (due primarily to one large flock observed), American robins, horned larks, and western meadowlarks. The next most abundant avian group varied by season, with corvids higher in spring and fall, and raptors more prevalent in summer. The most common raptor species observed were red-tailed hawks and American kestrels. Canada geese were observed primarily during spring, and common ravens were observed throughout the study period.

Compared to results of studies at other wind developments including Buffalo Ridge (MN), Foote Creek Rim (WY), Klondike (OR), Nine Canyon (WA), Zintel Canyon (WA), Stateline (OR/WA), and Vansycle (OR), the Kittitas Valley Project site had relatively high spring and summer raptor use and moderate fall raptor use. The higher use is primarily due to the presence of American kestrels and red-tailed hawks, two very common raptor species. Higher red-tailed hawk use is partly due to two nests located within 0.25 mile of two avian point count stations. In general, raptor mortality has been low at all new wind projects. Only one raptor fatality was recorded during a four-year study at the Buffalo Ridge wind project (~ 450 turbines). Five raptor fatalities were recorded over a three-year study at the Foote Creek Rim Phase I wind project (69 turbines), where there is much higher average raptor use as compared to most other sites (especially by golden eagles; Young *et al.* 2002). No raptor fatalities have been observed at the Vansycle wind project in Umatilla County, Oregon during a one-year study, or at the Klondike wind project in Sherman County, Oregon based on five months of surveys, respectively (Erickson *et al.* 2002).

Flight height characteristics were estimated for avian species and groups. Percentages of observations below, within, and above the rotor swept area (RSA) of 25 to 100 m above ground level were reported. Overall, 27.9% of the birds observed were recorded within the defined RSA, 64.9% were below the RSA and 7.1% were flying above the RSA (Table 8). Species commonly observed were often flying within the RSA, for example, 98.2% of 112 flying cedar waxwings, 85.7% of 14 common nighthawks, 79.2% of 322 American robins, 58.8% of 34 barn swallows, and 57.1% of 14 American goldfinches. However, other commonly observed species such as horned larks (8.1%) and western meadowlarks (4.3%), were not often observed within the RSA. Gray-crowned rosy finches, long-billed curlew, Townsend's solitaire, and unidentified swallow and accipiter were always observed within the RSA based upon one bird observation for each species (except for gray-crowned rosy finches which was one group of five individuals).

A relative exposure index (avian-use multiplied by proportion of observations within the RSA) was calculated for each species. This index is only based on flight height observations and relative abundance and does not account for other possible collision risk factors such as foraging or courtship behavior. American robins, cedar waxwings, and American pipits were the top three small bird species with a significant turbine exposure index. Larger bird species with the highest exposure index were common raven, red-tailed hawk and American kestrel. Mortality studies at other wind projects have indicated that although ravens are often observed at wind projects within the zone of risk, they appear to be less susceptible to collision with wind turbines than other similar size birds (e.g., raptors, waterfowl). Red-tailed hawks and American kestrels have been the most common species of the raptor fatalities at older wind projects in California,

and a few fatalities of these two species have been observed at new wind projects (one red-tailed hawk at Buffalo Ridge, MN, and three American kestrels at Foote Creek Rim, WY). One common nighthawk fatality was observed at Foote Creek Rim (WY), but apparently no other common nighthawk fatalities have been observed at other U.S. wind projects.

Aerial raptor nest surveys were conducted within approximately two miles of proposed turbine locations. The search area encompassed approximately 70 square miles. The survey was conducted via helicopter by searching suitable habitat for nests, such as stands of trees, shrubs, rocky areas, cliffs, and powerlines. A total of six red-tailed hawk nests and nine inactive raptor nests were found during surveys. Five of the six red-tailed hawk nests produced a total of 9 young for an average of 1.5 young per nest. One previously active red-tailed hawk nest was not found during the second visit. The nest may have been blown out of the tree during a high wind event. Of the 15 nests found during surveys, six were in mature cottonwoods, six were in coniferous trees, one was in a shrub, one was located on a powerline pole, and one was on a cliff. Much of the raptor nest survey area was dominated by coniferous forest. Due to the presence of foliage and interlocking crowns of coniferous forests, detection of raptor nests in many areas was difficult from the helicopter. Based on the current project layout, two of the six nests are within 0.25 mile of a proposed turbine string. One nest is between 0.25 and 0.5 mile of a proposed turbine string, and the other three nests are greater than one mile from proposed turbine strings.

Driving transects to evaluate the numbers of wintering bald eagles and their movements in the project area were initiated in mid-February 2002, and continued through mid-April. The surveys involved driving and counting bald eagles along Highway 10 (paralleling the Yakima River), Bettas Road, Hayward Road and Highway 97. A review of data suggests that 6 to 10 eagles were consistently observed along the survey routes during February and late March, with more observed to the south of the project area (along the Yakima River, and along the southern portion of Highway 97). The number of eagles observed dropped off significantly in late March (after the March 21 survey). There is a cattle pasture and calving area to the southeast of the project site along Smithson road where 2 to 3 eagles were commonly observed during the peak period. Bald eagles were only occasionally sited in the immediate project area, and no night roosting sites were identified in the project area. Overall, bald eagle use in the winter was relatively high at this site compared to other sites; and bald eagles in the vicinity of the project area were found primarily along the Yakima River.

The most probable impact to birds resulting from the project is direct mortality or injury due to collisions with the turbines or guy wires of temporary or permanent meteorological towers. Fatality projections based on the results of studies conducted at the modern 38 turbine Vansycle wind project in Umatilla County, Oregon (Erickson *et al.* 2000), the modern 69 turbine Foote Creek Rim Phase I wind project (Young *et al.* 2002), and the modern 400+ turbine Buffalo Ridge wind project in southwestern Minnesota (Johnson *et al.* 2000a, Johnson *et al.* 2002), indicate a range of 0.6 to 2.8 bird fatalities per turbine per year. Overall raptor mortality for this project is expected to be slightly higher than the Foote Creek Rim wind project, considering the moderate to high raptor use at the Project relative to the Foote Creek Rim project.

Portions of the proposed wind plant are within habitats designated by WDFW as winter range for mule deer and elk, although the human development that has occurred in the project area has

likely reduced the quality of the winter range. There is little information regarding wind project effects on big game. The elk and mule deer on site primarily occupy the grassland/shrub-steppe habitats, springs, and riparian corridors. During the construction period, it is expected that elk and mule deer will be displaced from the site due to the influx of humans and heavy construction equipment and associated disturbance. Construction related disturbance and displacement is expected to be temporary for the duration of the construction period. Most construction will take place during the summer months, minimizing construction disturbance to wintering big game. Following completion of the wind project, the disturbance levels from construction equipment and humans will diminish and the primary disturbances will be associated with operations and maintenance personnel, occasionally vehicular traffic, and the presence of the turbines and other facilities. If warranted due to winter weather conditions and the presence of substantial numbers of elk and mule deer in the project area, construction will take not take place during critical winter periods to minimize disturbance to wintering big game.

PARTICIPANTS

Name	Firm	Responsibilities
Kimberly Bay	WEST Inc.	Data Technician
Wallace Erickson	WEST Inc.	Project Manager, Statistician
Rhett Good	WEST Inc.	Field Biologist, GIS Technician
Bob Gritski	Northwest Wildlife Consultants Inc.	Field Biologist
Jay Jeffrey	WEST Inc.	Project Biologist, Field Supervisor
Karen Kronner	Northwest Wildlife Consultants Inc.	Reviewer and assisted with study protocol
Laurie Ness	Northwest Wildlife Consultants Inc.	Field Biologist
Karyn Sernka	WEST Inc.	Reviewer
David Young, Jr.	WEST Inc.	Project Biologist

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INTRODUCTION AND BACKGROUND

Zilkha Renewable Energy (the Applicant) proposes to construct and operate approximately 120 wind turbines in the Kittitas Valley northwest of Ellensburg, Washington (Figure 1). The Kittitas Valley Wind Power Project (the Project) is anticipated to provide up to 173 megawatts (MW) of capacity. It would be constructed on privately owned land, and public land administered by the Washington Department of Natural Resources (WDNR). The Applicant has contracted with CH2MHILL, Western Ecosystems Technology, Inc. (WEST), and Northwest Wildlife Consultants, Inc. to develop and implement a survey protocol for a baseline study of wildlife use of the project area. The protocol for the baseline study is similar to protocols used at the Vansycle, Klondike, Stateline, Maiden, Condon and Nine Canyon wind projects in Oregon and Washington, the Buffalo Ridge wind project in southwest Minnesota, and the Foote Creek Rim wind project in Wyoming.

This report summarizes the results of the ecological baseline studies conducted from February 2002 through early November 2002. The wildlife portion of the baseline studies consists of 1) point count and in-transit surveys for wildlife species with an emphasis on birds and big game, 2) two aerial surveys within approximately two miles of the project boundary for raptor nests in the spring of 2002 and 3) nine driving transect surveys along Highway 10, Highway 97, Bettas Road, and Hayward Road to estimate the number of wintering bald eagles in the project vicinity. Rare plant surveys and habitat mapping were also conducted and has been summarized in a separate report (Eagle Cap Consulting 2002). Information on sensitive plant and wildlife species within the vicinity of the project was requested from the U.S. Fish and Wildlife Service (USFWS), Washington Department of Fish and Wildlife (WDFW), and the Washington Natural Heritage Program (WNHP). The expected impacts of the project on wildlife are discussed. The recent synthesis of baseline and operational monitoring studies at wind developments by Erickson *et al.* (2002), as well as other relevant information was utilized for predicting avian impacts from the Project.

PROJECT DESCRIPTION

The proposed Project would consist of the installation, operation, and eventual decommissioning of approximately 120 wind turbines and supporting facilities. The project is anticipated to produce up to approximately 173 MW of electricity. The power would be sold to one or more regional utilities for transmission to regional consumers. The wind turbines proposed for the Project will have a capacity of 1.5 MW each and will be connected to adjacent turbines by a 34.5-kilovolt (kV) underground collector system. The turbines will be mounted on 50-75 m tubular towers, for a total height of approximately 100 m to the tip of the blade. The concrete tower foundations would be approximately 5-15 m square, and extend 6-15 m deep. Wind turbines would be grouped in turbine "strings" of about 4 to 32 turbines generally near the crest of the ridges. Turbines will be spaced approximately 90 to 150 m (300 to 500 ft) from the next or 1.5-2 times the diameter of the turbine rotor.

The electrical output of each turbine string would be connected to the project substation by a combination of overhead and underground 34.5-kV transmission lines. The substation would be connected to the BPA and/or PSE transmission lines that are located adjacent to the substation site. The project would be monitored and controlled from an operations and maintenance (O&M) building located adjacent to the substation (Figure 1). Existing roads would be improved, and some new graveled roads constructed to provide access to the wind turbine locations during construction and for O&M. Wind speeds will be monitored using 9 permanent metrological (met) towers.

Total acres of impacted habitat will be relatively small. Approximately 77.2 acres will be permanently disturbed (occupied by roads, turbines and other infrastructure) and approximately 301.7 acres temporarily disturbed during construction. Approximately 12 miles of new roads and driveway will be constructed, and approximately 10.4 miles of existing roads graveled and widened to 20-30 ft.

STUDY AREA DESCRIPTION

The Project is located in Kittitas County, Washington, approximately 14 kilometers (km) southeast of the town of Cle Elum, and 20 km northwest of the town of Ellensburg. The Yakima River flows in a southeasterly direction to the south of the Project. US Highway 97 runs north-south through the middle of the project area, and State Highway 10 and Interstate 90 parallel the Yakima River to the south. The project is located in the following sections: Township 19N, Range 17E, sections 1-3, 7, 9-16, 21-23, and 27, and Township 20N, Range 17E, section 34 (Figure 1).

The Project is located at the western edge of the Columbia Basin physiographic province at the eastern base of the Cascade Mountain range (Franklin and Dyrness 1988). The Columbia Basin province is surrounded on all sides by mountain ranges and highlands, and covers a large portion of eastern Washington, and extends south into Oregon.

The Project extends over an approximately six by nine kilometer (3.7 by 5.6 mile) block of land, which consists primarily of long north-south trending ridges. Between the ridges are ephemeral drainages of Dry Creek and associated tributaries that flow into the Yakima River to the south. Slopes within the project area generally range from 5^{B} to 20^{B}, but can reach 40^{B} in the canyons. Elevations in the project area ranges from approximately 670 m (2200 ft) above mean sea level along Highway 97, to approximately 960 m (3150 ft) near the northern most turbine string (see Figure 1).

A detailed survey for rare plants and habitat was conducted in April – August 2002. Additional results and discussions of vegetation of the project are included in Eagle Cap and CH2MHILL (2002). The project area is near the western edge of the big sagebrush/bluebunch wheatgrass zone as defined by Franklin and Dyrness (1988). In addition to big sagebrush (*Artemisia tridentata*), a number of other shrub species may be present in the zone including: rabbitbrushes

(*Chrysothamnus* spp. and *Ericameria* spp.), threetip sagebrush (*Artemisia tripartita*), and spiny hopsage (*Grayia spinosa*). The bluebunch wheatgrass is supplemented by variable amounts of grasses and forbs such as needle-and-thread grass (*Hesperostipa comata*), Thurber's needlegrass (*Achnatherum thurberianum*), Cusick's bludegrass (*Poa cusickii*), bottlebrush (*Elymus elymoides*), Sandberg's bluegrass (*Poa secunda*), cheatgrass (*Bromus tectorum)*, and flatspine stickseed (Lappula occidentalis).

Within the project area, many of the plant communities have been impacted and modified due to numerous factors, such as cattle grazing, introduction of exotic plant species, ground disturbance from development activities, past fires, transmission lines, roads and highways, and housing/farms. Much of the riparian areas are degraded from heavy cattle use, and riparian vegetation has been removed.

The majority of lands within the project area are privately owned, although several parcels are owned and administered by the State of Washington Department of Natural Resources (DNR). Livestock production (cattle grazing) is the primary land use, although some rural homesite development has also taken place. The area is also used, on a much more limited basis, for recreational activities such as hunting. A high-voltage transmission line corridor crosses on a roughly east-west line through the middle of the project area. This corridor contains four steel-tower 230 kV electrical transmission lines. Additionally, there is a wood-pole 230kV transmission line that roughly parallels the four-line corridor, and a steel-tower 345 kV line running through the northern portion of the project area.

AGENCY/LOCAL AUDUBON CONSULTATION

Consultation with local, regional and central office personnel of WDFW was initiated in early 2002 for the proposed project. A study protocol was provided to WDFW and the Kittitas Audubon Society in February 2002. Representatives of the Applicant, project consultants, and WDFW met in Yakima on February 27, 2002 to discuss the project and protocol. Representatives of the Applicant and project consultants also met with Kittitas Audubon Society on February 26, 2002 to introduce the proposed project and again after the spring surveys were completed to discuss the results of those surveys. Information on sensitive plant and wildlife species within the vicinity of the project was requested and received from the U.S. Fish and Wildlife Service (USFWS), Washington Department of Fish and Wildlife (WDFW), and the Washington Natural Heritage Program (WNHP).

METHODS

Diurnal Fixed-point and In-Transit Avian Use Surveys

The goal of the avian use surveys was to estimate the temporal and spatial use of the study area by birds. The avian use surveys combined observations collected at eleven fixed-point circular

plots in the study area with in-transit observations of birds made while driving to and from the study area. All wildlife species of concern and unusual species observed were recorded while the observers were in the study area traveling between observation points and while conducting other field activities. Two experienced wildlife and avian biologists, Jay Jeffrey of WEST Inc., and Laurie Ness of Northwest Wildlife Consultants Inc., conducted the avian surveys.

Fixed-point Surveys

Each plot consists of an 800-m radius circle centered on an observation point location (Figure 2). Landmarks were located to aid in identifying the 800 m boundary of each observation point. Observations of birds beyond the 800 m radius were recorded, but may be analyzed separately from observations made within the plot, if warranted.

All detections of birds, mammals, reptiles, and amphibians in and near plots during the 20-minute plot surveys were recorded. Visual and binocular scanning of the entire plot viewshed and beyond were continuously performed throughout the survey period. A unique observation number was assigned to each sighting. The following data were recorded for each plot survey: date, start and end time of observation period, plot number, species or best possible identification, number of individuals, sex and age class when known, distance from plot center when first observed, closest distance, altitude above ground (first, low and high), flight direction, behavior(s), habitat(s), whether observed during one or more of the three instantaneous counts, and in which of the two ten minute periods it was observed. Flight paths were mapped for raptors and species of concern and given corresponding observation numbers. The map indicates whether the bird was within or outside the survey radius based on reference points at known distances from the plot center. Flight paths were digitized using ARCVIEW 3.2. Climate information, such as temperature, wind speed, wind direction, precipitation and cloud cover were also recorded for each point count survey.

Behavior categories recognized included perched (PE), soaring (SO), flapping (FL), flushed (FH), circle soaring (CS), hunting (HU), gliding (GL), and other (OT). Habitats were recorded as grassland-steppe (GS), coniferous forest (CF), riparian (RI), shrub-steppe (SS), deciduous forest (DS), Rock (RO), and other (OT). Initial flight patterns and habitats were identified with ”1” in the data sheet and subsequent patterns and habitats (if any) recorded as an "x" or check mark. Any comments or unusual observations were recorded in the comment section of the data form.

Incidental/In-transit Observations

All wildlife species of concern and uncommon species observed while field observers were traveling between plots were recorded on incidental/in-transit data sheets. Other incidental observations made during other surveys or visits to the sites were also recorded. These observations were recorded in a similar fashion to those recorded during the plot studies. The observation number, date, time, species, number, sex/age class, height above ground, and habitat were recorded. Observations of species of concern and uncommon species were recorded in additional detail, mapped on a USGS quadrangle map by observation number, and digitized using ARCVIEW 3.2.

Observation Schedule

Surveys were conducted weekly at intervals designed to include approximately all daylight hours. During a set of surveys, each selected plot was visited once. A pre-established schedule was developed prior to field work to ensure that each station was surveyed about the same number of times each period of the day, during each season, and to most efficiently utilize personnel time. The schedule was altered in response to adverse weather conditions or farming operations, which required delays and/or rescheduling of observations.

Statistical Analysis

Avian Use

Species lists were generated by season including all observations of birds detected regardless of their distance from the observer. The number of birds seen during each point count survey was standardized to a unit area and unit time surveyed. The standardized unit time was 20 minutes and the standardized unit area was 2.01 km^2 (800 m radius viewshed for each station). For example, if four raptors were seen during the 20 minutes at a point with a viewing area of 2.01 km^2, these data may be standardized to 4/2.01 = 1.98 raptors/km^2 in a 20-minute survey. For the standardized avian use estimates, only observations of birds detected within 800 m of the observer were used. Estimates of avian use (expressed in terms of number of birds/plot/20-minute survey) were used to compare differences in avian use between 1) avian groups and 2) seasons.

Avian Diversity and Richness

The total number of unique species was calculated by season. The mean number of species observed per survey (i.e., per station per 20-minute survey) was tabulated to illustrate and compare differences in mean number of species per survey between seasons.

Avian Flight Height/Behavior

The first flight height recorded was used to estimate percentages of birds flying below, within and above the rotor swept area (RSA). The zone of collision risk was estimated at 25-100 m above ground level (AGL) which is the combination of proposed tower heights with 50 m diameter rotors.

Avian Exposure Index

A relative index to collision exposure (*R*) was calculated for bird species observed during the fixed-point surveys using the following formula:

$$R = A * P_f * P_t$$

Where A = mean relative use for species *i* (observations within 800 m of observer) averaged across all surveys, P_f = proportion of all observations of species *i* where activity was recorded as flying (an index to the approximate percentage of time species *i* spends flying during the daylight period), and P_t = proportion of all flight height observations of species *i* within the rotor-swept area (RSA). This index does not account for differences in behavior other than flight characteristics (i.e., flight heights and percent of birds observed flying).

Avian Flight Patterns and Behavior

Maps of flight paths of raptors and other species of concern were generated and reported to illustrate patterns in flight paths and behaviors.

Data Compilation and Storage

A Microsoft® ACCESS database was developed to store, organize and retrieve field observation data. Data from field forms were keyed into electronic data files using a pre-defined format to facilitate subsequent QA/QC and data analysis. All field data forms, field notebooks, and electronic data files were retained for reference.

Quality Assurance/Quality Control (QA/QC)

QA/QC measures were implemented at all stages of the study, field surveys, data entry, and during data analysis and report writing. At the end of each survey day, each observer was responsible for inspecting his or her data forms for completeness, accuracy, and legibility. Periodically data forms were reviewed to ensure completeness and legibility; any problems detected were corrected. Any changes made to the data forms were initialed and dated by the individual making the change.

A sample of records from the electronic files was compared to the raw data forms and any errors found were corrected. Any irregular codes detected, or any data suspected as questionable, was discussed with the observer and study team leader. All changes made to the raw data were documented for future reference. Any errors or suspect data identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps made.

Raptor Nest Surveys

Raptor nest surveys were conducted within approximately two miles of the proposed turbine locations (Figure 2). The search area encompassed approximately 70 square miles which is the Project area plus the two-mile radius buffer, referred to as the raptor nest study area (RNA). The survey was conducted via a helicopter by searching suitable habitat for nests, such as stands of trees, shrubs, rocky areas, cliffs, and powerlines. If a nest was observed the helicopter was moved to a position where nest occupancy and species could be determined. Efforts were made to minimize disturbance to breeding raptors, including keeping the helicopter a maximum distance from the nest to identify species. Those distances varied depending upon nest location and wind conditions. No nesting raptors were flushed from their nests during the aerial surveys.

Two surveys of the RNA were conducted. The purpose of the initial survey, conducted between May 5 and 8, 2002 was to document the location of all raptor nest structures and to determine nest occupancy. A total of approximately 908 linear miles was covered from the air during the initial visit.

A second survey was conducted on June 5, 2002 to determine productivity of nests occupied during the initial survey. Inactive nests found during the initial survey were also revisited to

determine if late nesting species (e.g. Swainson's hawks) occupied nests that were empty during the initial visit. Approximately 54 linear air miles were covered during the second visit.

Wintering Bald Eagle Surveys

Driving transects to evaluate the numbers of wintering bald eagles and their movements in the project area were initiated in mid-February, 2002. Surveys involved driving and counting bald eagles along four different routes (see below and Figure 3). Surveyors drove a pre-determined survey route at weekly intervals. A total of 9 surveys were conducted between February 15 and April 11, 2002. The one-way distance for all survey routes combined is approximately 35 miles. Most routes were surveyed twice on any given survey day (e.g., starting in the east to west direction, and returning on the west-east direction).

Route 1: From the junction of Highway 97 and Highway 10 along 97 North to the intersection with Bettas Road. Also includes approximately 2.5 miles of Smithson road. Total distance (one-way) is approximately 11 miles.

Route 2: North on Highway 97 from Bettas Road to Northern Bettas Road Junction including all of Bettas Road and south on Hayward Road. Total distance (one-way) is approximately 10 miles.

Route 3: Junction of Hayward Road and Highway 10, west on Highway 10 to Junction with Hart Road. Total distance (one-way) is approximately 7.4 miles.

Route 4: Junction of Highway 97 and Highway 10 west on Highway 10 to Hayward Road. Total distance (one-way) is approximately 6.7 miles.

Depending on the traffic and safe pull-off availability, the surveyor looked for eagles within the viewshed from the road. During periodic stops, the surveyor scanned areas of large cottonwoods and conifer trees with binoculars to look for perched eagles. A spotting scope was used if closer views were required to confirm identifications or if a potential roost tree grove was identified in the distance. Between stops, the observer drove at a slow speed of approximately 25 mph (40 kph), where appropriate. Surveys were conducted in the morning and evening hours, alternating each week. If bald eagles or other species of interest (e.g., raptors, elk) were sighted, they were assigned an observation number and mapped on USGS 7.5' quadrangle maps. Habitat, activity, and time of day were also recorded for each observation. Flight paths of bald eagles were mapped for as long as the bird was visible. Perch sites and evening roost sites were recorded on the topo maps. The direction of the route followed (forward or reverse), total time spent and distance driven was recorded for each survey route.

RESULTS

Field work (all survey types) on the Project occurred from February 15 through November 1, 2002. A total of 97 avian species were identified during the bald eagle surveys, point counts, in-transit travel, and incidentally while conducting other field tasks at the Project (Table 1).

Fixed-Point Avian Use Surveys

Fixed-point surveys were conducted weekly from March 21 through November 1, 2002 at the Project. A total of 279 20-minute point count surveys were conducted on the Project (Table 2).

Avian Diversity

A total of 90 species were observed during the fixed-point surveys at the Project site. The mean number of species observed per survey (20-minute point count) was 3.63 (Figure 3). The mean number of species was highest in the spring and summer, and lowest during the fall (Figures 3 and 4). The passerine diversity was high for the Project, likely due to the high diversity of habitats in the project area.

Avian Use by Species

A total of 3,600 individual bird detections within 1,210 separate groups were recorded from during the fixed-point surveys (Table 3). Cumulatively, four passerines, American pipits, American robins, horned larks, and western meadowlarks, comprised approximately 47% of the observations. All other species comprised less than 5% of the observations individually.

Mean avian-use estimates (number of birds/20-minute survey using detections within 800 m of each point) were calculated by species and season, and grouped by bird size due to differences in the detectability of small and large birds (Table 4). During the **spring**, large birds with the highest use were common raven (0.72), black-billed magpie (0.30), red-tailed hawk (0.26), American kestrel (0.22), and Canada goose (0.15). Small bird species with the highest spring use were American pipit (6.10), yellow-rumped warbler (1.11), horned lark (0.95), western meadowlark (0.91), and American robin (0.72) (Table 4). During the **summer**, large bird species with the highest use were American kestrel (0.45), red-tailed hawk (0.37), turkey vulture (0.17), common nighthawk (0.15), and common raven (0.11). Small bird species with the highest summer use were horned lark (1.61), western meadowlark (1.47), vesper sparrow (0.86), Brewer's blackbird (0.57), and barn swallow (0.35) (Table 4). During the **fall**, large birds with the highest use (Table 4) were common raven (0.47), red-tailed hawk (0.32), black-billed magpie (0.23), northern harrier (0.17), and rough-legged hawk (0.8). Small bird species with the highest fall use were American robin (3.08), horned lark (2.15), cedar waxwing (1.11), mountain bluebird (0.59), and American pipit (0.58) (Table 4).

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Table 1. List of avian species observed during fixed-point, in-transit and bald eagle surveys on the Kittitas Valley Project site.

Species/Group	Scientific Name	Species/Group	Scientific Name	Species/Group	Scientific Name
blue-winged teal	*Anas discors*	black-headed grosbeak	*Pheucticus melanocephalus*	Townsend's solitaire	*Myadestes townsendi*
Canada goose	*Branta canadensis*	Brewer's blackbird	*Euphagus cyanocephalus*	Townsend's warbler	*Dendroica townsendi*
greater white-fronted goose	*Anser Albifrons*	Brewer's sparrow	*Spizella breweri*	Vaux's swift	*Chaetura vauxi*
Mallard	*Anas platyrhynchos*	brown-headed cowbird	*Molothrus ater*	vesper sparrow	*Pooecetes gramineus*
great blue heron	*Ardea herodias*	Bullock's oriole	*Icterus bullockii*	violet-green swallow	*Tachycineta thalassina*
herring gull	*Larus argentatus*	Cassin's finch	*Carpodacus purpureus*	warbling vireo	*Vireo gilvus*
common snipe	*Gallinago Gallinago*	cedar waxwing	*Bombycilla cedrorum*	western kingbird	*Tyrannus verticalis*
greater yellowlegs	*Tringa melanoleuca*	chipping sparrow	*Spizella passerina*	western meadowlark	*Sturnella neglecta*
Killdeer	*Charadrius vociferus*	cliff swallow	*Petrochelidon pyrrhonota*	western tanager	*Piranga ludoviciana*
long-billed curlew	*Numenius americanus*	dark-eyed junco	*Junco hyemalis*	western wood-pewee	*Contopus virens*
spotted sandpiper	*Actitis macularia*	eastern kingbird	*Tyrannus tyrannus*	white-crowned nuthatch	*Sitta carolinenis*
Wilson's phalarope	*Phalaropus tricolor*	European starling	*Sturnus vulgaris*	white-crowned sparrow	*Zonotrichia leucophrys*
American kestrel	*Falco sparverius*	golden-crowned kinglet	*Regulus satrapa*	yellow-headed blackbird	*Xanthocephalus xanthocephalus*
bald eagle	*Haliaeetus leucocephalus*	golden-crowned sparrow	*Zonotrichia atricapilla*	yellow-rumped warbler	*Dendroica coronata*
Cooper's hawk	*Accipiter cooperii*	gray-crowned rosy finch	*Leucosticte arctoa*	common nighthawk	*Chordeiles minor*
Golden eagle	*Aquila chrysaetos*	horned lark	*Eremophila alpestris*	downy woodpecker	*Picoides pubescens*
great-horned owl	*Bubo virginianus*	house finch	*Carpodacus mexicanus*	Lewis's woodpecker	*Melanerpes lewis*
Gyrfalcon	*Falco rusticolus*	lazuli bunting	*Passerina amoena*	northern flicker	*Colaptes auratus*
Merlin	*Falco columbarius*	Lincoln's sparrow	*Melospiza lincolnii*	Rufous hummingbird	*Selasphorus rufus*
northern goshawk	*Accipiter gentilis*	loggerhead shrike	*Lanius ludovicianus*	blue grouse	*Dendragapus obscurus*
northern harrier	*Circus cyaneus*	Macgillivray's warbler	*Oporornis tolmiei*	California quail	*Callipepla californica*
Osprey	*Pandion haliaetus*	mountain bluebird	*Sialia currucoides*	gray partridge	*Perdix perdix*
Prairie falcon	*Falco mexicanus*	mountain chickadee	*Poecile gambeli*	ruffed grouse	*Bonasa umbellus*
red-tailed hawk	*Buteo jamaicensis*	northern shrike	*Lanius excubitor*	mourning dove	*Zenaida macroura*
rough-legged hawk	*Buteo lagopus*	orange-crowned warbler	*Vermivora celata*		
sharp-shinned hawk	*Accipter striatus*	pine grosbeak	*Pinicola enucleator*		
Turkey vulture	*Cathartes aura*	purple finch	*Carpodacus purpureus*		
black-billed magpie	*Pica pica*	red crossbill	*Loxia curvirostra*	unidentified duck	
common raven	*Corvus corax*	red-breasted nuthatch	*Sitta canadensis*	unidentified accipiter	
Steller's jay	*Cyanocitta stelleri*	red-winged blackbird	*Agelaius phoeniceus*	unidentified buteo	
American goldfinch	*Carduelis tristis*	ruby-crowned kinglet	*Regulus calendula*	unidentified eagle	
American green-winged teal	*Anas crecca*	sage thrasher	*Oreoscoptes montanus*	unidentified falcon	
American pipit	*Anthus rubescens*	savannah sparrow	*Passerculus sandwichensis*	unidentified finch	
American redstart	*Setophaga ruticilla*	Say's phoebe	*Sayornis saya*	unidentified flycatcher	
American robin	*Turdus migratorius*	song sparrow	*Melospiza melodia*	unidentified passerine	
barn swallow	*Hirundo rustica*	spotted towhee	*Pipilo maculatus*	unidentified swallow	
black-capped chickadee	*Poecile atricapillus*			unidentified bluebird	

Table 2. Mean use, mean # species/survey, total number of species, and total number of fixed-point surveys conducted by season and overall for the Project site.

Season	Number of Visits	Mean Use[a]	# Species/ Survey[b]	# Species	# Surveys Conducted
Spring	8	15.14	3.84	56	85
Summer	9	9.16	4.39	56	98
Fall	9	12.20	2.70	48	96
Overall	26	12.05	3.63	90	279

[a] # observations per 20-minute survey
[b] % of 20-minute surveys species/group is recorded

Table 3. Avian species observed while conducting fixed-point surveys (March 21, 2002 – November 1, 2002) on the Project Site. [a]

Species/Group	Spring		Summer		Fall		Grand Total	
	# obs.	# groups	# obs.	# groups	# obs.	# groups	# obs.	# groups
Waterfowl								
blue-winged teal	0	0	3	1	0	0	3	1
Canada goose	141	4	1	1	0	0	142	5
Mallard	24	4	5	2	0	0	29	6
unidentified duck	0	0	0	0	7	1	7	1
Subtotal	165	8	9	4	7	1	181	13
Waterbird								
herring gull	2	1	0	0	0	0	2	1
Shorebirds								
common snipe	1	1	0	0	0	0	1	1
greater yellowlegs	1	1	0	0	0	0	1	1
Killdeer	5	4	6	3	4	2	15	9
long-billed curlew	1	1	0	0	0	0	1	1
Wilson's phalarope	0	0	1	1	0	0	1	1
Subtotal	8	7	7	4	4	2	19	13
Corvids								
black-billed magpie	26	12	8	7	23	18	57	37
common raven	65	35	11	10	46	25	122	70
Steller's jay	2	2	2	1	8	6	12	9
Subtotal	93	49	21	18	77	49	191	116
Upland Gamebirds								
blue grouse	3	3	0	0	4	1	7	4
California quail	7	2	2	1	4	2	13	5
ruffed grouse	0	0	1	1	0	0	1	1
Subtotal	10	5	3	2	8	3	21	10
Doves								
mourning dove	1	1	4	3	3	3	8	7

[a] Includes all observations, including those recorded at distances greater than 800 m from the observer.

Table 3 (*continued*).

Species/Group	Spring		Summer		Fall		Grand Total	
	# obs.	# groups	# obs.	# groups	# obs.	# groups	# obs.	# groups
Raptors								
Accipiter								
Cooper's hawk	4	4	0	0	3	3	7	7
northern goshawk	0	0	0	0	2	2	2	2
sharp-shinned hawk	5	5	1	1	4	4	10	10
unidentified accipiter	1	1	0	0	1	1	2	2
Subtotal	10	10	1	1	10	10	21	21
Buteos								
red-tailed hawk	23	22	41	38	32	32	96	92
rough-legged hawk	9	9	0	0	7	7	16	16
unidentified buteo	1	1	1	1	1	1	3	3
Subtotal	33	32	42	39	40	40	115	111
Eagles								
bald eagle	7	7	0	0	0	0	7	7
golden eagle	4	4	2	2	1	1	7	7
unidentified eagle	1	1	1	1	0	0	2	2
Subtotal	12	12	3	3	1	1	16	16
Falcons								
American kestrel	21	20	44	43	6	5	71	68
merlin	2	2	0	0	0	0	2	2
prairie falcon	5	5	0	0	0	0	5	5
unidentified falcon	1	1	0	0	0	0	1	1
Subtotal	29	28	44	43	6	5	79	76
Other Raptors								
great-horned owl	0	0	0	0	1	1	1	1
northern harrier	1	1	0	0	17	17	18	18
osprey	1	1	0	0	0	0	1	1
turkey vulture	7	7	18	18	1	1	26	26
Subtotal	9	9	18	18	19	19	46	46
Raptor Subtotal	93	91	108	104	76	75	277	270
Passerines								
American goldfinch	0	0	0	0	16	5	16	5
American pipit	537	2	0	0	57	1	594	3
American redstart	0	0	1	1	0	0	1	1
American robin	63	11	25	15	305	15	393	41
barn swallow	0	0	35	5	5	2	40	7
black-capped chickadee	1	1	1	1	11	4	13	6
black-headed grosbeak	0	0	1	1	0	0	1	1
Brewer's blackbird	41	6	55	13	0	0	96	19
Brewer's sparrow	0	0	2	1	2	1	4	2

[a] Includes all observations, including those recorded at distances greater than 800 m from the observer.

Table 3 (*continued*).

Species/Group	Spring		Summer		Fall		Grand Total	
	# obs.	# groups	# obs.	# groups	# obs.	# groups	# obs.	# groups
Passerines (*continued*)								
brown-headed cowbird	0	0	18	7	0	0	18	7
Bullock's oriole	0	0	2	2	0	0	2	2
Cassin's finch	0	0	0	0	1	1	1	1
cedar waxwing	0	0	5	3	110	1	115	4
chipping sparrow	4	1	33	18	10	2	47	21
cliff swallow	4	1	30	6	0	0	34	7
dark-eyed junco	2	2	0	0	36	4	38	6
eastern kingbird	0	0	5	4	0	0	5	4
European starling	53	5	29	3	26	2	108	10
golden-crowned kinglet	4	1	0	0	0	0	4	1
golden-crowned sparrow	0	0	0	0	1	1	1	1
gray-crowned rosy finch	0	0	0	0	5	1	5	1
horned lark	84	35	158	72	207	53	449	160
house finch	6	3	1	1	5	2	12	6
lazuli bunting	0	0	6	5	0	0	6	5
Lincoln's sparrow	0	0	0	0	2	1	2	1
Macgillivray's warbler	0	0	1	1	0	0	1	1
mountain bluebird	13	6	15	8	55	11	83	25
mountain chickadee	7	3	0	0	4	1	11	4
northern shrike	0	0	0	0	2	2	2	2
orange-crowned warbler	4	2	1	1	0	0	5	3
pine grosbeak	0	0	1	1	0	0	1	1
purple finch	7	1	0	0	0	0	7	1
red crossbill	0	0	5	1	0	0	5	1
red-breasted nuthatch	0	0	0	0	1	1	1	1
red-winged blackbird	15	1	0	0	0	0	15	1
ruby-crowned kinglet	4	2	0	0	1	1	5	3
sage thrasher	0	0	1	1	0	0	1	1
savannah sparrow	1	1	0	0	53	9	54	10
Say's phoebe	1	1	2	2	0	0	3	3
song sparrow	0	0	3	3	0	0	3	3
spotted towhee	17	15	30	27	7	3	54	45
Townsend's solitaire	2	2	0	0	2	2	4	4
Townsend's warbler	0	0	1	1	0	0	1	1
unidentified bluebird	0	0	12	2	0	0	12	2
unidentified finch	0	0	7	1	8	1	15	2
unidentified flycatcher	0	0	1	1	0	0	1	1
unidentified passerine	6	2	4	2	12	1	22	5
unidentified swallow	1	1	0	0	0	0	1	1
Vaux's swift	0	0	2	1	0	0	2	1

[a] Includes all observations, including those recorded at distances greater than 800 m from the observer.

Table 3 (*continued*).

Species/Group	Summer		Fall		Spring		Grand Total	
	# obs.	# groups	# obs.	# groups	# obs.	# groups	# obs.	# groups
Passerines (*continued*)								
vesper sparrow	35	29	85	60	4	2	124	91
violet-green swallow	4	2	0	0	0	0	4	2
warbling vireo	0	0	5	4	0	0	5	4
western kingbird	1	1	4	3	0	0	5	4
western meadowlark	80	64	144	82	24	18	248	164
western tanager	0	0	2	2	0	0	2	2
western wood-pewee	0	0	4	4	0	0	4	4
white-crowned sparrow	2	1	0	0	32	5	34	6
yellow-headed blackbird	1	1	0	0	0	0	1	1
yellow-rumped warbler	98	14	1	1	17	7	116	22
Subtotal	1098	217	738	367	1021	160	2857	744
Other								
common nighthawk	0	0	15	8	0	0	15	8
downy woodpecker	1	1	0	0	0	0	1	1
Lewis's woodpecker	0	0	1	1	1	1	2	2
northern flicker	7	6	3	3	12	12	22	21
rufous hummingbird	2	2	2	2	0	0	4	4
Subtotal	10	9	21	14	13	13	44	36
Grand Total	1480	388	911	516	1209	306	3600	1210

[a] Includes all observations, including those recorded at distances greater than 800 m from the observer.

Table 4. Avian species observed within 800 m of the observer and estimated mean use (#/20-minute survey) on the Project site (March 21, 2002 - November 1, 2002).

Large Birds					
Spring		**Summer**		**Fall**	
Species/Group	Use	Species/Group	Use	Species/Group	Use
common raven	0.72	American kestrel	0.45	common raven	0.47
black-billed magpie	0.30	red-tailed hawk	0.37	red-tailed hawk	0.32
red-tailed hawk	0.26	turkey vulture	0.17	black-billed magpie	0.23
American kestrel	0.22	common nighthawk	0.15	northern harrier	0.17
Canada goose	0.15	common raven	0.11	rough-legged hawk	0.08
rough-legged hawk	0.13	black-billed magpie	0.08	American kestrel	0.06
mallard	0.10	killdeer	0.06	killdeer	0.04
California quail	0.08	mallard	0.02	sharp-shinned hawk	0.04
turkey vulture	0.08	golden eagle	0.02	California quail	0.04
bald eagle	0.06	California quail	0.02	blue grouse	0.04
killdeer	0.06	Canada goose	0.01	northern goshawk	0.02
prairie falcon	0.06	Wilson's phalarope	0.01	Cooper's hawk	0.01
sharp-shinned hawk	0.06	sharp-shinned hawk	0.01	great-horned owl	0.01
golden eagle	0.05	unidentified buteo	0.01	golden eagle	0.01
Cooper's hawk	0.05	ruffed grouse	0.01	turkey vulture	0.01
blue grouse	0.03			Cooper's hawk	0.05
herring gull	0.02			blue grouse	0.03
merlin	0.02			herring gull	0.02
common snipe	0.01			merlin	0.02
greater yellowlegs	0.01			common snipe	0.01
long-billed curlew	0.01			greater yellowlegs	0.01
northern harrier	0.01			long-billed curlew	0.01
osprey	0.01			northern harrier	0.01
unidentified accipiter	0.01			osprey	0.01
				unidentified accipiter	0.01

Table 4 (*continued*).

Small Birds					
Spring		**Summer**		**Fall**	
Species/Group	Use	Species/Group	Use	Species/Group	Use
American pipit	6.10	horned lark	1.61	American robin	3.08
yellow-rumped warbler	1.11	western meadowlark	1.47	horned lark	2.15
horned lark	0.95	vesper sparrow	0.86	cedar waxwing	1.11
western meadowlark	0.91	Brewer's blackbird	0.57	mountain bluebird	0.59
American robin	0.72	barn swallow	0.35	American pipit	0.58
European starling	0.60	chipping sparrow	0.35	savannah sparrow	0.54
Brewer's blackbird	0.47	spotted towhee	0.31	dark-eyed junco	0.36
vesper sparrow	0.40	cliff swallow	0.30	white-crowned sparrow	0.32
spotted towhee	0.19	European starling	0.29	European starling	0.26
red-winged blackbird	0.17	American robin	0.26	western meadowlark	0.24
mountain bluebird	0.15	brown-headed cowbird	0.18	yellow-rumped warbler	0.17
mountain chickadee	0.08	mountain bluebird	0.15	American goldfinch	0.16
purple finch	0.08	unidentified bluebird	0.13	unidentified passerine	0.12
northern flicker	0.08	unidentified finch	0.07	northern flicker	0.12
house finch	0.07	lazuli bunting	0.06	black-capped chickadee	0.11
unidentified passerine	0.07	cedar waxwing	0.05	chipping sparrow	0.10
chipping sparrow	0.05	eastern kingbird	0.05	Steller’s jay	0.08
cliff swallow	0.05	red crossbill	0.05	unidentified finch	0.08
golden-crowned kinglet	0.05	warbling vireo	0.05	spotted towhee	0.07
orange-crowned warbler	0.05	unidentified passerine	0.04	barn swallow	0.05
ruby-crowned kinglet	0.05	western kingbird	0.04	gray-crowned rosy finch	0.05
violet-green swallow	0.05	western wood-pewee	0.04	house finch	0.05
dark-eyed junco	0.03	mourning dove	0.04	mountain chickadee	0.04
Steller’s jay	0.02	song sparrow	0.03	vesper sparrow	0.04
Townsend's solitaire	0.02	northern flicker	0.03	mourning dove	0.03
white-crowned sparrow	0.02	Bullock's oriole	0.02	Brewer's sparrow	0.02
rufous hummingbird	0.02	Steller’s jay	0.02	Lincoln's sparrow	0.02
black-capped chickadee	0.01	Brewer's sparrow	0.02	northern shrike	0.02
Say's phoebe	0.01	Say's phoebe	0.02	Townsend's solitaire	0.02
savannah sparrow	0.01	Vaux's swift	0.02	Cassin's finch	0.01
unidentified swallow	0.01	western tanager	0.02	golden-crowned sparrow	0.01
western kingbird	0.01	rufous hummingbird	0.02	red-breasted nuthatch	0.01
yellow-headed blackbird	0.01	Lewis's woodpecker	0.01	ruby-crowned kinglet	0.01
downy woodpecker	0.01	American redstart	0.01	Lewis's woodpecker	0.01
mourning dove	0.01	black-capped chickadee	0.01		
		black-headed grosbeak	0.01		
		house finch	0.01		
		Macgillivray's warbler	0.01		
		orange-crowned warbler	0.01		
		pine grosbeak	0.01		
		sage thrasher	0.01		
		Townsend's warbler	0.01		
		unidentified flycatcher	0.01		
		yellow-rumped warbler	0.01		

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Frequency of Occurrence by Species

Frequency of occurrence measures how often a species is observed during 20-minute point count surveys (% of surveys) and is calculated as the percent of surveys in which a particular species was observed (Table 5). During the **spring**, common raven (31.7%), red-tailed hawk (22.9%), American kestrel (18.2%), black-billed magpie (14.1%) and rough-legged hawk (10.1%) were observed during more than ten percent of the surveys. Small bird species observed during more than ten percent of the surveys were western meadowlark (55.7%), horned lark (34.1%), vesper sparrow (28.4%), spotted towhee (15.9%), yellow-rumped warbler (15.9%), and American robin (12.5%).

During the **summer**, American kestrel had the highest frequency of occurrence (40.5%) for large birds, followed by red-tailed hawk (30.7%), turkey vulture (16.2%), common raven (8.3%) and black-billed magpie (7.1%). Small bird species observed during more than ten percent of the surveys were western meadowlark (64.4%), horned lark (53.0%), vesper sparrow (49.9%), spotted towhee (25.5%), chipping sparrow (15.4%), American robin (14.3%) and Brewer's blackbird (11.3%).

During the **fall**, red-tailed hawk (25.0%), common raven (21.6%), northern harrier (16.5%) and black-billed magpie (16.2%) were observed during more than ten percent of the surveys. Small bird species observed during more than ten percent of the surveys were horned lark (39.5%), western meadowlark (18.2%), mountain bluebird (12.2%), American robin (12.1%) and northern flicker (11.1%).

Avian Use by Seasons and Groups

Higher overall avian use occurred in the spring (15.14) and fall (12.20) compared to the summer use (9.16) (Table 6, Figures 5 and 6). The apparent higher use in spring was primarily due to observations of relatively large flocks of birds (i.e., 520 American pipit, 141 Canada geese).

Passerines

Passerines were the most abundant avian group observed during all seasons (Table 6). Passerines showed higher abundance in spring (12.48) and fall (10.40) compared to summer (7.55), for spring this was primarily due to one large flock of American pipits (Figure 5 and 6). Passerines made up approximately 82% or more of the avian use in all seasons. Passerines were observed during 97.0% of the surveys in the summer, 73.6% in the fall and 80.0% in the spring (Figure 7).

Raptors

Raptor use was second highest to passerines in the summer (1.03) and third to passerines and corvids, in the fall (0.73) and spring (1.01) (Figures 5 and 8). Raptor use was similar in all seasons with American kestrels, red-tailed hawks and northern harriers the most abundant species. In all seasons, raptors made up less than twelve percent of the avian use, and were observed in 59.1% of the summer surveys, 42.6% in the fall and 62.8% of the spring surveys (Figure 7). The high red-tailed hawk use is, in part, due to the proximity of two active nests near two of the observation stations (nests located within ~¼ mile of the station).

Corvids
The majority of corvid use occurred in the spring and fall, and consisted of several groups of common ravens (Figures 5, 7 and 8).

Waterfowl
The majority of waterfowl use occurred in the spring, and consisted primarily of several groups of Canada geese.

Spatial Use of the Project Area
No large differences are apparent other than the higher use at station B from the large flock of American pipits observed (Figure 9). Mean use for the three stations to the west of the project area (A, B and K) is higher, but again this is mainly due to the large flock of American pipits (Figure 10). Passerine use by station shows the same pattern as all birds (Figures 9 and 10).

Raptor use by station ranged from 0.5 to 1.5, indicating relatively similar spatial use of the project area (Figure 11). Overall raptor use for the three stations to the west was slightly less than the use for the east stations (Figure 10). Raptor use for the east stations was very similar to the west stations in the spring and summer, with higher use in the fall. Higher buteo and northern harrier use for the east stations appears to drive this difference (Figure 12).

Flight paths of raptors and other species of interest and perched raptor locations observed during fixed-point and in-transit surveys were summarized to look for spatial patterns of use (Figures 13-19). The two most common raptor species, red-tailed hawk and American kestrel, differed in how they used the project area. High red-tailed hawk use in the eastern portion of the study area appears to be associated with the two active nests in that area. Red-tailed hawks were observed typically flying parallel and off the west edge of the ridges. American kestrels were observed throughout the study area with no obvious patterns or concentrations of use.

Flight Height Characteristics
At least 20 groups of flying birds were observed for seven species during the fixed-point surveys. Of these species, American robin (79.2%), red-tailed hawk (52.1%), common raven (48.4%) and American kestrel (42.9%) were most often observed within the RSA. Common passerines including horned lark (8.1%) and western meadowlark (4.3%) were not often observed within the RSA (Table 7).

Overall, 27.9% of the birds observed were recorded within the defined RSA, 64.9% were below the RSA and 7.1% were flying above the RSA (Table 8). As a group, raptors had the third highest percentage of observations within the RSA (40.9%) behind other birds and shorebirds. Raptor subgroups observed above this mean percent within the RSA included buteos (50.0%), accipiters (41.2%) and small falcons (41.4%; mostly American kestrel). Eagles were relatively evenly split between the three categories. Waterfowl and waterbirds were not typically observed within the RSA. Doves, passerines, upland gamebirds and waterbirds were typically observed below the RSA, while waterfowl were typically observed above the RSA.

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Table 5. Avian species observed within 800 m of observer and estimated frequency of occurrence for large and small birds on the Project Site (March 21, 2002 – July 11, 2002).

Large Birds					
Spring		**Summer**		**Fall**	
Species/Group	% freq.	Species/Group	% freq.	Species/Group	% freq.
common raven	31.7	American kestrel	40.5	red-tailed hawk	25.0
red-tailed hawk	22.9	red-tailed hawk	30.7	common raven	21.6
American kestrel	18.2	turkey vulture	16.2	northern harrier	16.5
black-billed magpie	14.1	common raven	8.3	black-billed magpie	16.2
rough-legged hawk	10.1	black-billed magpie	7.1	rough-legged hawk	6.8
turkey vulture	8.0	common nighthawk	6.1	American kestrel	4.0
prairie falcon	5.7	killdeer	2.0	sharp-shinned hawk	4.0
golden eagle	5.0	Canada goose	1.1	killdeer	2.0
killdeer	4.5	mallard	1.0	northern goshawk	2.0
bald eagle	4.5	Wilson's phalarope	1.0	California quail	2.0
Cooper's hawk	4.5	golden eagle	1.0	Cooper's hawk	1.0
sharp-shinned hawk	4.5	sharp-shinned hawk	1.0	great-horned owl	1.0
blue grouse	3.4	unidentified buteo	1.0	golden eagle	1.0
Canada goose	2.3	California quail	1.0	turkey vulture	1.0
mallard	2.3	ruffed grouse	1.0	blue grouse	1.0
merlin	2.3				
California quail	2.3				
herring gull	1.1				
common snipe	1.1				
greater yellowlegs	1.1				
long-billed curlew	1.1				
northern harrier	1.1				
osprey	1.1				
unidentified accipiter	1.1				

Table 5 (*continued*).

Small Birds					
Summer		**Fall**		**Spring**	
Species/Group	% Freq	Species/Group	% Freq	Species/Group	% Freq
western meadowlark	55.7	western meadowlark	64.4	horned lark	39.5
horned lark	34.1	horned lark	53.0	western meadowlark	18.2
vesper sparrow	28.4	vesper sparrow	49.9	mountain bluebird	12.2
spotted towhee	15.9	spotted towhee	25.5	American robin	12.1
yellow-rumped warbler	15.9	chipping sparrow	15.4	northern flicker	11.1
American robin	12.5	American robin	14.3	savannah sparrow	8.1
Brewer's blackbird	6.8	Brewer's blackbird	11.3	yellow-rumped	7.1
mountain bluebird	6.8	mountain bluebird	7.2	Steller's jay	6.1
northern flicker	6.8	brown-headed cowbird	7.1	American goldfinch	5.1
European starling	4.5	barn swallow	5.1	white-crowned	5.1
house finch	3.4	cliff swallow	5.1	dark-eyed junco	4.0
mountain chickadee	3.4	lazuli bunting	5.1	mourning dove	3.4
dark-eyed junco	2.7	eastern kingbird	4.0	black-capped	3.0
Steller's jay	2.3	warbling vireo	4.0	barn swallow	2.0
orange-crowned	2.3	cedar waxwing	3.0	chipping sparrow	2.0
ruby-crowned kinglet	2.3	song sparrow	3.0	European starling	2.0
Townsend's solitaire	2.3	western kingbird	3.0	house finch	2.0
unidentified passerine	2.3	western wood-pewee	3.0	northern shrike	2.0
violet-green swallow	2.3	northern flicker	3.0	spotted towhee	2.0
rufous hummingbird	2.3	mourning dove	3.0	Townsend's solitaire	2.0
American pipit	1.1	Bullock's oriole	2.1	vesper sparrow	2.0
black-capped chickadee	1.1	unidentified bluebird	2.1	American pipit	1.0
chipping sparrow	1.1	European starling	2.0	Brewer's sparrow	1.0
Cliff swallow	1.1	Say's phoebe	2.0	Cassin's finch	1.0
golden-crowned kinglet	1.1	unidentified passerine	2.0	cedar waxwing	1.0
purple finch	1.1	rufous hummingbird	2.0	gray-crowned rosy	1.0
red-winged blackbird	1.1	Lewis's woodpecker	1.1	golden-crowned	1.0
Say's phoebe	1.1	Steller's jay	1.0	Lincoln's sparrow	1.0
savannah sparrow	1.1	American redstart	1.0	mountain chickadee	1.0
unidentified swallow	1.1	black-capped chickadee	1.0	red-breasted nuthatch	1.0
white-crowned sparrow	1.1	black-headed grosbeak	1.0	ruby-crowned kinglet	1.0
western kingbird	1.1	Brewer's sparrow	1.0	unidentified finch	1.0
yellow-headed	1.1	house finch	1.0	unidentified	1.0
downy woodpecker	1.1	Macgillivray's warbler	1.0	Lewis's woodpecker	1.0
mourning dove	1.1	orange-crowned warbler	1.0		
		pine grosbeak	1.0		
		red crossbill	1.0		
		sage thrasher	1.0		
		Townsend's warbler	1.0		
		unidentified finch	1.0		
		unidentified flycatcher	1.0		
		Vaux's swift	1.0		
		western tanager	1.0		
		yellow-rumped warbler	1.0		

Table 6. Mean use, percent composition and percent frequency of occurrence for avian groups by season for the Kittitas Valley Project site.

Species/Group	Mean Use (#/20 minute survey)			Group Composition (%)			% Frequency		
	Spring	Summer	Fall	Spring	Summer	Fall	Spring	Summer	Fall
Waterfowl	0.25	0.03	0.00	1.7	0.3	0.0	4.5	2.1	0.0
Waterbirds	0.02	0.00	0.00	0.2	0.0	0.0	1.1	0.0	0.0
Shorebirds	0.09	0.07	0.04	0.6	0.8	0.3	6.8	2.0	2.0
Accipiters	0.11	0.01	0.07	0.8	0.1	0.6	10.2	1.0	6.1
Buteos	0.39	0.38	0.40	2.6	4.1	3.3	28.7	31.7	28.0
Northern Harriers	0.01	0.00	0.17	0.1	0.0	1.4	1.1	0.0	16.5
Eagles	0.11	0.02	0.01	0.7	0.2	0.1	8.4	1.0	1.0
Large Falcons	0.06	0.00	0.00	0.4	0.0	0.0	5.7	0.0	0.0
Small Falcons	0.24	0.45	0.06	1.6	4.9	0.5	19.3	40.5	4.0
Other – Raptor	0.09	0.17	0.02	0.6	1.9	0.2	8.0	16.2	2.0
Raptors Subtotal	1.01	1.03	0.73	6.7	11.2	6.0	62.8	59.1	47.6
Corvids	1.04	0.21	0.78	6.9	2.2	6.4	38.5	16.4	39.8
Passerines	12.48	7.55	10.40	82.5	82.3	85.3	80.0	97.0	73.6
Other Birds	0.11	0.21	0.13	0.8	2.3	1.1	10.2	11.2	12.1
Gamebirds	0.11	0.03	0.08	0.8	0.3	0.7	5.7	1.0	3.0
Doves/Pigeons	0.01	0.04	0.03	0.1	0.4	0.3	1.1	3.0	3.4
Subtotal	15.14	9.16	12.20						

Table 7. Flight height characteristics by species observed during fixed-point surveys.

Species/Group	# Groups Flying	# Birds Flying	% Birds Flying	Collision Risk Height (25-100 m AGL)		
				Below	Within	Above
gray-crowned rosy finch	1	5	100.0	0.0	100.0	0.0
long-billed curlew	1	1	100.0	0.0	100.0	0.0
unidentified swallow	1	1	100.0	0.0	100.0	0.0
unidentified accipiter	1	1	50.0	0.0	100.0	0.0
Townsend's solitaire	1	1	25.0	0.0	100.0	0.0
cedar waxwing	2	112	97.4	1.8	98.2	0.0
common nighthawk	7	14	93.3	0.0	85.7	14.3
American robin	23	322	81.9	14.3	79.2	6.5
violet-green swallow	2	4	100.0	25.0	75.0	0.0
killdeer	2	4	26.7	25.0	75.0	0.0
unidentified buteo	3	3	100.0	0.0	66.7	33.3
barn swallow	6	34	85.0	41.2	58.8	0.0
American goldfinch	3	14	87.5	42.9	57.1	0.0
red-tailed hawk	69	73	76.0	28.8	52.1	19.2
Lewis's woodpecker	2	2	100.0	50.0	50.0	0.0
northern goshawk	2	2	100.0	0.0	50.0	50.0
unidentified eagle	2	2	100.0	0.0	50.0	50.0
Cooper's hawk	4	4	57.1	50.0	50.0	0.0
northern flicker	4	4	18.2	50.0	50.0	0.0
common raven	51	91	74.6	40.7	48.4	11.0
American kestrel	53	56	78.9	51.8	42.9	5.4
golden eagle	5	5	71.4	0.0	40.0	60.0
bald eagle	6	6	85.7	50.0	33.3	16.7
sharp-shinned hawk	10	10	100.0	40.0	30.0	30.0
rough-legged hawk	10	10	62.5	70.0	30.0	0.0
northern harrier	17	17	94.4	70.6	29.4	0.0
mourning dove	7	8	100.0	75.0	25.0	0.0
prairie falcon	4	4	80.0	75.0	25.0	0.0
mountain bluebird	16	56	67.5	75.0	25.0	0.0
cliff swallow	6	31	91.2	77.4	22.6	0.0
turkey vulture	24	24	92.3	41.7	20.8	37.5
Steller’s jay	6	8	66.7	87.5	12.5	0.0
American pipit	3	594	100.0	90.4	9.6	0.0
horned lark	59	258	57.5	91.9	8.1	0.0
Brewer's blackbird	14	65	67.7	93.8	6.2	0.0
unidentified passerine	4	17	77.3	94.1	5.9	0.0
western meadowlark	16	23	9.3	95.7	4.3	0.0
black-billed magpie	21	31	54.4	96.8	3.2	0.0
European starling	6	81	75.0	98.8	1.2	0.0
American redstart	1	1	100.0	100.0	0.0	0.0
black-headed grosbeak	1	1	100.0	100.0	0.0	0.0
blue-winged teal	1	3	100.0	100.0	0.0	0.0
greater yellowlegs	1	1	100.0	100.0	0.0	0.0

Table 7 (*continued*).

Species/Group	# Groups Flying	# Birds Flying	% Birds Flying	Collision Risk Height (25-100 m AGL)		
				Below	Within	Above
herring gull	1	2	100.0	100.0	0.0	0.0
merlin	2	2	100.0	50.0	0.0	50.0
purple finch	1	7	100.0	100.0	0.0	0.0
red-breasted nuthatch	1	1	100.0	100.0	0.0	0.0
red-winged blackbird	1	15	100.0	100.0	0.0	0.0
rufous hummingbird	4	4	100.0	100.0	0.0	0.0
unidentified bluebird	2	12	100.0	100.0	0.0	0.0
unidentified falcon	1	1	100.0	100.0	0.0	0.0
unidentified finch	2	15	100.0	100.0	0.0	0.0
unidentified flycatcher	1	1	100.0	100.0	0.0	0.0
Vaux's swift	1	2	100.0	100.0	0.0	0.0
yellow-headed blackbird	1	1	100.0	100.0	0.0	0.0
yellow-rumped warbler	10	100	86.2	100.0	0.0	0.0
Canada goose	1	100	70.4	0.0	0.0	100.0
blue grouse	1	4	57.1	100.0	0.0	0.0
dark-eyed junco	2	25	65.8	100.0	0.0	0.0
mountain chickadee	2	6	54.5	100.0	0.0	0.0
savannah sparrow	5	29	53.7	100.0	0.0	0.0
house finch	3	6	50.0	100.0	0.0	0.0
black-capped chickadee	1	6	46.2	100.0	0.0	0.0
chipping sparrow	3	19	40.4	100.0	0.0	0.0
Say's phoebe	1	1	33.3	100.0	0.0	0.0
eastern kingbird	1	1	20.0	100.0	0.0	0.0
western kingbird	1	1	20.0	100.0	0.0	0.0
white-crowned sparrow	1	4	11.8	100.0	0.0	0.0
mallard	1	3	10.3	100.0	0.0	0.0
vesper sparrow	6	7	5.6	100.0	0.0	0.0
brown-headed cowbird	1	1	5.6	100.0	0.0	0.0
spotted towhee	3	3	5.6	100.0	0.0	0.0
Brewer's sparrow	0	0	0.0	N/A	N/A	N/A
Bullock's oriole	0	0	0.0	N/A	N/A	N/A
California quail	0	0	0.0	N/A	N/A	N/A
Cassin's finch	0	0	0.0	N/A	N/A	N/A
common snipe	0	0	0.0	N/A	N/A	N/A
downy woodpecker	0	0	0.0	N/A	N/A	N/A
golden-crowned kinglet	0	0	0.0	N/A	N/A	N/A
golden-crowned sparrow	0	0	0.0	N/A	N/A	N/A
great-horned owl	0	0	0.0	N/A	N/A	N/A
lazuli bunting	0	0	0.0	N/A	N/A	N/A
Lincoln's sparrow	0	0	0.0	N/A	N/A	N/A
Macgillivray's warbler	0	0	0.0	N/A	N/A	N/A
northern shrike	0	0	0.0	N/A	N/A	N/A
orange-crowned warbler	0	0	0.0	N/A	N/A	N/A
osprey	0	0	0.0	N/A	N/A	N/A
pine grosbeak	0	0	0.0	N/A	N/A	N/A
red crossbill	0	0	0.0	N/A	N/A	N/A
ruby-crowned kinglet	0	0	0.0	N/A	N/A	N/A
ruffed grouse	0	0	0.0	N/A	N/A	N/A

Table 7 (*continued*).

Species/Group	# Groups Flying	# Birds Flying	% Birds Flying	Collision Risk Height (25-100 m AGL)		
				Below	Within	Above
sage thrasher	0	0	0.0	N/A	N/A	N/A
song sparrow	0	0	0.0	N/A	N/A	N/A
Townsend's warbler	0	0	0.0	N/A	N/A	N/A
unidentified duck	0	0	0.0	N/A	N/A	N/A
warbling vireo	0	0	0.0	N/A	N/A	N/A
western tanager	0	0	0.0	N/A	N/A	N/A
western wood-pewee	0	0	0.0	N/A	N/A	N/A
Wilson's phalarope	0	0	0.0	N/A	N/A	N/A
Subtotal	539	2383	66.2	64.9	27.9	7.1

Table 8. Flight height characteristics by avian group during fixed-point surveys.

Group	# Groups Flying	# Birds Flying	% Birds Flying	Collision Risk Height (25-100 m AGL)		
				Below	Within	Above
Waterbirds	1	2	100.0	100.0	0.0	0.0
Waterfowl	3	106	58.6	5.7	0.0	94.3
Shorebirds	4	6	31.6	33.3	66.7	0.0
Accipiters	17	17	81.0	35.3	41.2	23.5
Buteos	82	86	74.8	32.6	50.0	17.4
Northern Harriers	17	17	94.4	70.6	29.4	0.0
Eagles	13	13	81.3	23.1	38.5	38.5
Small Falcons	55	58	79.5	51.7	41.4	6.9
Large Falcons	4	4	80.0	75.0	25.0	0.0
Unid. Falcons	1	1	100.0	100.0	0.0	0.0
Other Raptors	24	24	85.7	41.7	20.8	37.5
All Raptors	213	220	79.4	42.3	40.9	16.8
Corvids	78	130	68.1	56.9	35.4	7.7
Upland Gamebirds	1	4	19.0	100.0	0.0	0.0
Doves	7	8	100.0	75.0	25.0	0.0
Passerines	215	1883	65.9	71.9	27.0	1.1
Other	17	24	54.5	29.2	62.5	8.3
Subtotal	539	2383	66.2	64.9	27.9	7.1

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Exposure Indices

Relative exposure indices (use multiplied by proportion of observations where bird flew within the rotor swept area) were calculated by species (Table 9). This index is only based on flight height observations and relative abundance and does not account for other possible factors such as foraging behavior. Small bird species with the three highest exposure indexes were American robin, cedar waxwing and American pipit. Due to high use estimates, horned lark had the highest exposure index at the Stateline and Foote Creek Rim wind plants, and has been the most commonly observed fatality. The large bird species with the highest exposure index was common raven, followed by red-tailed hawk, and American kestrel. Mortality studies at other wind projects have indicated that although ravens are often observed at wind projects within the zone of risk, they appear to be less susceptible to collision with wind turbines than other similar size birds (e.g., raptors, waterfowl).

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Table 9. Mean exposure indices calculated by species observed during fixed-point surveys at the Project site.

Species/Group	Overall Mean Use	% Flying	% Flying within RSA	Exposure Index
American robin	1.377	81.9	79.2	0.893
cedar waxwing	0.402	97.4	98.2	0.385
American pipit	2.077	100.0	9.6	0.199
common raven	0.421	74.6	48.4	0.152
red-tailed hawk	0.319	76.0	52.1	0.126
American kestrel	0.242	78.9	42.9	0.082
horned lark	1.595	57.5	8.1	0.075
barn swallow	0.140	85.0	58.8	0.070
mountain bluebird	0.301	67.5	25.0	0.051
common nighthawk	0.052	93.3	85.7	0.042
American goldfinch	0.056	87.5	57.1	0.028
cliff swallow	0.119	91.2	22.6	0.024
gray-crowned rosy finch	0.017	100.0	100.0	0.017
northern harrier	0.061	94.4	29.4	0.017
turkey vulture	0.087	92.3	20.8	0.017
Brewer's blackbird	0.342	67.7	6.2	0.014
rough-legged hawk	0.068	62.5	30.0	0.013
killdeer	0.052	26.7	75.0	0.010
sharp-shinned hawk	0.035	100.0	30.0	0.010
violet-green swallow	0.014	100.0	75.0	0.010
golden eagle	0.026	71.4	40.0	0.007
mourning dove	0.029	100.0	25.0	0.007
northern flicker	0.077	18.2	50.0	0.007
bald eagle	0.017	85.7	33.3	0.005
Cooper's hawk	0.017	57.1	50.0	0.005
Lewis's woodpecker	0.007	100.0	50.0	0.004
black-billed magpie	0.201	54.4	3.2	0.004
western meadowlark	0.873	9.3	4.3	0.004
European starling	0.378	75.0	1.2	0.003
unidentified passerine	0.077	77.3	5.9	0.003
Steller’s jay	0.042	66.7	12.5	0.003
prairie falcon	0.017	80.0	25.0	0.003
Townsend's solitaire	0.014	25.0	100.0	0.003
northern goshawk	0.007	100.0	50.0	0.003
long-billed curlew	0.003	100.0	100.0	0.003
unidentified swallow	0.003	100.0	100.0	0.003
unidentified buteo	0.003	100.0	66.7	0.002
unidentified accipiter	0.003	50.0	100.0	0.002
blue-winged teal	N/A	100.0	0.0	0.000
unidentified duck	N/A	0.0	N/A	0.000
unidentified eagle	N/A	100.0	50.0	0.000
unidentified falcon	N/A	100.0	0.0	0.000
vesper sparrow	0.435	5.6	0.0	0.000
yellow-rumped warbler	0.406	86.2	0.0	0.000
spotted towhee	0.190	5.6	0.0	0.000

Table 9 (*continued*).

Species/Group	Overall Mean Use	% Flying	% Flying within RSA	Exposure Index
savannah sparrow	0.189	53.7	0.0	0.000
chipping sparrow	0.169	40.4	0.0	0.000
Dark-eyed junco	0.134	65.8	0.0	0.000
white-crowned sparrow	0.119	11.8	0.0	0.000
brown-headed cowbird	0.063	5.6	0.0	0.000
red-winged blackbird	0.052	100.0	0.0	0.000
unidentified finch	0.052	100.0	0.0	0.000
Canada goose	0.049	70.4	0.0	0.000
California quail	0.045	0.0	N/A	0.000
black-capped chickadee	0.045	46.2	0.0	0.000
unidentified bluebird	0.045	100.0	0.0	0.000
house finch	0.042	50.0	0.0	0.000
mallard	0.038	10.3	0.0	0.000
mountain chickadee	0.038	54.5	0.0	0.000
purple finch	0.024	100.0	0.0	0.000
blue grouse	0.024	57.1	0.0	0.000
lazuli bunting	0.021	0.0	N/A	0.000
orange-crowned warbler	0.017	0.0	N/A	0.000
red crossbill	0.017	0.0	N/A	0.000
ruby-crowned kinglet	0.017	0.0	N/A	0.000
warbling vireo	0.017	0.0	N/A	0.000
eastern kingbird	0.017	20.0	0.0	0.000
western kingbird	0.017	20.0	0.0	0.000
Brewer's sparrow	0.014	0.0	N/A	0.000
golden-crowned kinglet	0.014	0.0	N/A	0.000
western wood-pewee	0.014	0.0	N/A	0.000
rufous hummingbird	0.014	100.0	0.0	0.000
song sparrow	0.010	0.0	N/A	0.000
Say's phoebe	0.010	33.3	0.0	0.000
Bullock's oriole	0.007	0.0	N/A	0.000
Lincoln's sparrow	0.007	0.0	N/A	0.000
northern shrike	0.007	0.0	N/A	0.000
western tanager	0.007	0.0	N/A	0.000
Vaux's swift	0.007	100.0	0.0	0.000
herring gull	0.007	100.0	0.0	0.000
merlin	0.007	100.0	0.0	0.000
Cassin's finch	0.003	0.0	N/A	0.000
Macgillivray's warbler	0.003	0.0	N/A	0.000
Townsend's warbler	0.003	0.0	N/A	0.000

Table 9 (*continued*).

Species/Group	Overall Mean Use	% Flying	% Flying within RSA	Exposure Index
Wilson's phalarope	0.003	0.0	N/A	0.000
common snipe	0.003	0.0	N/A	0.000
downy woodpecker	0.003	0.0	N/A	0.000
golden-crowned sparrow	0.003	0.0	N/A	0.000
great-horned owl	0.003	0.0	N/A	0.000
osprey	0.003	0.0	N/A	0.000
pine grosbeak	0.003	0.0	N/A	0.000
ruffed grouse	0.003	0.0	N/A	0.000
sage thrasher	0.003	0.0	N/A	0.000
American redstart	0.003	100.0	0.0	0.000
black-headed grosbeak	0.003	100.0	0.0	0.000
greater yellowlegs	0.003	100.0	0.0	0.000
red-breasted nuthatch	0.003	100.0	0.0	0.000
unidentified flycatcher	0.003	100.0	0.0	0.000
yellow-headed blackbird	0.003	100.0	0.0	0.000

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In-transit Survey Data and Non-avian Observations

Avian Observations During In-transit Surveys

Observations of state or federally listed species, raptors, and other species of interest observed while in-transit between surveys points were recorded (Table 10). The most abundant avian species recorded (# of observations) were turkey vulture (34), followed by American kestrel (30), and red-tailed hawk (30). Six species observed during in-transit surveys were not detected during the fixed-point surveys including gray partridge, greater white-fronted goose, white-breasted nuthatch, spotted sandpiper, green-winged teal, and great blue heron (Table 10).

Mammals

Mule deer (*Odocoileus hemionus*) were commonly observed throughout the project area (Table 11). Observations of 10-20 individuals were commonly observed in the spring, with 3-7 individuals observed throughout the summer. Observations in the fall were typically small groups of does. Elk (*Cervis elaphus*) were observed in some large groups (15-25) individuals near the northern points (A, E, F and G) during the spring surveys, with few observations made in the summer and fall periods. American pika (*Ochotona princeps*) has been heard regularly on the large talus slope near station A. Coyotes and coyote sign were occasionally observed within the project site.

Reptiles and Amphibians

Reptiles observed during the field studies included rubber boa (*Charina bottae*), Great Basin gopher snake (*Pituophis catenifer deserticola*), Northern Pacific rattlesnake (*Crotalus viridis oreganus*), and short-horned lizard (*Phrynosoma douglassii*). One amphibian chorus was heard during the spring at a distance of over 300 meters, and is likely one of the true frog species (e.g., Cascade frog, *Rana cascadae*). Spotted frogs (*Rana pretiosa*) and red-legged frogs (*Rana aurora*) have auditory calls that typically don't carry over 30 meters, and the northern leopard frog (*Rana pipiens*) is not known to occur in Kittitas county.

Table 10. Summary of observations of state or federal-listed species, raptors, and other species observed during in-transit surveys that were not observed during the fixed-point surveys.

Species	# Obs.	# Groups
turkey vulture	34	11
American kestrel	30	27
red-tailed hawk	30	24
gray partridge	15	1
greater white-fronted goose	10	1
golden eagle	6	6
Cooper's hawk	4	4
rough-legged hawk	3	3
Brewer's sparrow	2	1
sharp-shinned hawk	2	2
northern harrier	2	2
prairie falcon	2	2
unidentified accipiter	1	1
white-breasted nuthatch	1	1
spotted sandpiper	1	1
American green-winged teal	1	1
osprey	1	1
great blue heron	1	1
Avian Subtotal	146	90

Table 11. Summary of observations and mean use of big game species observed during the fixed-point surveys.

Species	Station	# Obs.	# Groups	Mean Use[a]
Mule deer	A	37	4	1.48
	B	50	7	2.08
	C	44	7	1.69
	D	0	0	0.00
	E	7	1	0.27
	F	4	1	0.15
	G	38	5	1.46
	H	15	2	0.58
	I	0	0	0.00
	J	33	4	1.32
	K	121	10	5.04
Subtotal		349	41	1.28
Elk	A	0	0	0.00
	B	66	4	2.75
	C	0	0	0.00
	D	0	0	0.00
	E	0	0	0.00
	F	8	1	0.31
	G	6	2	0.23
	H	0	0	0.00
	I	0	0	0.00
	J	0	0	0.00
	K	7	1	0.29
Subtotal		87	8	0.33
Grand Total		436	49	1.61

[a] # observations/20-minute survey

Raptor Nest Survey

A total of approximately 70 square miles was covered by helicopter during the raptor nest surveys. A total of six red-tailed hawk nests and nine inactive raptor nests were found (Table 12). Five of the six red-tailed hawk nests produced a total of 9 young for an average of 1.5 young per nest. One previously active red-tailed hawk nest was not found during the second visit. The nest may have been blown out of the tree during a high wind event. Of the 15 nests found during surveys, six were in mature cottonwoods, six were in coniferous trees, one was in a shrub, one was on a cliff, and one was located on a powerline pole. Much of the survey area was dominated by coniferous forest. Due to the presence of thick foliage and interlocking crowns of coniferous forests, detection of raptor nests in these areas was difficult from the helicopter.

Active raptor nest density was 0.085 nest/mi^2. This index of raptor nest density falls below the range of other wind projects that have been studied, however, detection of nests was difficult throughout much of the area due to the presence of large stands of coniferous forest. For example, the nest density in a 10-mile buffer surrounding the Foote Creek Rim wind project in Wyoming is 0.19 nest/mi^2 (Johnson *et al.* 2000b). Nest density within a 2-mile buffer around the Stateline wind project in Oregon and Washington is 0.20 nest/mi^2 (URS and WEST 2001).

Table 12. A summary of raptor nests found at the Project site.

Species	# Young	Date Nest Was Found	Nest Status	Revisit Nest Status	Nest Substrate
red-tailed hawk	2	5/6/2002	Young Present	Young present	Cottonwood
red-tailed hawk	1	5/6/2002	Young Present	Young present	Cottonwood
red-tailed hawk	2	5/6/2002	Bird Incubating	Young present	Conifer
red-tailed hawk	0	5/6/2002	Young Present	Not Found[a]	Conifer
red-tailed hawk	3	5/7/2002	Bird Incubating	Young present	Conifer
red-tailed hawk	1	5/8/2002	Young Present	Young present	Powerline
Unknown		5/8/2002	Inactive	Inactive	Cliff
Unknown		5/6/2002	Inactive	Not Found[1]	Conifer
Unknown		5/6/2002	Inactive	Inactive	Cottonwood
Unknown		5/6/2002	Inactive	Inactive	Conifer
Unknown		5/6/2002	Inactive	Inactive	Cottonwood
Unknown		5/6/2002	Inactive	Inactive	Conifer
Unknown		5/6/2002	Inactive	Inactive	Cottonwood
Unknown		5/6/2002	Inactive	Inactive	Cottonwood
Unknown		5/7/2002	Inactive	Inactive	Shrub
Unknown		5/7/2002	Inactive	Inactive	Conifer

[a] The nest may have been blown out of the tree by the wind.

Wintering Bald Eagle Surveys

Nine surveys were conducted along the four winter bald eagle survey routes established for the Project between February 15 and April 11, 2002. Counts of bald eagles (repeat counts are not included) observed during each surveys were tallied by route (Table 13). The maximum number of bald eagles observed during one survey day was 12 (March 12, 2002), with one of the twelve observations an unidentified eagle (either golden or bald eagle). On average, 5.6 bald eagles were observed per survey (including the unidentified eagle). Approximately 58 percent of the observations were adults, 30 percent were subadults (1-3 years of age), 10 percent were juveniles (<1 year old), and 1 observation unidentified as to age class (Table 13).

Route 4, the southernmost route (Figure 3), had the highest bald eagle use (0.33/survey mile, [0.12, 0.61][1]), followed by Route 3 (0.20/survey mile, [0.10, 0.48]), Route 1 (0.15/survey mile, [0.06, 0.29]) and Route 2 (0.04/survey mile, [0.04, 0.09]). The mean observed at routes 4 and 3 were significantly higher than the mean for Route 2 ($p<0.10$). No night roost sites were identified in the upland areas. One potential night roost was identified along the river, although no large groups (> 3) of eagles were ever observed at one location, including this roost.

Several of the eagle observations on Route 3 were near cattle pasture/calving area along Smithson Road (Figure 9). The survey route nearest the proposed development is Route 2, which had the lowest bald eagle use. Three unique observations (an additional likely repeat observation of an adult is mapped as well) were recorded along this route. One adult bald eagle was observed flying just south of the intersection of Hayward and Bettas Road (February 15) approximately 200 m above ground level. One adult eagle was observed perched in a conifer tree to the west of Highway 97 (February 18), 1.3 miles north of Bettas Road. Another adult eagle was observed perched in a lone tree one mile north of the intersection of Highway 10 and Highway 97 near the crest of the ridge above the Yakima River (April 3). The eagle apparently had been feeding on a dead cow, which was observed in close proximity to the tree.

Other Avian Observations

Other raptors observed during the survey included red-tailed hawks and one gyrfalcon observed on Route 3 on March 27, 2002. In addition, one loggerhead shrike and 2 unidentified shrikes (northern or loggerhead) were observed along Route 2. Eight elk were observed along Route 3 on March 21, 2002.

[1] lower and upper limit of a 95% confidence interval

Table 13. Results of bald eagle surveys in the vicinity of the Project site.

	Number of Eagle Observations								
	Route					Age Classification			
Date	**1**	**2**	**3**	**4**	**Total**	**AD[a]**	**SA[b]**	**JUV[c]**	**UNK[d]**
02/15/2002	0	1	6	0	7	3	3	1	0
02/18/2002	2	1	1	2	6	3	2	1	0
02/26/2002	4	0	0	3	7	5	2	0	0
03/04/2002	5	0	3	0	8	5	3	0	0
03/12/2002	2	0	3	7	12	8	3	0	1
03/21/2002	1	0	0	5	6	3	1	2	0
03/27/2002	0	0	0	2	2	0	1	1	0
04/03/2002	0	1	0	1	2	2	0	0	0
04/11/2002	0	0	0	0	0	0	0	0	0
Total	14	3	13	20	50	29	15	5	1
#/survey	1.56	0.33	1.44	2.22	5.56				
#/mile/survey	0.15	0.04	0.20	0.33					
95% CI (LL[g])	0.06	0.02	0.10	0.12					
95% CI (UL[h])	0.29	0.09	0.48	0.61					

[a] Adults (>3 years old)
[b] Subadults (1-3 years old)
[c] Juveniles (<1 year old)
[d] Unknown
[e] Lower limit of a 95% confidence interval
[f] Upper limit of a 95% confidence interval

Sensitive, Threatened, and Endangered Species

A list of state and federally protected species that potentially occur within the project area was generated to assess the potential for impacts to these species (Table 14). Species were identified based on the WDFW Species of Concern list, which includes state listed endangered, threatened, sensitive and candidate species; and the USFWS, Central Washington Ecological Services office list of Endangered, Threatened, Proposed, Candidate and Species of Concern for Kittitas County.

Information about occurrence of these species in the project area is based largely on the following resources:

- Habitat mapping and predicted distribution from Washington State Gap Analysis Program (GAP) project,
- WDFW Priority Habitats and Species (PHS) records for the project area and a buffer or approximately 5 miles,
- Breeding Bird Atlas of Washington State, Location Data and Predicted Distributions (Smith *et al.* 1997)
- Baseline field studies being conducted on site (this report), and
- Other published literature where available.

Of the special status species potentially occurring in the project, five were observed on site during surveys (Table 15). In addition, five State Monitor status species were observed. Fatality references in the table are based on Erickson *et al.* (2001) and Erickson *et al.* (2002).

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Table 14. A list of state and federally protected species potentially occurring within the Project area.

Species	State Status	Federal Status	Occurrence	Documentation
Birds				
Northern goshawk (*Accipiter gentilis*)	C	SC	Documented breeder north and west of project; numerous PHS records from mountains north and west of project [T19N, R16E, Secs 21, 24, 28; T20N, R17E, Secs 6, 11, 14, 15]; coniferous and aspen forests	PHS 1989-1996
Golden eagle (*Aquila chrysaetos*)	C	-	Documented on site (6 observations in spring/ summer); No nest found	Erickson *et al.* 2002
Bald eagle (*Haliaeetus leucocephalus*)	T	T	Documented winter resident	Erickson *et al.* 2002
Merlin *(Falco columbarius*)	C	-	Possible breeder; one old PHS record from project area [T19N, R17E, Sec 8]	PHS 1981
Peregrine falcon (*Falco peregrinus*)	S	SC	Unlikely; most records in western WA; possible transient or migrant	Smith *et al.* 1997
Ferruginous hawk (*Buteo regalis*)	T	SC	Unlikely; most records in eastern WA in steppe zones; possible rare transient or migrant	Smith *et al.* 1997
Harlequin duck (*Histrionicus histrionicus*)	-	SC	Unlikely, occurs in fast flowing mountain rivers and streams; recorded in Kittitas Co. west of project	Smith *et al.* 1997
Spotted owl (*Strix occidentalis*)	E	T	Documented site centers north and west of project; PHS - T20N, R17E; T20N, R16E; T20N, R18E	PHS no date
Flammulated owl (*Otus flammeolus*)	C	-	Possible in forests nearby; unlikely in steppe habitats; recorded in Kittitas Co.	recorded in Kittitas Co.
Burrowing owl (*Athene cunicularia*)	-	SC	Unlikely due to species distribution in WA; possible in extreme eastern Kittitas Co.	Smith *et al.* 1997
Black tern (*Chlidonias niger*)	-	SC	Unlikely due to species distribution in WA; no records from Kittitas Co.	Smith *et al.* 1997
Pileated woodpecker (*Dryocopus pileatus*)	C	-	Possible in forests nearby, unlikely on-site; recorded in Kittitas Co.	Smith *et al.* 1997
Black-backed woodpecker (*Picoides arcticus*)	C	-	Possible in forests/burns nearby, unlikely on-site; recorded in Kittitas Co.	Smith *et al.* 1997
White-headed woodpecker (*Picoides albolarvatus*)	C	-	Possible in forests nearby, unlikely on-site; recorded in Kittitas Co.	Smith *et al.* 1997
Lewis' woodpecker (*Melanerpes lewis*)	C	-	Possible in forests nearby, unlikely on-site; recorded in Kittitas Co.	Smith *et al.* 1997

Table 14 (*continued*).

Species	State Status	Federal Status	Occurrence	Documentation
Birds (*continued*)				
Vaux's swift (*Chaetura vauxi*)	C	-	Possible breeder; varied habitats below alpine habitats and excluding extensive steppe; recorded in Kittitas Co.	Smith *et al.* 1997
Olive-sided flycatcher (*Contopus borealis*)	-	SC	Possible breeder in forested habitats; recorded in Kittitas Co.	Smith *et al.* 1997
Willow flycatcher (*Empidonax traillii*)	-	SC	Possible breeder; moist forested areas, riparian habitats; recorded in Kittitas Co.	Smith *et al.* 1997
Sage thrasher (*Oreoscoptes montanus*)	C	-	Possible breeder; sagebrush shrublands; records from southern and eastern Kittitas Co.	Smith *et al.* 1997
Loggerhead shrike (*Lanius ludovicianus*)	C	SC	Possible breeder; shrub steppe, shrublands, agriculture, mixed habitats; recorded in Kittitas Co.	Smith *et al.* 1997
Sage sparrow (*Amphispiza belli*)	C	-	Possible breeder; sagebrush shrublands; records from southern and eastern Kittitas Co.	Smith *et al.* 1997
Mammals				
Gray wolf (*Canis lupus*)	E	E	Unlikely; unknown status in Washington but suitable habitat in North Kittitas Co., nearest PHS records from 1992 and 1993 from L.T. Murray State Wildlife Recreation Area southwest of I-90 [T19N, R16E, Sec 16, 34]	WDFW web page; WA GAP Analysis Project[a]; PHS 1992-1993
Grizzly bear (*Ursus arctos*)	E	T	Unlikely; unknown status in Washington but suitable habitat in North Kittitas Co., one PHS record north of project [T20N, R17E, Sec 15]	WA GAP Analysis Project; PHS 1993
Wolverine (*Gulo gulo*)	C	SC	Unlikely; generally associated with northern coniferous forest; suitable habitat in western Kittitas Co.; PHS record from northeast of project [T20N, R18E, Sec 29]	WA GAP Analysis Project; PHS 1991
Fisher (*Martes pennanti*)	E	SC	Unlikely resident; associated with mature coniferous forests; suitable habitat in western Kittitas Co.	WA GAP Analysis Project
Western gray squirrel (*Sciurus griseus*)	T	SC	Unlikely resident; suitable habitat in northeast Kittitas Co.; PHS records from south of I-90 in L.T. Murray State Wildlife Recreation Area [T19N, R16E, Sec 35]	WA GAP Analysis Project; PHS 1997, 2000

Table 14 (*continued*).

Species	State Status	Federal Status	Occurrence	Documentation
Mammals (*continued*)				
White-tailed jackrabbit (*Lepus townsendii*)	C	-	Possible resident; grassland/ shrub habitats; recorded in northeast Kittitas Co.	WA GAP Analysis Project
Black-tailed jackrabbit (*Lepus californicus*)	C	-	Possible resident; grassland/shrub habitats; records from southeast Kittitas Co.	WA GAP Analysis Project
Townsend's big-eared bat (*Coryhorhinus townsendii*)	C	SC	Unlikely resident; varied habitats but tends to prefer forested and riparian areas, hibernates in caves; no records from Kittitas Co.	WA GAP Analysis Project
Long-legged myotis (*Myotis evotis*)	-	SC	Unlikely due to habitat; coniferous and mixed forests, riparian areas; roosts caves, crevices, buildings, mines; potential habitat in western and northern Kittitas Co.	WA GAP Analysis Project
Long-eared myotis (*Myotis volans*)	-	SC	Unlikely due to habitat; primarily forested habitats and edges, juniper woodland, mixed conifers, riparian areas; roosts snags, crevices, bridges, buildings, mines; potential habitat in western and northern Kittitas Co.	WA GAP Analysis Project
Fringed myotis (*Myotis thysanodes*)	-	SC	Possible; varied habitats, forested or riparian habitats, shrublands; roosts buildings, trees; hibernates in mines and caves; potential habitat throughout eastern two-thirds of Kittitas Co.	WA GAP Analysis Project
Small-footed myotis (*Myotis ciliolabrum*)	-	SC	Possible; varied arid grasslands/ shrublands, mixed forests; roosts in crevices, cliffs; hibernates in caves, mines; records from eastern Kittias Co.	WA GAP Analysis Project
Yuma myotis (*Myotis yumanensis*)	-	SC	Possible resident; closely associated with water in varied habitats; no records from Kittitas Co.	WA GAP Analysis Project
Merriam's shrew (*Sorex merriami*)	C	-	Possible resident; sagebrush shrub and mesic grass/shrub habitats; records from southeast Kittitas Co.	WA GAP Analysis Project

Table 14 (*continued*).

Species	State Status	Federal Status	Occurrence	Documentation
Reptiles and Amphibians (*continued*)				
Striped whipsnake (*Masticophis taeniatus*)	C	-	Possible resident; occurs in grasslands, sagebrush, dry rocky canyons; records from eastern Kittitas Co.	WA GAP Analysis Project; Nussbaum *et al.* 1983
Sharptail snake (*Contia tenuis)*	C	-	Likely resident; found in stable talus slopes, damp/moist habitats; forest edges; records from Kittitas Co.	WA GAP Analysis Project; Nussbaum *et al.* 1983
Larch mountain salamander (*Plethodon larselli*)	S	SC	Unlikely resident; found in lava talus slopes; recorded in western Kittitas Co.	WA GAP Analysis Project
Western toad (*Bufo boreas*)	C	SC	Possible resident; occurs in spring pools, ponds, lake shallows, slow moving streams and uplands nearby; documented in Kittitas Co.	WA GAP Analysis Project; Nussbaum *et al.* 1983
Columbia spotted frog (*Rana luteiventris*)	C	SC	Likely resident; occurs in wetlands, marshy edges of ponds/lakes; documented throughout Kittitas Co.; two PHS records north of project T20N, R17E, Sec 22	WA GAP Analysis Project; Nussbaum *et al.* 1983; PHS 1992-1993
Cascades frog (*Rana cascadae*)	-	SC	Unlikely due to habitat; occurs in wet mountain meadows with ponds and potholes; records in western and northern Kittitas Co.	WA GAP Analysis Project; Nussbaum *et al.* 1983;
Red-legged frog (*Rana aurora*)	-	SC	Unlikely due to species range; moist forests, streams, and ponds; recorded in western Kittitas Co.	WA GAP Analysis Project; Nussbaum *et al.* 1983
Tailed frog (*Ascaphus truei*)	-	SC	Unlikely due to habitat; fast flowing permanent streams in forested areas; records in western and northern Kittitas Co.	WA GAP Analysis Project; Nussbaum *et al.* 1983;
Fish				
Chinook salmon (*Oncorhynchus tshawytscha*)	C	T	Yakima River and major tributaries; PHS record from Swauk Creek T20N, R17E and Yakima River T20N R16E	PHS 1997
Steelhead (*Oncorhynchus mykiss*)	C	T	Yakima River and major tributaries; PHS record from Swauk Creek T20N, R17E and Yakima River T20N R16E	PHS 1997
Bull trout (*Salvelinus confluentus*)	C	T	Yakima River and major tributaries; PHS records from Teanaway River and Yakima River T20N R16E	PHS 1997

Species	State Status	Federal Status	Occurrence	Documentation
Fish (*continued*)				
Westslope cutthroat (*Oncorhynchus clarki lewisi*)	-	SC	Yakima River and major tributaries	no records located
Interior Redband trout (*Oncorhynchus mykiss gairdneri*)	-	SC	Yakima River and major tributaries	no records located
Mountain sucker (*Catostomus platyrhynchus*)	C	-	Yakima River and major tributaries; PHS record from Teanaway River north west of project [T20N, R16E, Sec 25]	PHS 1994
Pacific lamprey (*Lampetra tridentate*)	-	SC	Yakima River and major tributaries	no records located

E=Endangered, T=Threatened, C=Candidate, S = Sensitive, SC=Species of Concern

[a] GAP Analysis Program (GAP). The Washington State Gap Analysis Project is based on a two primary data sources: vegetation types (actual vegetation, vegetation zone, and ecoregion) and species distribution. The two data sources are combined to map the predicted distribution of vertebrate species. More information about the Washington Gap Analysis Project can be found on the WDFW web page: www.wa.gov/wdfw/wlm/gap/dataprod.htm

Table 15. A summary of State and Federal sensitive species and State Monitor species observed during 2002 wildlife surveys at the Project site.

Species	Description
bald eagle	***State and Federally Threatened*** – Average of 5.6 bald eagles per winter driving survey, with a maximum survey day count of 12 (3/11/02). Winter use relatively high compared to other wind projects, but mostly along Yakima river. No bald eagle fatalities documented at any U.S. wind project.
golden eagle	***State Candidate*** –Six observations during fixed-point surveys, six during in-transit surveys. Much lower use at KVP (0.02-0.05 per 20-minute survey) compared to Foote Creek Rim (WY) (0.2 – 0.3 per 20-minute survey) and Altamont Pass (CA) (0.2-0.3 per 20-minute survey). One golden eagle was killed during two years of monitoring at the Foote Creek Rim Phase I and II facility.
merlin	***State Candidate*** – Two observations during spring and summer surveys. Occasional merlin observations have been recorded at several wind projects. No fatalities have been reported at U.S. wind projects.
Lewis's woodpecker	***State Candidate*** – One observation. Observed as a fatality at Vansycle in 1999.
loggerhead shrike	***State Candidate and Federal Species of Concern*** – Not observed during spring and summer avian use surveys. One observation during winter bald eagle surveys as well as two unidentified shrike observations. One fatality observed each at Altamont Pass and Tehachapi Pass (CA).
long-billed curlew	***State Monitor***[b] – One observation. Also observed occasionally at Stateline. No fatalities documented at any U.S. wind projects.
turkey vulture	***State Monitor*** – Twenty-five observations during fixed-point surveys, 31 during in-transit surveys. A few fatalities observed at U.S. wind projects, but apparently not very susceptible to collision due to foraging/scavenging behavior.
prairie falcon	***State Monitor*** – Five observations during the spring. Observed occasionally at most wind projects. One fatality documented at Foote Creek Rim (WY), two at Altamont Pass (CA), one at Montezuma Hills and one at Tehachapi Pass (CA).
gyrfalcon	***State Monitor*** – One observation during winter bald eagle surveys. No fatalities documented at U.S. wind projects.
osprey	***State Monitor*** – One observation during fixed-point surveys, one in-transit. No fatalities documented at U.S. wind projects.

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POTENTIAL IMPACTS

Birds

Risk of Turbine Collision

Raptors

Based on the level of raptor use within the Project, raptor mortality is expected to be slightly higher compared to other wind projects with similar turbine types. American kestrels and red-tailed hawks account for much of the raptor use at the site, and are expected to be the species with the highest mortality. The potential exists for other raptor species to collide with turbines, including northern harrier, rough-legged hawk, bald eagle, and turkey vulture. However, the mortality risk associated with these species is expected to be lower than the risk for American kestrel and red-tailed hawk. Turkey vultures appear less susceptible to collision that most other raptors (Orloff and Flannery 1992). Very few northern harrier fatalities and no rough-legged hawk or bald eagle fatalities have been observed at wind projects to date. Golden eagle use of the site is low relative to other wind sites and the mortality risk for golden eagles is also expected to be very low.

As a group, raptor use ranged from 0.73 per 20-minute survey in the fall to 1.03 in the summer, with an overall average of approximately 0.9. For comparison, raptor use at three wind projects studied with the same methods[2] was lower. Raptor use at the Vansycle wind project was approximately 0.36 raptors per 20-minute survey; at the Buffalo Ridge wind project raptor use was approximately 0.49 raptors per 20-minute survey; and at the Foote Creek Rim wind project raptor use was approximately 0.73 raptors per 20-minute survey. Overall raptor use as well as habitat is most similar to the Foote Creek Rim, Wyoming wind project.

Raptor mortality at other newer generation wind projects has been very low. The estimate of raptor mortality at the Foote Creek Rim wind project in Wyoming is the highest observed and is 0.03 raptors per turbine per year based on a three-year study of 69 turbines (Young *et al.* 2002). No raptor mortality was observed at the Vansycle wind project in Oregon during a one-year study; and 1 raptor was recorded over a four-year study at the Buffalo Ridge wind project (Erickson *et al.* 2001).

[2] Fixed-point surveys were conducted following the same methods at all three wind projects but had variable survey duration. The calculated use at these wind projects was standardized to 20-minute duration surveys under the assumption that raptor observations were uniform across time for each survey period.

Considering these mortality results as well as raptor use estimates at these wind projects, it is estimated that potential raptor mortality at the proposed project would be approximately 25% greater than that of the Foote Creek Rim Wind project (or approximately 0.038 raptors per turbine per year). Using these raptor mortality rates, a range of approximately 0 to 4 raptor fatalities per year at the Project may be expected if 120 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 project after construction, turbine size and other site specific and/or weather variables. It should also be noted that the majority of raptor fatalities are expected to be American kestrels and red-tailed hawks, two very common raptor species. No significant population level impacts to raptor species is anticipated.

Passerines

Passerines have been the most abundant avian fatality at other wind projects studied (see Johnson *et al.* 2000a, Johnson *et al.* 2002, Young *et al.* 2002, Erickson *et al.* 2000, Erickson *et al.* 2001), 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 on-site, it is expected passerines will make up the largest proportion of fatalities. Species most common to the study area will likely be most at risk, including western meadowlark, vesper sparrow and horned lark. Horned larks have been the most commonly observed fatality at several wind projects, including Vansycle and Foote Creek Rim (Erickson *et al.* 2000, Young *et al.* 2002). A few large flocks of birds such as American pipits were observed, but given their infrequent use, mortality would be expected to be low. Nocturnal migrating species may also be affected, but it is not expected that they would be found in large numbers based on data collected at other wind plants [i.e., no large mortality events documented (Erickson *et al.* 2001)]. Estimates of the percentage of bird fatalities that are migrants have ranged from approximately 30% at the Wisconsin wind plant to 60% at Buffalo Ridge, Minnesota (Erickson et al. 2001). Estimates of total bird mortality at other wind plants have ranged from approximately 0.6 birds per turbine per year at the Vansycle wind plant in Oregon to 2.8 birds per turbine per year at the Buffalo Ridge wind plant in Minnesota (Erickson *et al.* 2001). Provided 120 turbines are constructed at the proposed project, approximately 50-300 birds may be killed at the wind plant annually. The number of these that would be expected to be migrants would vary from approximately 30-180 birds. Actual levels of mortality that could result from the project may vary from these predictions. No significant population level impacts to passerine species is anticipated.

Carcass search studies at the Foote Creek Rim Wind Plant, Wyoming, have found avian casualties associated with guyed met towers. Based on searches of five permanent met towers at Foote Creek Rim over a three-year period, it was estimated that these towers resulted in approximately 8.1 avian casualties per tower per year (Young *et al.* 2002). The vast majority of these avian casualties were passerines. The nine permanent met towers proposed for the project would be expected to result in collision deaths for passerines at the site, although the use of bird flight diverter's on guy wires should reduce the risk of collision.

Waterfowl

Some waterfowl mortality has been documented at other wind plants (Erickson *et al.* 2001). However, studies at Foote Creek Rim, Vansycle, and Buffalo Ridge have not documented mortality of Canada geese, one the most common waterfowl species observed flying over the Project study area. Because of the low use of the site by waterfowl, little mortality would be expected from the project.

Other Groups/Species

Other avian groups (e.g., upland game birds, doves, shorebirds) occur in relatively low numbers within the study area and mortality would be expected to be low. Other species only observed during migration may be at risk; however, mortality would be expected to be low given the low use estimates by these species and groups.

Displacement

Most studies of displacement effects have been conducted in Europe, and most of the impacts have involved wetland habitats and groups of birds not common on this Project, including waterfowl, shorebirds and waders (Larsen and Madsen 2000, Pederson and Poulsen 1991, Vauk 1990, Winkelman 1989, Winkelman 1990, Winkelman 1992). Most disturbance has involved feeding, resting, and migrating birds in these groups (Crockford 1992). European studies of disturbance to breeding birds suggest negligible impacts and disturbance effects were documented during only one study (Pedersen and Poulsen 1991). For most avian groups or species or at other European wind plants, no displacement effects on breeding birds were observed (Karlsson 1983, Phillips 1994, Winkelman 1989, Winkelman 1990).

Avian displacement associated with wind power development has not received as much attention in the U.S. At a large wind plant on Buffalo Ridge, Minnesota, abundance of shorebirds, waterfowl, upland gamebirds, woodpeckers, and several groups of passerines was found to be significantly lower at survey plots with turbines than at plots without turbines. There were fewer differences in avian use as a function of distance from turbine, however, suggesting that the area of reduced use was limited primarily to those areas within 100 m of the turbines (Johnson *et al.* 2000a). A sizeable portion of these displacement effects are likely due to the direct loss of habitat near the turbine for the turbine pad and associated roads. These results are similar to those of Osborn *et al.* (1998) who reported that birds at Buffalo Ridge avoided flying in areas with turbines. Also at Buffalo Ridge, Leddy *et al.* (1999) found that densities of male songbirds were significantly lower in Conservation Reserve Program (CRP) grasslands containing turbines than in CRP grasslands without turbines. Grasslands without turbines as well as portions of grasslands located at least 180 m from turbines had bird densities four times greater than grasslands located near turbines. Reduced avian use near turbines was attributed to avoidance of turbine noise and maintenance activities and reduced habitat effectiveness due to the presence of access roads and large gravel pads surrounding turbines (Leddy 1996, Johnson *et al.* 2000a).

Construction and operation of the Foote Creek Rim wind plant did not appear to cause reduced use of the wind plant and adjacent areas by most avian groups, including raptors, corvids, or passerines (Johnson *et al.* 2000b). Some reduced use of the areas near turbines was apparent for

a local population of mountain plovers. A pair of golden eagles successfully nested 0.5 miles from the wind plant after one phase was operational and another phase was under construction.

Avoidance of windplants by raptors has not been reported at any U.S. windplants, and anecdotal evidence indicates that raptor use of the Altamont Pass, California wind resource area (WRA) may have increased since installation of wind turbines (American Wind Energy Association 1995). Although displacement of birds by wind plants is not desirable, especially where important habitats may be limited, if other suitable habitats are available, one potential benefit of avian avoidance of turbines is the reduced potential for collision mortality to occur (Crockford 1992).

Based on the available information, it is probable that some displacement effects may occur to the grassland/shrub-steppe avian species occupying the study area. The extent of these effects and their significance is unknown and hard to predict but could range from none to several hundred feet, resulting in a low level of impacts.

Operation of the proposed project would not affect raptor nests unless there were displacement effects that caused raptors to not return to the nests close to the project site. Impacts would be considered very low, given the low density observed in close proximity to the turbines, and the species involved (red-tailed hawk).

Big Game

The project area is within a transition zone between the dry grassland/shrub steppe basin towards the Columbia River and the wetter coniferous forest of the east slope of the Cascade Mountains. Portions of the proposed wind plant are within habitats designated by WDFW as winter range for mule deer and elk, although the human development that has already occurred in the project area has likely reduced the quality of the winter range. In addition, portions of the wind plant are near elk calving areas and elk migration routes. Wintering elk forage on native grass species such as Sandberg's bluegrass, which greens up with fall and winter rains, while mule deer likely utilize more shrub species in the project area. Wind-blown slopes and ridges remain snow-free most of the year. West and south-facing slopes green up earlier and provide accessible nutritious forage during the harsh winter months. Elk travel through the area between seasons and calving occurs at Lookout Mountain during the spring.

Although this area has been designated as elk and deer winter range, significant amounts of human activity has already occurred within the project area. Highway 97, which accommodates an average of 2,200 vehicles a day, runs through the project area, with turbine strings on both sides of the road. Bettas and Hayward roads each serve approximately 20 vehicles per day. Several of the turbine strings and associated roads will follow existing roads which are currently used to access private property in the project area.

The WDFW has expressed some concern over the potential effects of wind project development on wintering big game. Winter is a crucial period of time for the survival of many big game species. Deer, for example, cannot maintain body condition during the winter because of

reduced forage availability combined with the increased costs of thermogenesis (Reeve and Lindzey 1991). In other words, as deer expend more energy than they take in, body condition gradually declines throughout the winter (Short 1981). Unnecessary energy expenditures may increase the rate at which body condition declines, and the energy balance determining whether a deer will survive the winter is thought to be relatively narrow, especially for fawns (Wood 1998). Overwinter fawn survival may decrease in response to human activity or other disturbances (Stephenson *et al.* 1996). Roads and energy development may also fragment otherwise continuous patches of suitable habitat, effectively decreasing the amount of winter range available for big game. Fragmentation of habitat may also limit the ability of big game populations to move throughout the winter range as conditions change, causing big game to utilize less suitable habitat (Brown 1992).

Two published studies of big game winter use may be relevant to the development of wind turbines and wintering deer and elk (Rost and Bailey 1979, Van Dyke and Klein 1996). Van Dyke and Klein (1996) documented elk movements through the use of radio telemetry before, during and after the installation of a single oil well within an area used year round by elk. Drilling activities during their study ceased by November 15, however, maintenance activities continued throughout the year. Elk showed no shifts in home range between the pre and post drilling periods, however, elk shifted core use areas out of view from the drill pad during the drilling and post drilling periods. Elk also increased the intensity of use in core areas after drilling and slightly reduced the total amount of range used. It was not clear if the avoidance of the well site during the post drilling period was related to maintenance activities or to the use of a new road by hunters and recreationalists. The authors concluded that if drilling activities occupy a relatively small amount of elk home ranges, that elk are able to compensate by shifting areas of use within home ranges.

While several authors have documented elk avoiding roads within forested environments during the summer, the effects of roads and associated human activity on wintering elk and mule deer have not been well documented. Rost and Bailey (1979) found that wintering mule deer and elk avoided areas within 200 m of roads in eastern portions of their Colorado study area, where presumably greater amounts of winter habitat were present. Road avoidance was greater where roads were more traveled. Only mule deer showed a clear avoidance of roads in the western portion of their study area, where winter range was assumed to be more limiting. Mule deer also showed greater avoidance of roads in shrub habitats versus more forested areas. The authors concluded that impacts of roads depended on the availability of suitable winter range away from roads, as well as the amount of traffic associated with roads.

There is little information regarding wind project effects on big game. At the Foote Creek Rim wind project in Wyoming, pronghorn observed during raptor use surveys were recorded year round (Johnson *et al.* 2000b). The mean number of pronghorn observed at the six survey points was 1.07 prior to construction of the wind plant and 1.59 and 1.14/survey the two years immediately following construction, indicating no reduction in use of the immediate area. Mule deer and elk also occurred at Foote Creek Rim, but their numbers were so low that meaningful data on wind plant avoidance could not be collected.

The elk and mule deer on site primarily occupy the grassland/shrub-steppe habitats, springs, and riparian corridors. During the construction period, it is expected that elk and mule deer will be displaced from the site due to the influx of humans and heavy construction equipment and associated disturbance. Construction related disturbance and displacement is expected to be limited to the construction period time frame. Most construction will take place during the summer months, minimizing construction disturbance to wintering big game. Following completion of the wind plant, the disturbance levels from construction equipment and humans will diminish and the primary disturbances will be associated with operations and maintenance personnel, occasionally vehicular traffic, and the presence of the turbines and other facilities.

Due to the lack of knowledge regarding the potential impacts of energy development on big game, it is difficult to predict with certainty the effects of the proposed wind project on mule deer and elk. Van Dyke and Klein (1996) showed wintering elk shifted use of core areas out of view of human related activities associated with an oil well and access road. Most turbines and roads in the project area will be located on ridges and will be visible over a fairly large area. Where wind turbines will be constructed in elk wintering areas, elk may concentrate use away from the wind development during construction. While human related activity at wind turbines during regular maintenance will be less than during the construction period, it is not known if human activity associated with regular maintenance activity will exceed tolerance thresholds for wintering elk. If tolerance thresholds during regular maintenance activities are exceeded, elk are likely to permanently utilize areas away from the wind development. Given the amount of residential development and the existing roads and disturbance within the project area (approximately half are existing roads that will be improved), and including Highway 97 which runs through the middle of the project area, disturbance levels after operation begins will not be greatly increased.

The proposed wind facility occurs approximately 3 miles southeast of mapped elk calving areas. Assuming calving areas are mapped accurately, the proposed project is not likely to impact the mapped calving area.

Bats

The potential for bats to occur is based on key habitat elements such as food sources, water, and roost sites. Potential roost structures such as trees are abundant along the riparian areas within the project area. Ponds in the project area such as those located along the Dry Creek drainage may be used as foraging and watering areas. Little is known about bat species distribution, but several species of bats could occur in the project area based on the Washington GAP project and inventories conducted on the Handford Site, Arid Lands Ecology Reserve (ALE) located in Benton County to the southeast (Table 16).

Bat research at other wind plants indicates that migratory bat species are at some risk of collision with wind turbines, mostly during the fall migration season. It is likely that some bat fatalities would occur at the proposed project site. Most bat fatalities found at wind plants have been tree-dwelling bats, with hoary and silver-haired bats being the most prevalent fatalities. Both hoary bats and silver-haired bats may use the forested habitats near the project site and may migrate through the Project.

At the Buffalo Ridge Wind Plant, Minnesota, based on a 2-year study, bat mortality was estimated to be 2.05 bats per turbine per year (Johnson *et al.*, 2000b). At the Foote Creek Rim Wind Plant, based on 2 years of study, bat mortality was estimated at 1.51 bats per turbine per year (Young *et al.*, 2001). At the Vansycle Ridge Wind Plant in Oregon, bat mortality was estimated at 0.74 bats per turbine for the first year of operation (Erickson *et al.*, 2000).

Although potential future mortality of migratory bats is difficult to predict, an estimate can be calculated based on levels of mortality documented at other wind plants. Using the estimates from other wind plants, full buildout of the proposed project could result in approximately 240 bat fatalities per year. Actual levels of mortality are unknown and could be higher or lower depending on regional migratory patterns of bats, patterns of local movements through the area, and the response of bats to turbines, individually and collectively. The significance of this impact is hard to predict since there is very little information available regarding bat populations. Studies do suggest resident bats do not appear to be significantly impacted by wind turbines (Johnson et al. 2002, Gruver 2002), since almost all mortality is observed during the fall migration period. Furthermore, hoary bat, which is expected to be the most common fatality, is one of the most widely distributed bats in North America. Preconstruction studies to predict impacts to bats may be relatively ineffective, because current state-of-the-art technology for studying bats does not appear to be highly effective for documenting migrant bat use of a site (Johnson et al. 2002).

Table 16. Bat species of potential occurrence in the Project area.

Common Name and Scientific Name	Typical Habitat	Expected Occurrence in Project Area	Occurrence Documentation
California bat *Myotis californicus*	Generally found in open habitats where it forages along tree edges, riparian areas, open water; roosts in cliffs, caves, trees	Possible; documented on ALE	WA GAP Analysis Project[a] England, 2000; Fitzner and Gray, 1991
small-footed myotis *Myotis ciliolabrum*	Varied arid grass/shrublands, ponderosa pine and mixed forests; roosts in crevices and cliffs; hibernates in caves, mines	Possibe; documented on ALE	WA GAP Analysis Project; England ,2000; West *et al.*, 1998, 1999
long-eared myotis *Myotis evotis*	Primarily forested habitats and edges, juniper woodland, mixed conifers, riparian areas; roosts snags, crevices, bridges, buildings, mines	Unlikely due to habitat; not documented on ALE	WA GAP Analysis Project; England, 2000; TNC, 1999
little brown bat *Myotis lucifugus*	Closely associated with water; riparian corridors; roosts buildings, caves, hollow trees; hibernates in caves	Possible; documented on ALE	WA GAP Analysis Project; England, 2000; West *et al.*, 1998, 1999
fringed myotis *Myotis thysanodes*	Primarily forested or riparian habitats; roosts buildings, trees; hibernates in mines and caves	Possible in suitable habitat; not documented on ALE	WA GAP Analysis Project; England, 2000; TNC, 1999
long-legged myotis *Myotis volans*	Coniferous and mixed forests, riparian areas; roosts caves, crevices, buildings, mines	Possible in suitable habitat; documented on ALE	WA GAP Analysis Project; England, 2000; itzner and Gray, 1991
yuma myotis *Myotis ymanensis*	Closely associated with water; varied habitats: riparian, shrublands, forests woodlands; roosts in mines, buildings, caves, bridges	Possible; documented on ALE	WA GAP Analysis Project; England, 2000; West *et al.*, 1998, 1999
hoary bat *Lasiurus cinereus*	Forested habitats, closely associated with trees; roosts in trees; migratory species	Possible in suitable habitat; probable migrant; documented on ALE	WA GAP Analysis Project; England, 2000; West *et al.*, 1998, 1999
silver-haired bat *Lasionycteris noctivagans*	Forested habitats; generally coniferous forests; roosts under bark; believed to be a migratory species	Possible in suitable habitat; probable migrant; documented on ALE	WA GAP Analysis Project; England, 2000; West *et al.*, 1998, 1999
western pipistrelle *Pipistrellus hesperus*	Primarily desert lowlands; desert shrublands; canyons; roosts under rocks, crevices and possibly in sagebrush	Possible; documented on ALE	WA GAP Analysis Project; England, 2000; West *et al.*, 1998, 1999

Table 16 (*continued)*.

Common Name and Scientific Name	Typical Habitat	Expected Occurrence in Project Area	Occurrence Documentation
big brown bat *Eptesicus fuscus*	Generally deciduous forests; buildings; roosts in buildings, trees, crevices; hibernates in caves, mines	Possible; documented on ALE	WA GAP Analysis Project; England, 2000; West *et al.*, 1998, 1999
spotted bat *Euderma maculatum*	Varied habitat—pine forests to desert scrub with nearby cliffs; roosts in crevices, cliff faces	Unlikely due to rarity; not documented on ALE	WA GAP Analysis Project; England, 2000; TNC, 1999
Townsend's big-eared bat *Corynorhinus townsendii*	Varied habitats—forests to desert scrub; roosts in buildings, caves, mines, bridges; hibernates in caves	Possible in suitable habitat; not documented on ALE	WA GAP Analysis Project; England, 2000; TNC, 1999
Pallid Bat *Antrozous pallidus*	Generally occurs in arid regions, desert scrub habitats; roosts in cliff faces, caves, mines, buildings	Unlikely due to lack of suitable habitat; documented on ALE	WA GAP Analysis Project; England, 2000; West *et al.*, 1998, 1999

[a] GAP Analysis Program (GAP). The Washington State Gap Analysis Project is based on a two primary data sources: vegetation types (actual vegetation, vegetation zone, and ecoregion) and species distribution. The two data sources are combined to map the predicted distribution of vertebrate species. More information about the Washington Gap Analysis Project can be found on the WDFW web page: www.wa.gov/wdfw/wlm/gap/dataprod.htm

Other Mammals

Other mammals that likely exist within the project site include, badger, coyote, pocket gopher, bobcat, American pika, and other small mammals such as rabbits, voles and mice. Construction of the wind project may affect these mammals on site through loss of habitat and direct mortality of individuals occurring in construction zones. Excavation for turbine pads, roads, or other wind project facilities could kill individuals in underground burrows. Road and facility construction will result in loss of foraging and breeding habitat for small mammals. Ground-dwelling mammals will lose the use of the permanently impacted areas; however, they are expected to repopulate the temporarily impacted areas. Some small mammal fatalities can be expected from vehicle activity. Impacts are expected to be very low and not significant.

Reptiles and Amphibians

Construction of the wind project may affect reptiles and amphibians on site through loss of habitat and direct mortality of individuals occurring in construction zones. The level of mortality associated with construction would be based on the abundance of the species on site. Some mortality may be expected as common reptiles such as short-horned lizards and yellow-bellied racers often retreat to underground burrows for cover or during periods of winter dormancy. Excavation for turbine pads, roads, or other wind project facilities could kill individuals in

underground burrows. While above ground, yellow-bellied racers and other snakes are generally mobile enough to escape construction equipment, however, short-horned lizards do not move fast over long distances and rely heavily on camouflage for predator avoidance. Some individual lizard fatalities can be expected from vehicle activity. Impacts are expected to be very low and not significant.

Fish

Facilities for the project are located more than ¼ mile from the Yakima River, and the small tributaries such as Dry Creek apparently do not support fish habitat (PHS data). No impacts to fish are likely to occur as a result of the project.

Threatened and Endangered Species Impacts

The project area occurs within the potential range of 21 bird, 14 mammal, eight reptile and amphibian and six fish species which are of interest based on designations made under the State of Washington or Federal Endangered Species Act, or which are species of concern because of declining numbers (Table 13). Several of these species are unlikely to occur within the project area due to limited habitat or occurrence on the periphery of the known species distributions. These species are not likely to occur within the project area and the Project should have no effect on them.

Birds

Bald eagle and northern spotted owl are the only bird species listed under the Endangered Species Act that may potentially occur within the project area. Bald eagle is documented wintering, but not breeding within the project area. While bald eagle fatalities have not been documented at other wind sites, bald eagle winter use is higher surrounding the project area than at other wind sites. Few bald eagles were observed within the project area during surveys, rather most bald eagles were observed along the Yakima River and in areas where cattle are pastured. Although the risk is low, the potential exists for bald eagle fatalities at the proposed wind project.

Northern spotted owl site centers and associated territory buffers are mapped by the WDFW approximately ½ mile to the north of the project area. Spotted owls occur almost exclusively within forested environments. The project area is located within the transition zone between forest and grassland. No nesting habitat is present within the project area. Although possible, it is unlikely that spotted owls will hunt within or disperse through the project area. The project is not expected to impact the northern spotted owl.

Northern goshawks are documented as breeding within the National Forest a few miles from the Project. Although the project area does not contain suitable nesting habitat for northern goshawks, the species may occasionally occur within the project area while hunting or migrating. This is expected to be a very rare occurrence, as no goshawks were observed during surveys within the project area. The proposed project is not expected to affect northern goshawks.

One historic record of a breeding merlin is present within the project area, and two merlins were observed during avian use surveys. No merlin fatalities have been documented at other wind plants and considering the low use of the project area by merlins, the proposed project is not expected to impact merlins in the area.

Mammals

The project occurs within the potential range of several species of federally and state protected mammals, which are unlikely to occur within the project area due to habitat constraints and/or uncertain population status in Washington. These species include gray wolf, grizzly bear, wolverine, fisher, western gray squirrel, Townsend's big-eared bat, long-legged myotis, and long-eared myotis. These species are not expected to occur within the project area and no impacts to these species are likely to occur.

Both the white-tailed and black-tailed jackrabbits have been documented within Kittitas County, and suitable habitat for these species is present in the project area. Assuming these species are present in the project area, the potential exists for individuals to be killed by vehicles on roads, and some suitable habitat for these species will be lost to turbine pads and road construction. Limits on vehicle speeds within the Project will minimize the potential for roadkills, and the permanent loss of suitable habitat is relatively small. Overall, impacts to these species should be minimal.

Suitable habitat for three bat species, which are listed as federal species of concern, is present within the project area: fringed myotis, small-footed myotis and Yuma myotis. However, only general descriptions of habitat requirements and potential distribution are available for the three species. Very little is known concerning the ecology of the three species, making it even more difficult to accurately predict potential impacts to these species. To date, we are unaware of any documented fatalities of these species at wind projects within the U.S.

Merriam's shrew has been documented within Kittitas County, and suitable habitat for the species occurs within the project area. Assuming the species is present within the project area, the construction of turbine pads and roads, and vehicle traffic has the potential to crush individuals within burrows or moving about above ground. Overall, total impacts to habitat are small and no significant impacts to the species are expected to occur as a result of this project.

Reptiles and Amphibians

There is very little suitable habitat for amphibians or aquatic reptiles (e.g., turtles) in the Project area. Two species of sensitive-status amphibians have been documented near the Project by the WDFW (PHS database), including tailed frog and Columbia spotted frog, however, these species are not expected to be impacted by the project.

Fish

Eight species of state and federally protected fish species occur within the Yakima River and major tributaries. However, facilities for the project are located more than ¼ mile from the Yakima River, and the small tributaries such as Dry Creek apparently do not support fish habitat (PHS data). No

impacts to state or federally protected species are likely to occur as a result of this project.

MITIGATION AND MONITORING

It is recommended that a Technical Advisory Committee (TAC) be convened to evaluate the mitigation and monitoring program and determine the need for further studies or further mitigation measures. The TAC should be composed of representatives from Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service, Kittitas County, local interest groups (e.g., Kittitas Audubon Society), project landowners, and the project proponent. The role of the TAC will be to coordinate appropriate mitigation measures, monitor impacts to wildlife and habitat, and address issues that arise regarding wildlife impacts during construction and operation of the wind plant. The post-construction monitoring plan should be developed in coordination with the TAC.

Mitigation

The following are potential mitigation measures for impacts to wildlife from construction and operation of the KVP Wind Farm:

- An environmental inspector should be designated by the TAC (see above) to monitor construction activity and ensure compliance with the mitigation measures.

- Sensitive habitat areas such as springs, riparian corridors, and raptor nest sites should be mapped, flagged, and identified to all contractors working on-site and should be designated as "no disturbance zones" during the construction phase. If any new nesting, denning, or otherwise sensitive wildlife sites are located during construction, these areas should also be mapped and flagged and included in the off-limit areas.

- During project construction, best management practices should be employed to reduce peripheral impacts to adjacent vegetation and habitats and to minimize the construction footprint.

- All areas disturbed during construction should be re-seeded with native plant mixes to minimize the spread of noxious weeds.

- Any hay bales used during construction should be certified as weed free.

- A site management plan should be developed in coordination with the TAC to address the following items at a minimum:
  - minimizing road construction and vehicle use where possible to reduce impacts to sensitive habitats
  - educating construction personnel to the sensitive nature of the habitat and wildlife resources
  - maintaining and enforcing reasonable driving speeds so as not to harass or accident-

ally strike wildlife
    - providing adequate on-site waste disposal
    - identifying off-limit zones
    - identifying fire management and erosion control procedures
    - identifying animal carcasses that may attract eagles and other raptors and arrange for removal

- The raptor nests on-site should be monitored for activity prior to construction of the wind plant to determine the need for construction timing and use restrictions around the nest or adjustment to the project design to avoid impacts.

- All new power and communication poles on-site should be fitted with perch guards

- Powerline conductor spacing should be set to minimize the potential for raptor electrocutions

- Guyed permanent met towers should be equipped with Bird Flight Diverters (BFD's) to minimize the potential for avian collisions with guy wires.

- If warranted due to winter weather conditions and the presence of substantial numbers of elk and mule deer in the area, construction will take not take place during critical winter periods to minimize disturbance to wintering big game.

Monitoring

A post construction monitoring study is recommended for the project to quantify impacts to avian species and to assess the adequacy of mitigation measures implemented and the need for additional measures. A monitoring plan for the project should consider the following components: 1) fatality monitoring involving standardized carcass searches, scavenger removal trials, searcher efficiency trials, and reporting of incidental fatalities by maintenance personnel and others; 2) a minimum of one breeding season raptor nest survey of the Project and a 1 mile buffer to locate and monitoring active raptor nests potentially affected by the construction and operation of the wind plant.

The protocol for the fatality monitoring study should be similar to protocols used at the Vansycle Wind Plant in northeastern Oregon (Erickson *et al.* 2000) and the Stateline Wind Plant in Washington and Oregon (FPL *et al.* 2001).

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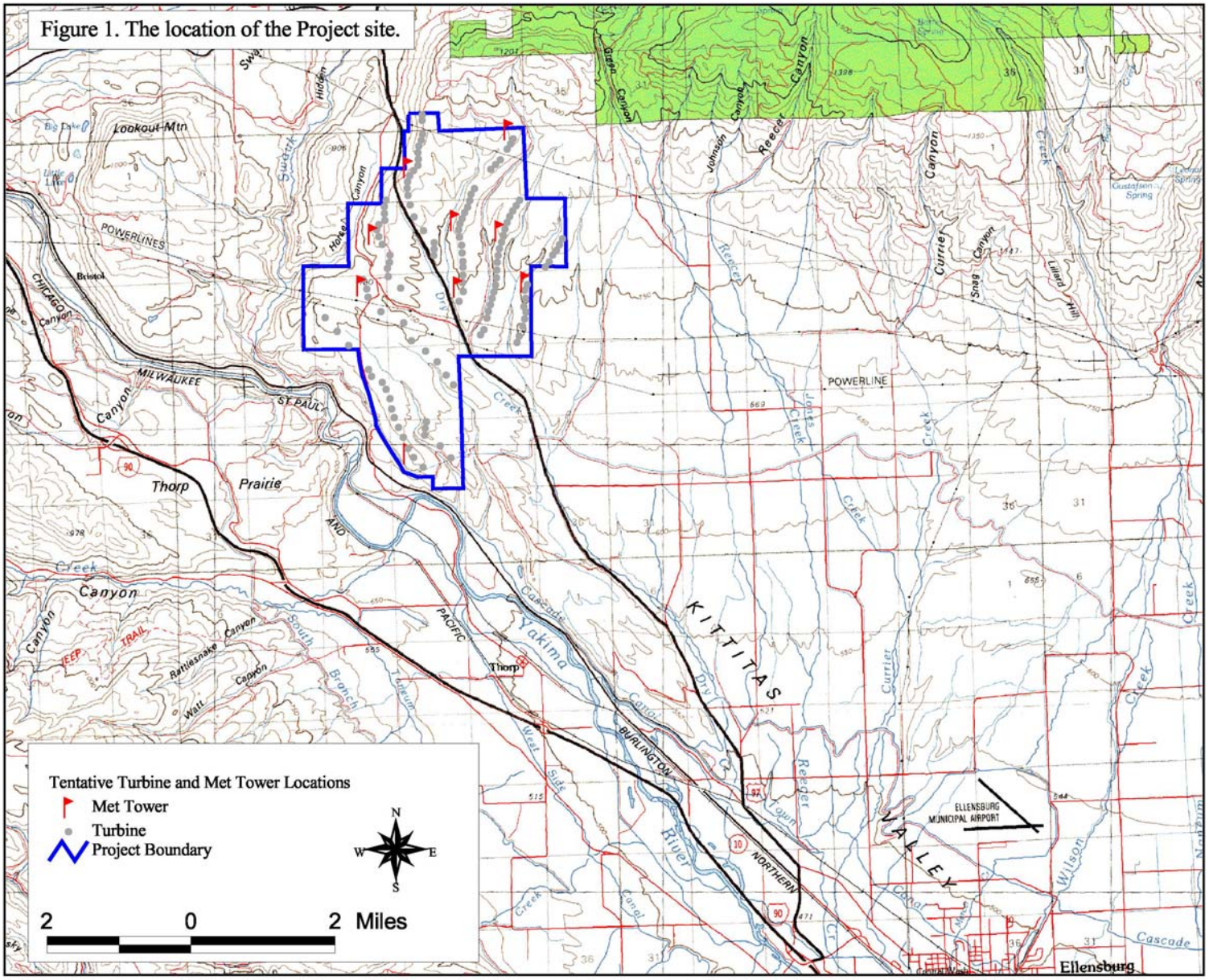
Figure 1. The location of the Project site.
Tentative Turbine and Met Tower Locations
Met Tower
Turbine
Project Boundary
N
W
E
S
2
0
2 Miles
Lookout Mtn
POWERLINES
Bristol
MILWAUKEE
ST PAUL
Thorp
Prairie
Canyon
POWERLINE
KITTITAS
Yakima
Cascade
PACIFIC
BURLINGTON
NORTHERN
ELLENSBURG MUNICIPAL AIRPORT
Ellensburg

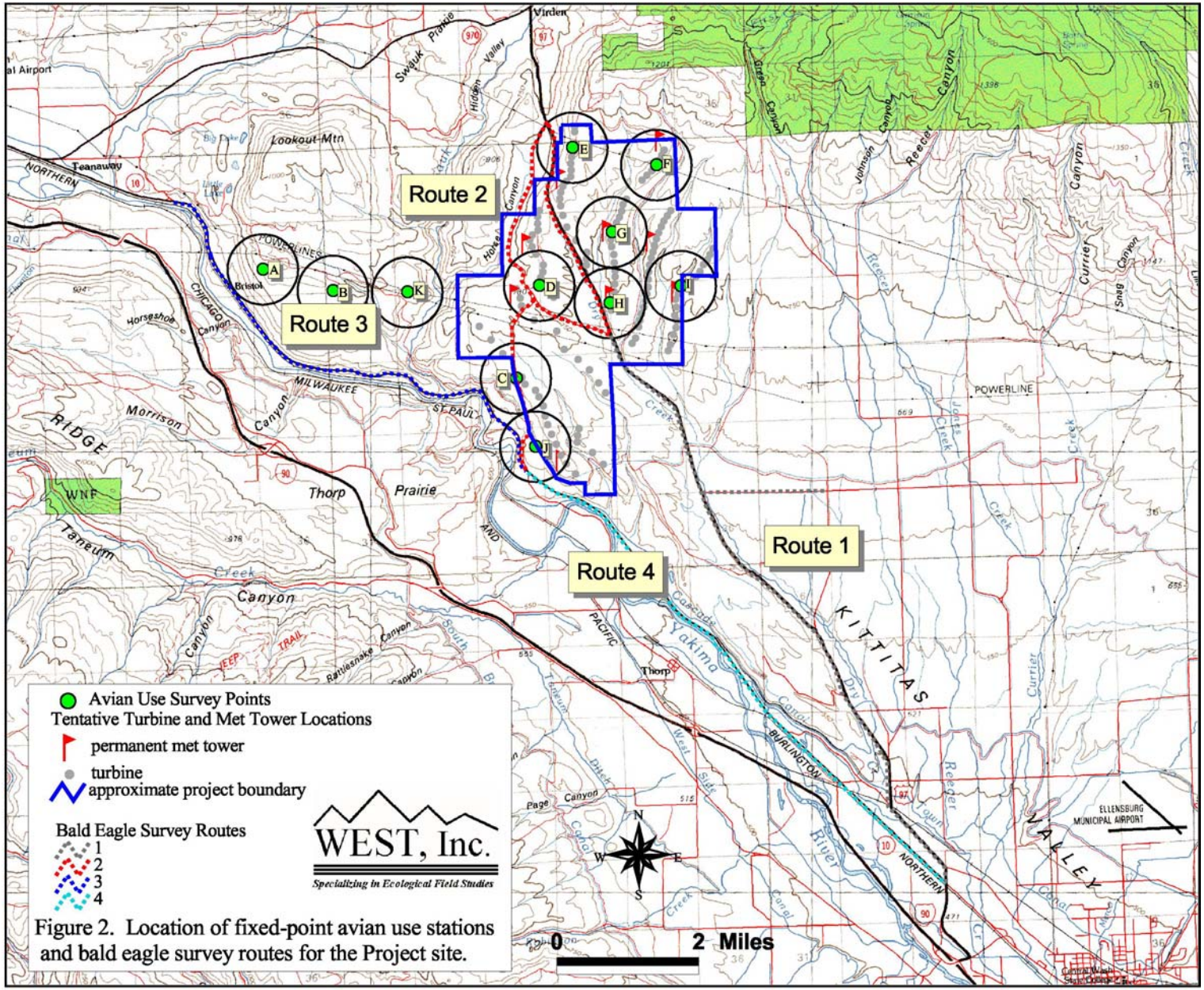

Figure 2. Location of fixed-point avian use stations and bald eagle survey routes for the Project site.

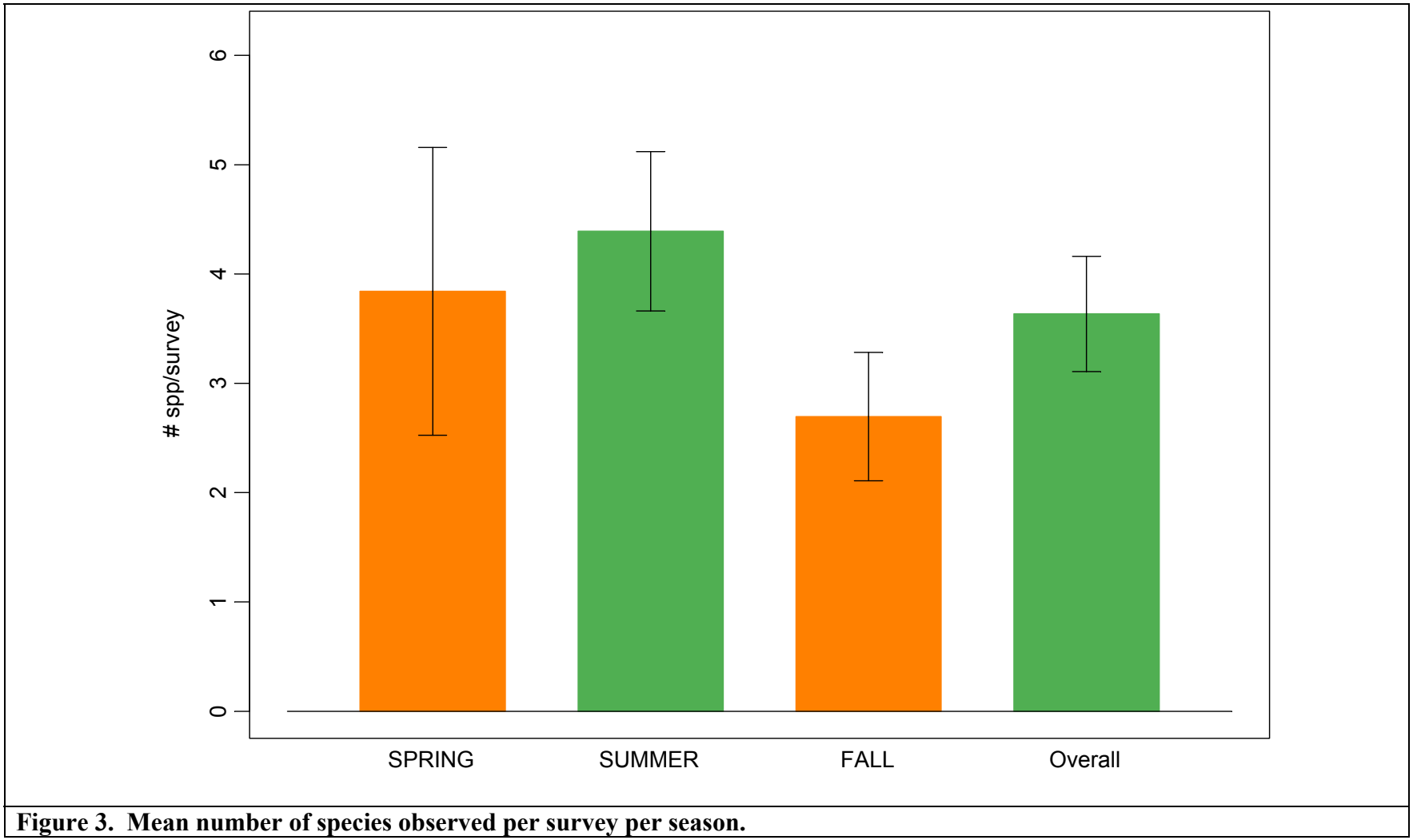

Figure 3. Mean number of species observed per survey per season.

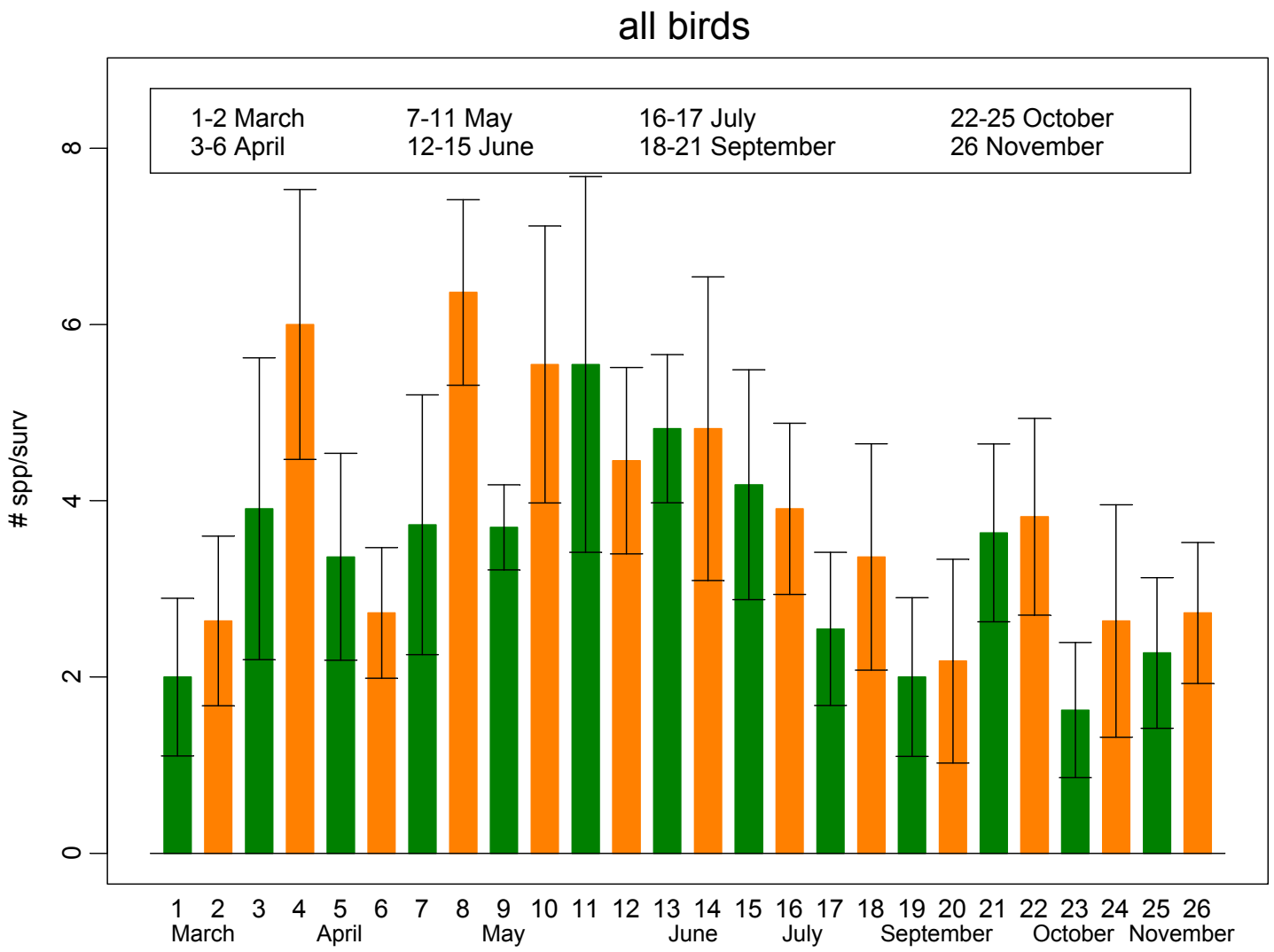

Figure 4. Mean number of species observed per survey per season.

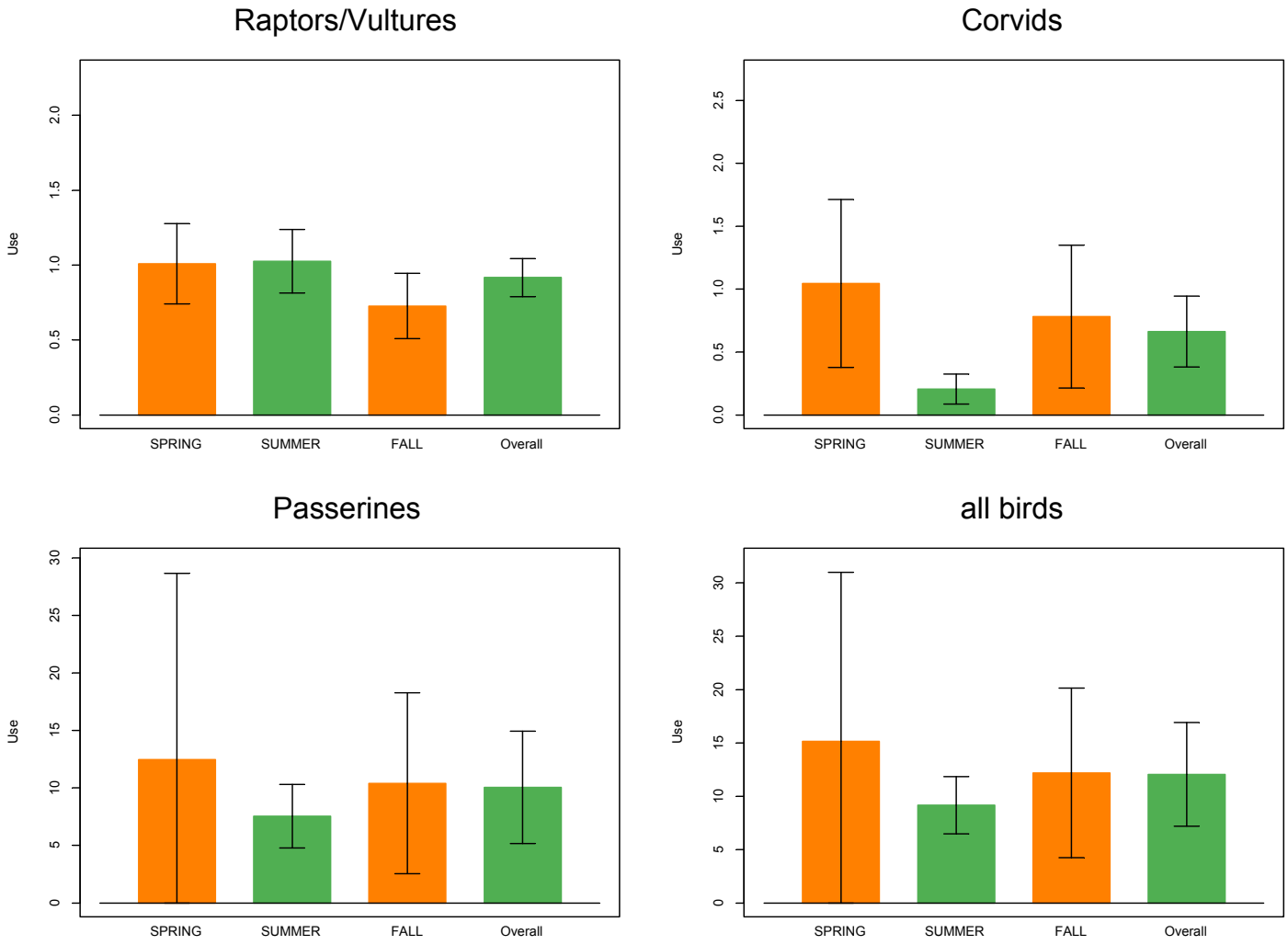

Figure 5. Avian use by major bird group.

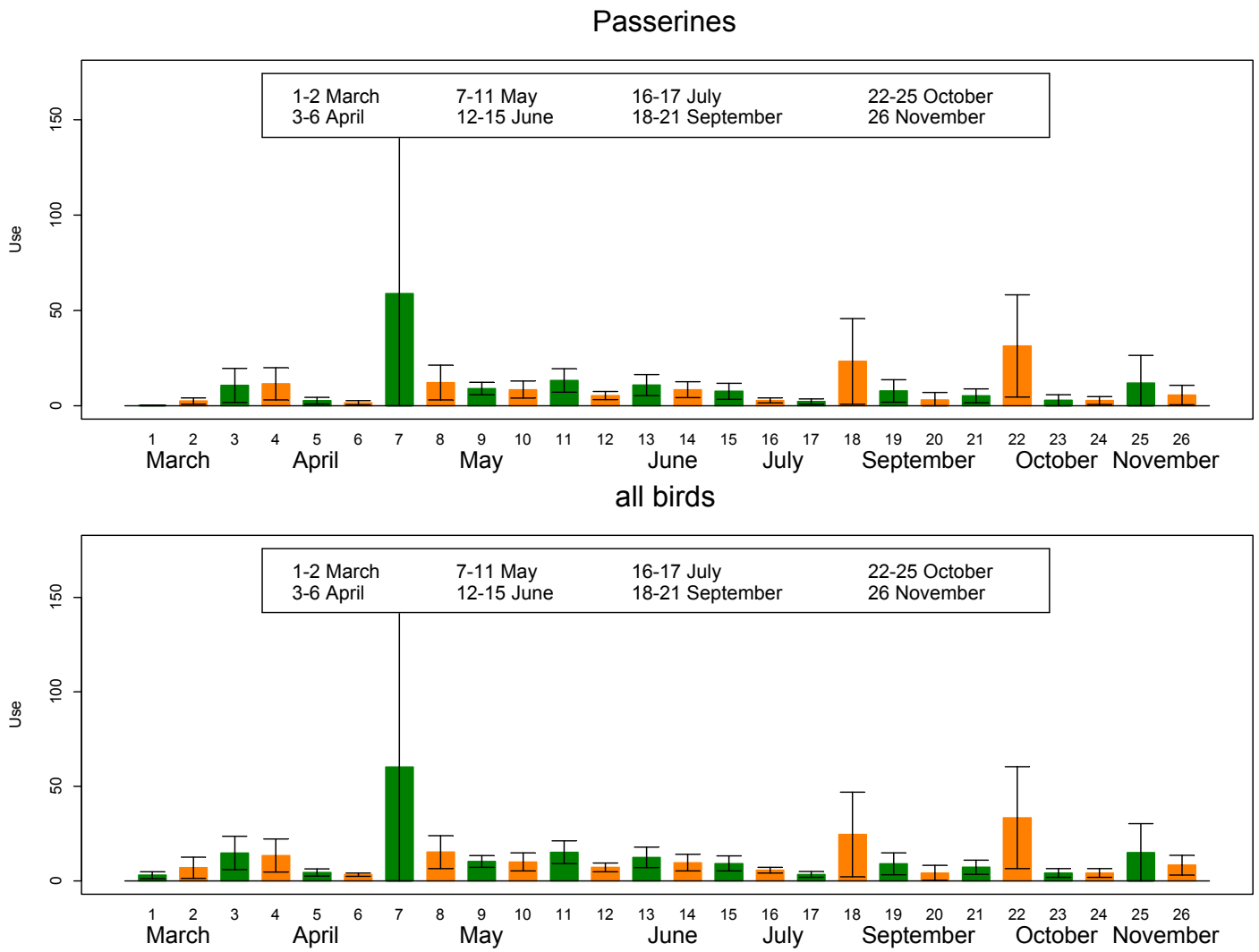

Figure 6. Mean use by visit for passerines and all birds combined.

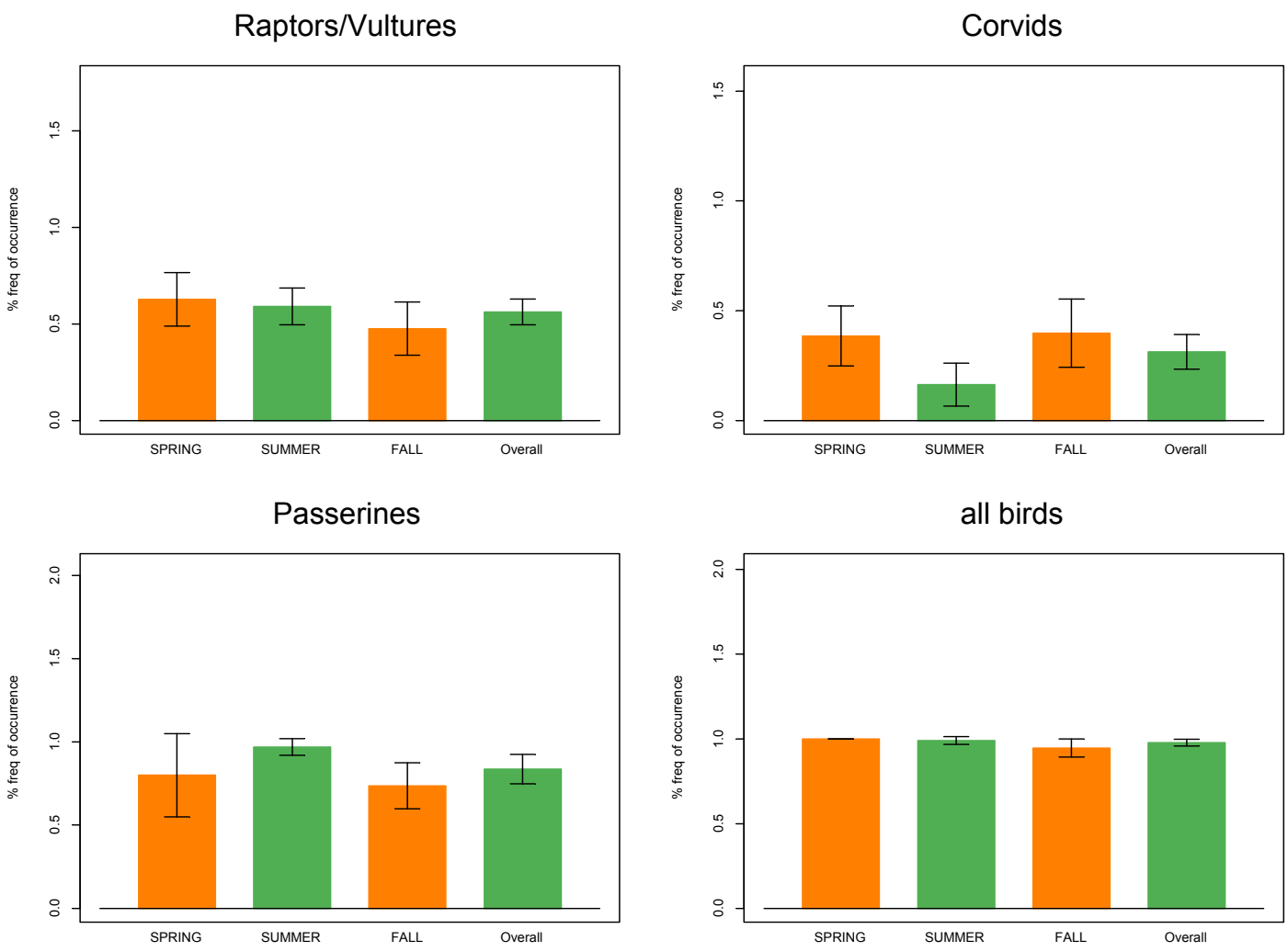

Figure 7. Frequency of use by major bird groups.

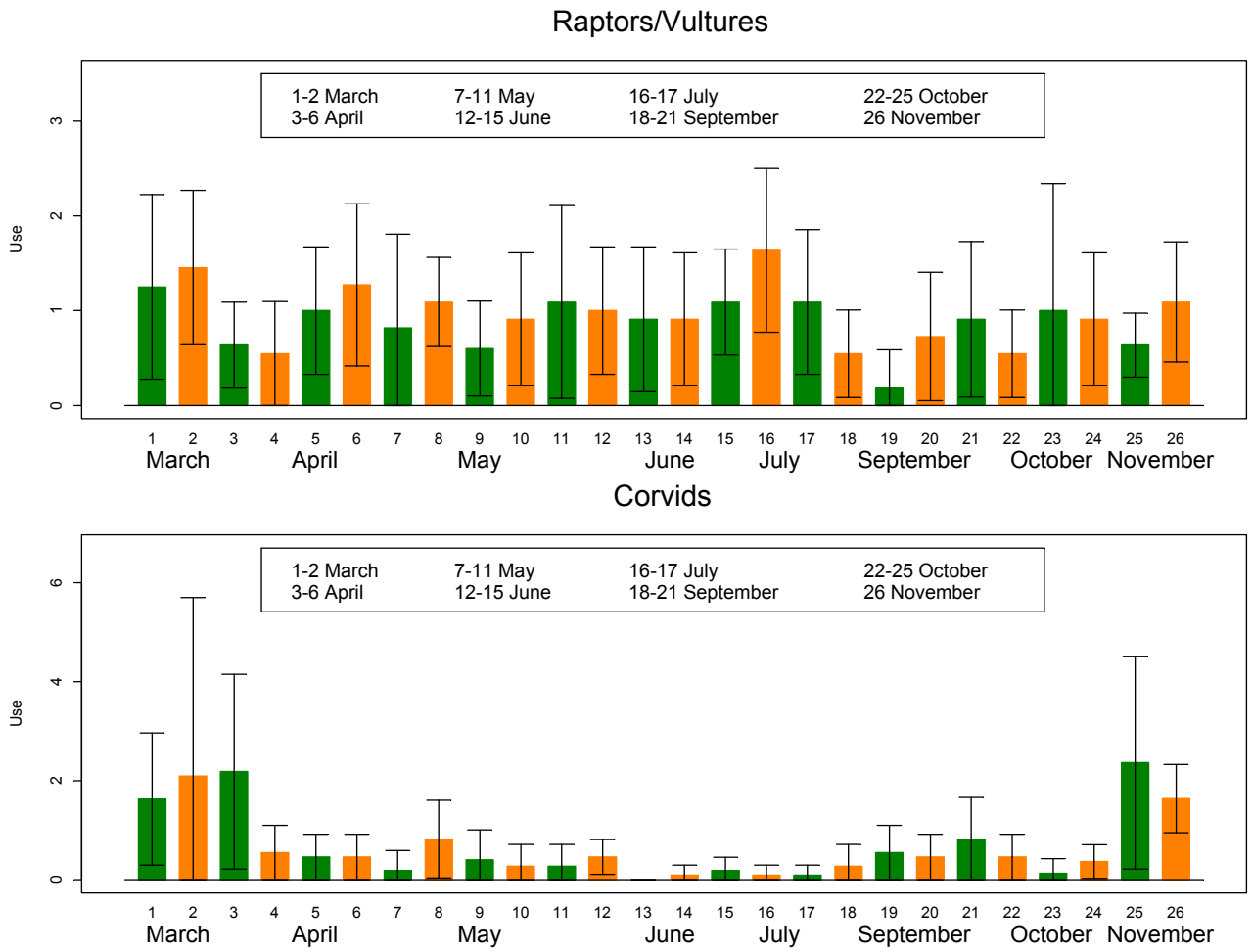

Figure 8. Mean use by visit for raptors and corvids.

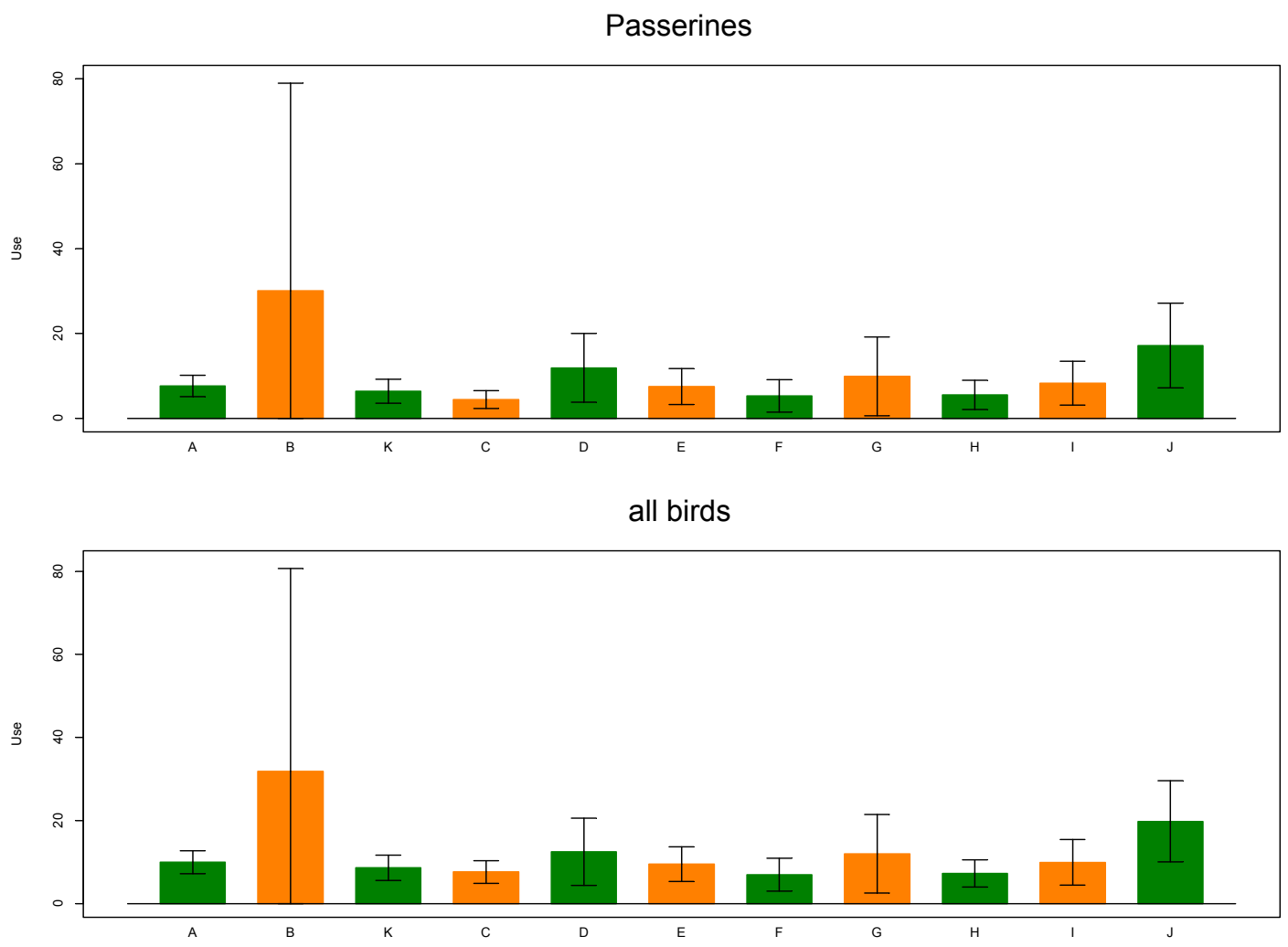

Figure 9. Mean use for passerines and all birds combined by station. Stations A, B and K are to the west of the area proposed to be developed.

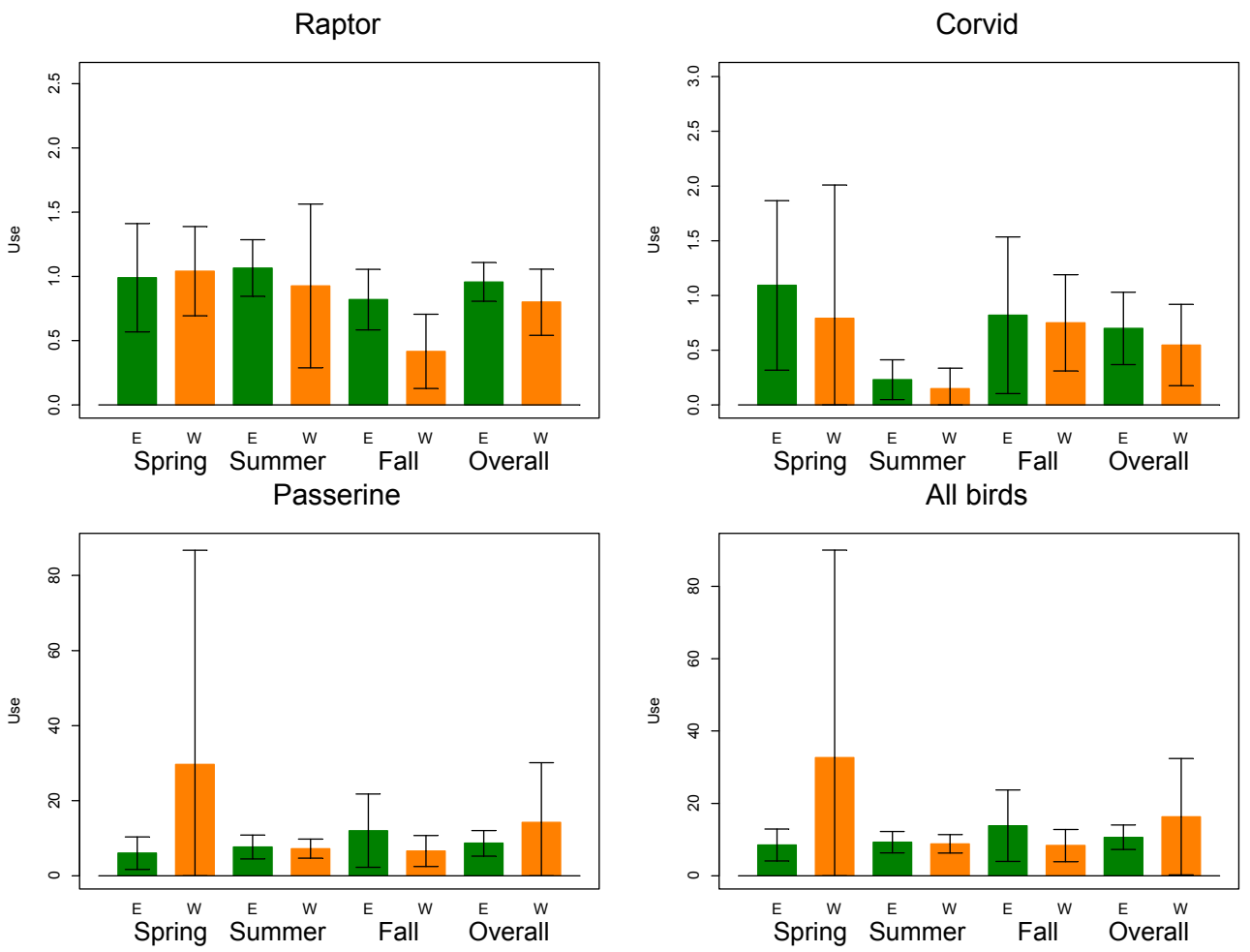

Figure 10. Mean use by major bird group by season and overall for west (W) stations (A, B, K) and the east stations. Stations A, B and K are to the west of the area proposed to be developed.

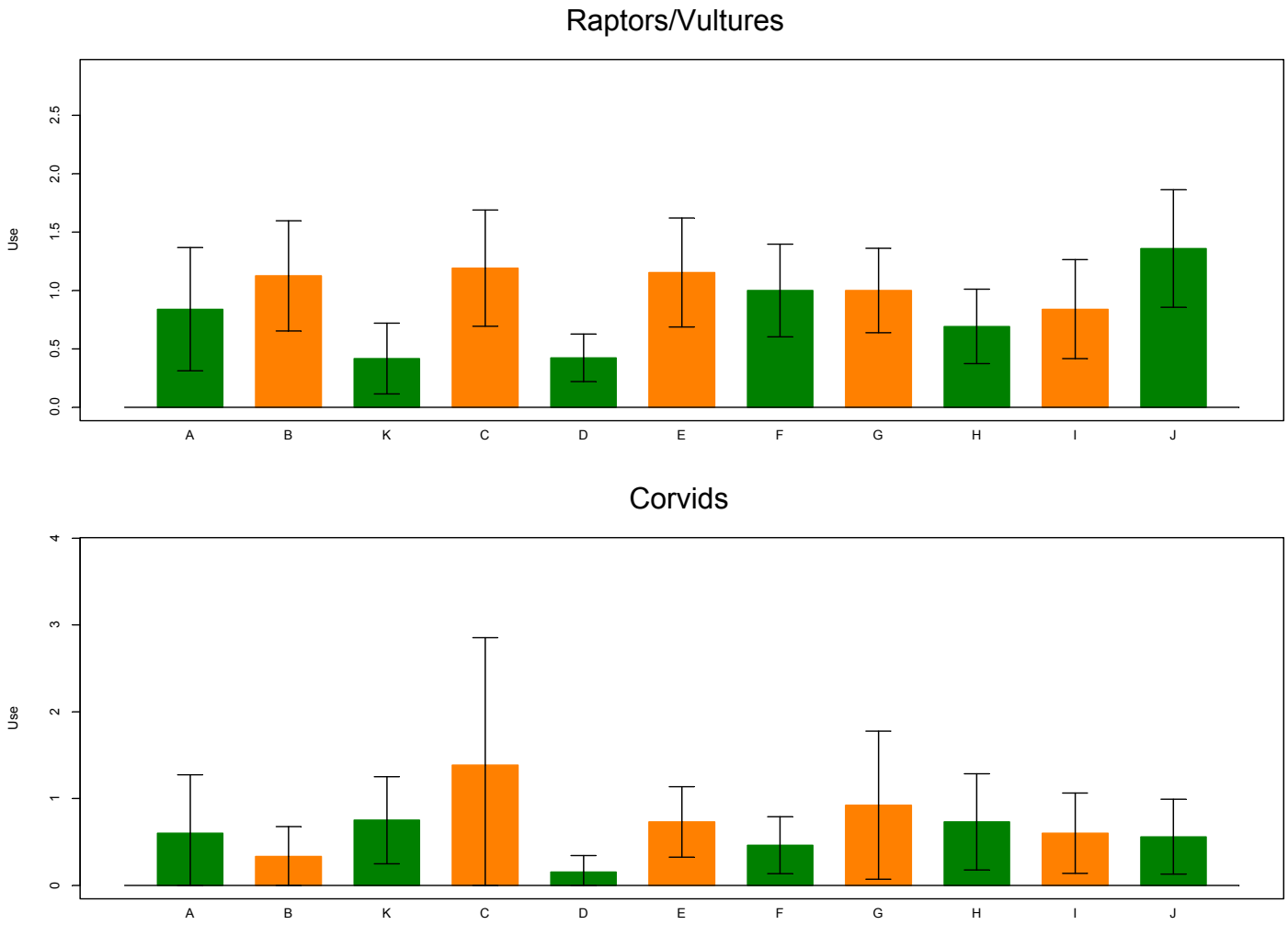

Figure 11. Mean use for raptors and corvids by station. Stations A, B and K are to the west of the area proposed to be developed.

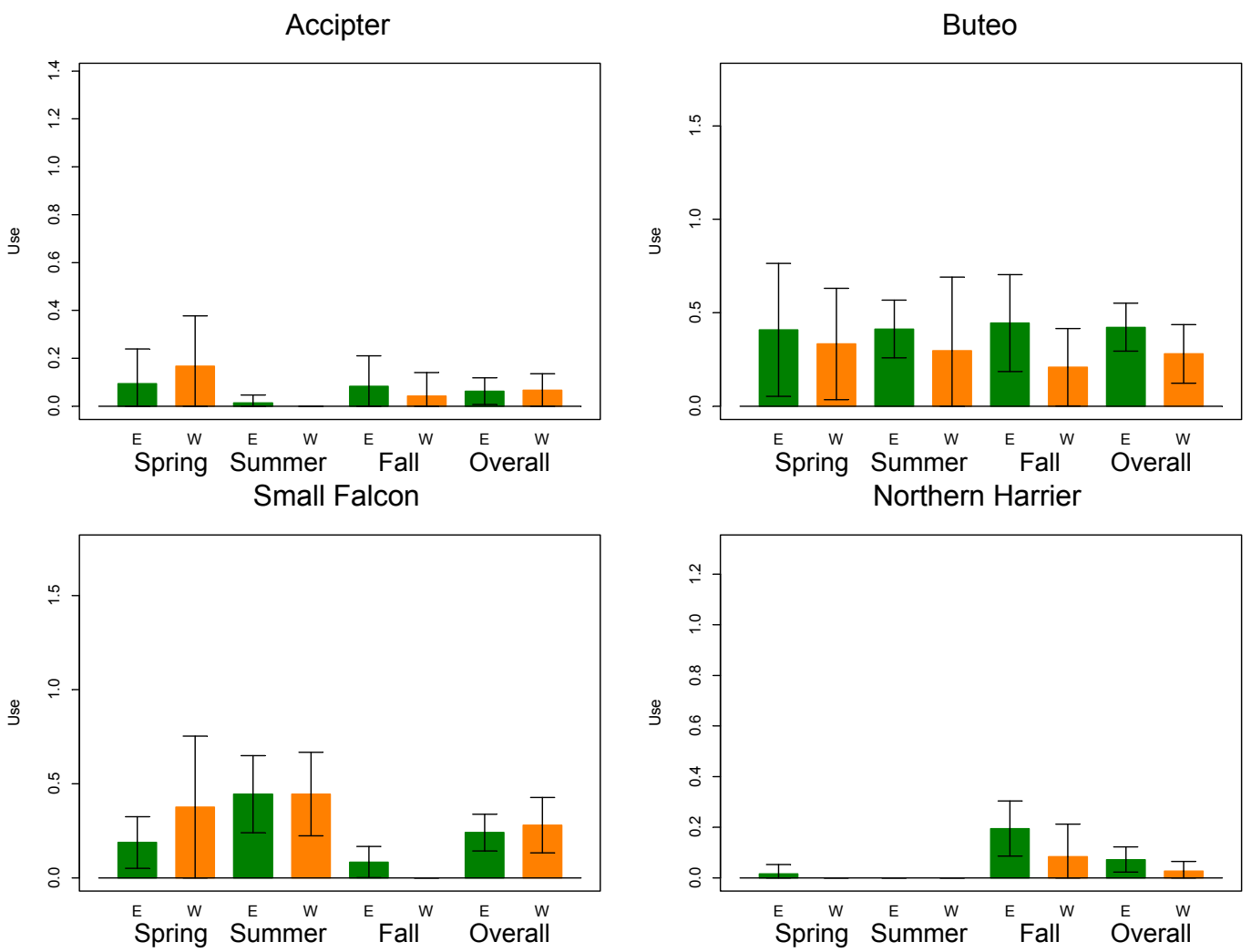

Figure 12. Mean use by major bird group by season and overall for west (W) stations (A, B, K) and the east stations. Stations A, B and K are to the west of the area proposed to be developed.

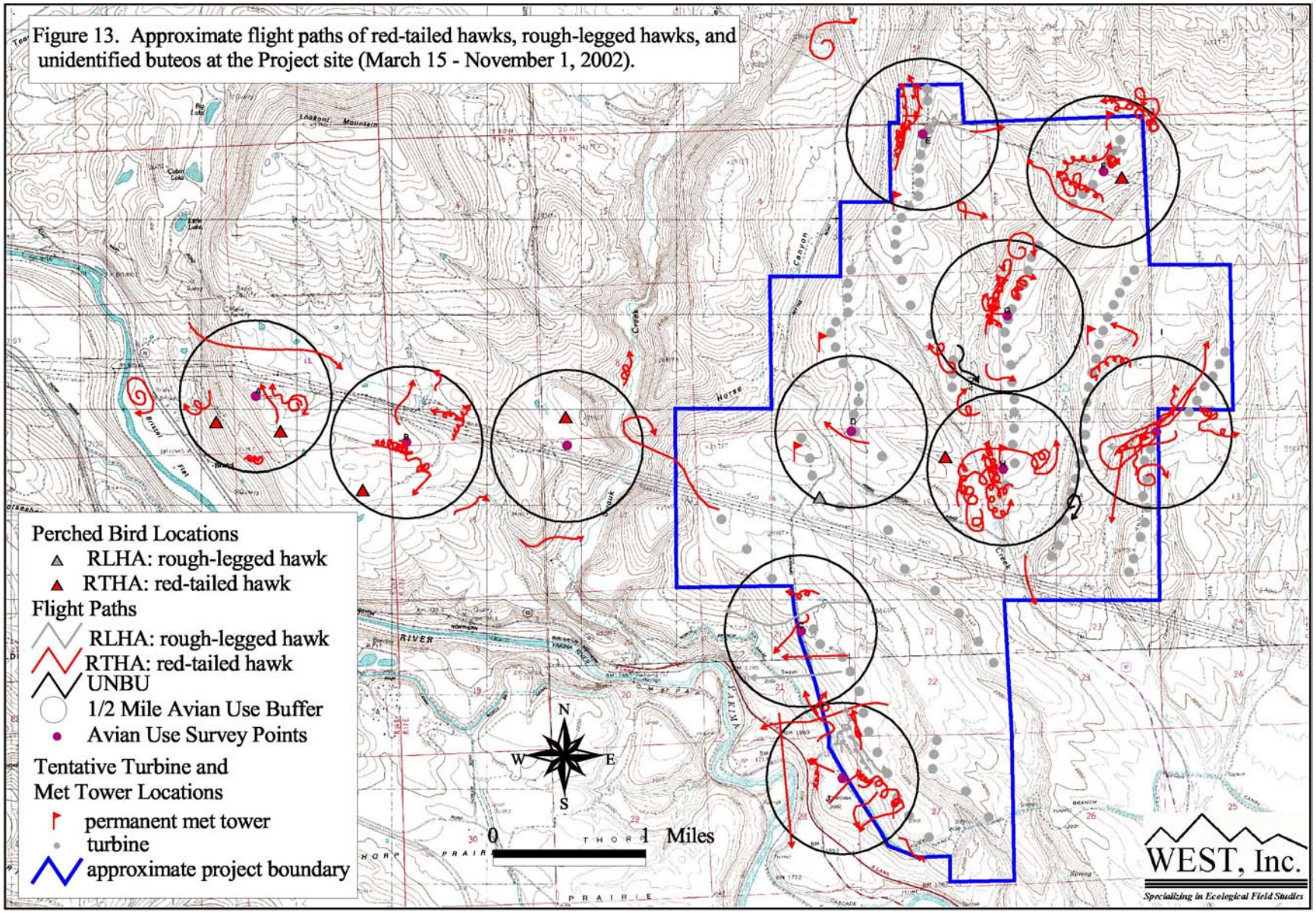
Figure 13. Approximate flight paths of red-tailed hawks, rough-legged hawks, and unidentified buteos at the Project site (March 15 - November 1, 2002).
Perched Bird Locations
RLHA: rough-legged hawk
RTHA: red-tailed hawk
Flight Paths
RLHA: rough-legged hawk
RTHA: red-tailed hawk
UNBU
1/2 Mile Avian Use Buffer
Avian Use Survey Points
Tentative Turbine and Met Tower Locations
permanent met tower
turbine
approximate project boundary
N
W
E
S
0
1 Miles
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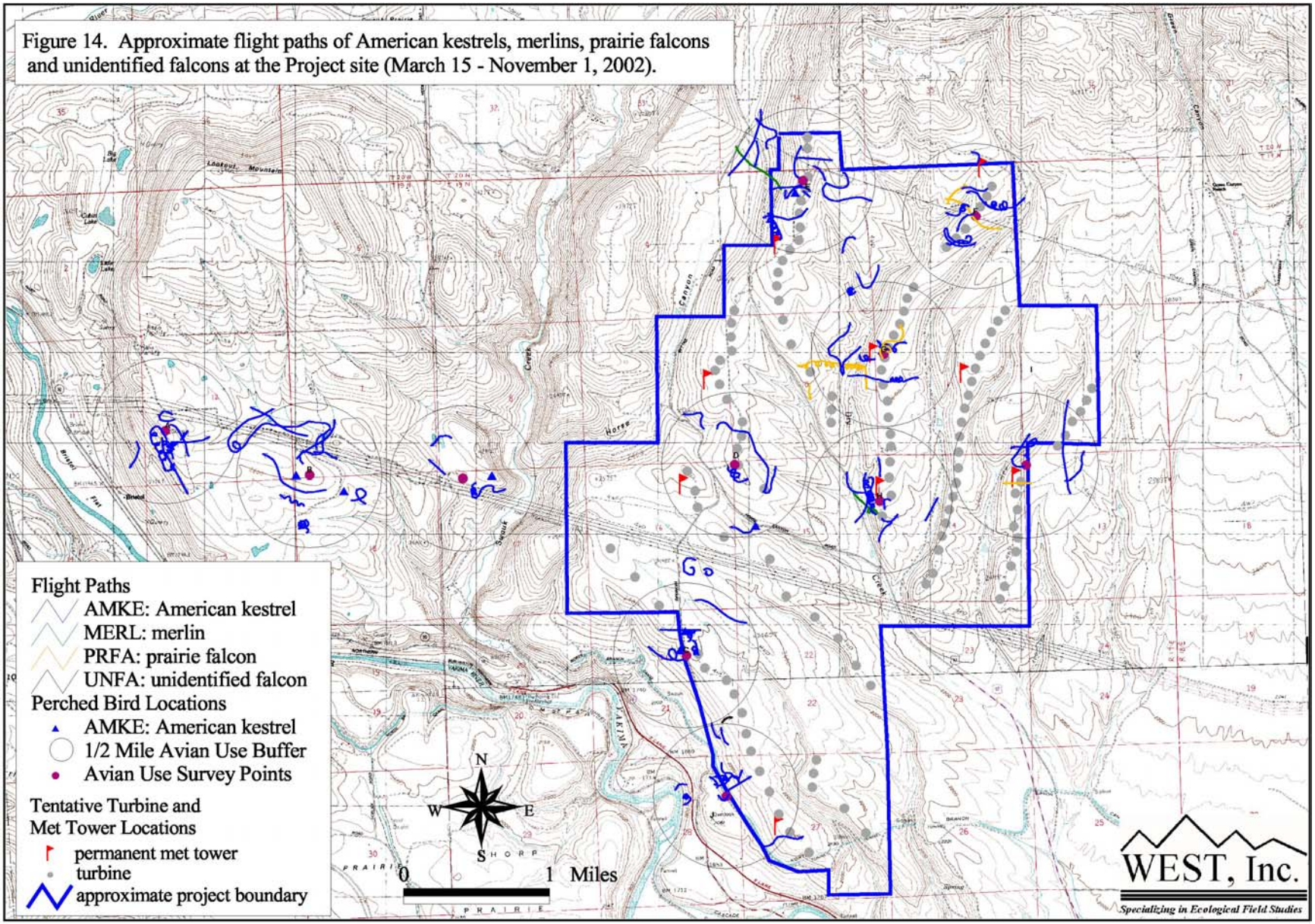
Figure 14. Approximate flight paths of American kestrels, merlins, prairie falcons and unidentified falcons at the Project site (March 15 - November 1, 2002).
Flight Paths
AMKE: American kestrel
MERL: merlin
PRFA: prairie falcon
UNFA: unidentified falcon
Perched Bird Locations
AMKE: American kestrel
1/2 Mile Avian Use Buffer
Avian Use Survey Points
Tentative Turbine and Met Tower Locations
permanent met tower
turbine
approximate project boundary
N
W
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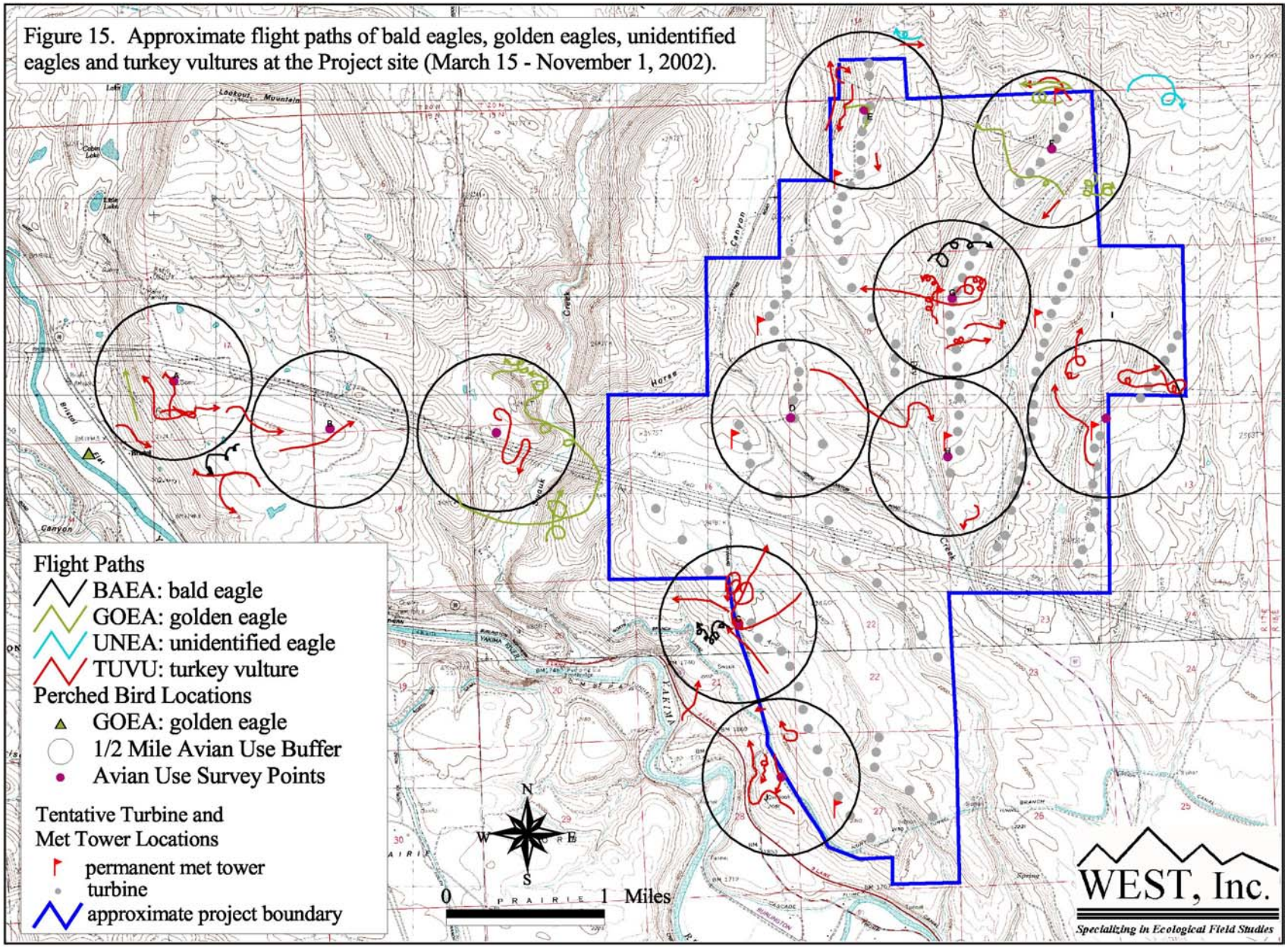
Figure 15. Approximate flight paths of bald eagles, golden eagles, unidentified eagles and turkey vultures at the Project site (March 15 - November 1, 2002).
Flight Paths
BAEA: bald eagle
GOEA: golden eagle
UNEA: unidentified eagle
TUVU: turkey vulture
Perched Bird Locations
GOEA: golden eagle
1/2 Mile Avian Use Buffer
Avian Use Survey Points
Tentative Turbine and
Met Tower Locations
permanent met tower
turbine
approximate project boundary
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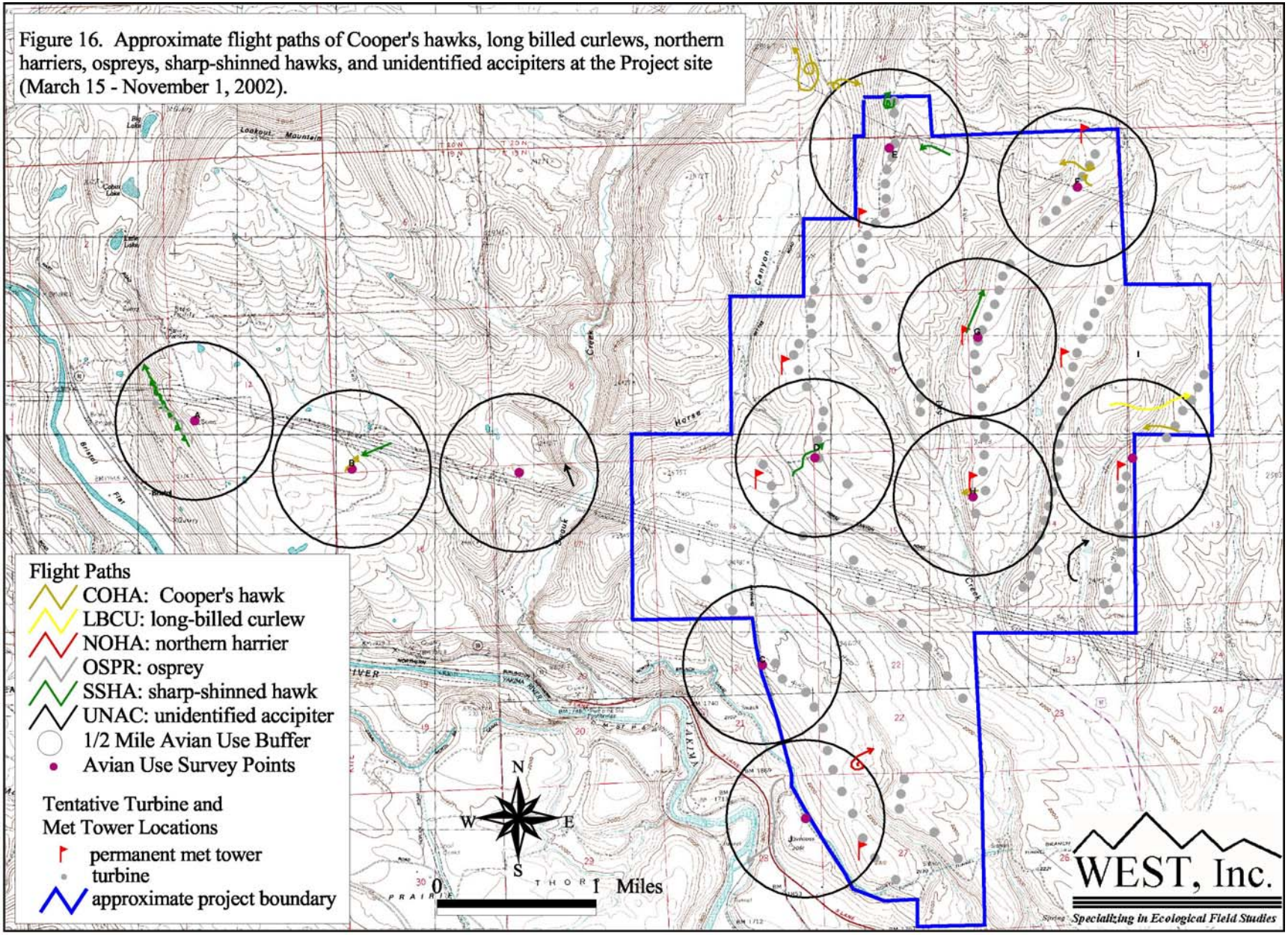
Figure 16. Approximate flight paths of Cooper's hawks, long billed curlews, northern harriers, ospreys, sharp-shinned hawks, and unidentified accipiters at the Project site (March 15 - November 1, 2002).
Flight Paths
COHA: Cooper's hawk
LBCU: long-billed curlew
NOHA: northern harrier
OSPR: osprey
SSHA: sharp-shinned hawk
UNAC: unidentified accipiter
1/2 Mile Avian Use Buffer
Avian Use Survey Points
Tentative Turbine and Met Tower Locations
permanent met tower
turbine
approximate project boundary
N
W
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0
1 Miles
WEST, Inc.
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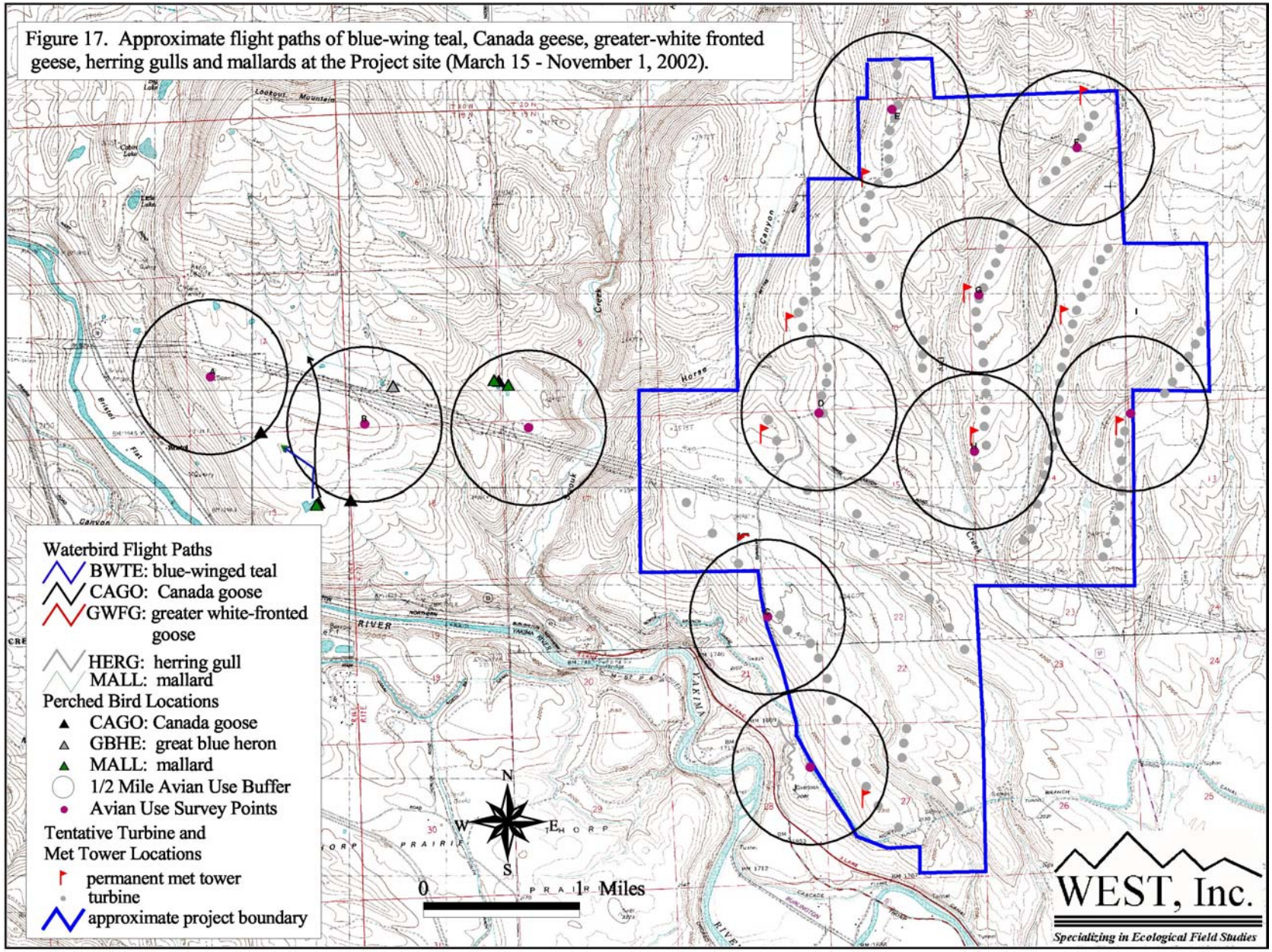
Figure 17. Approximate flight paths of blue-wing teal, Canada geese, greater-white fronted geese, herring gulls and mallards at the Project site (March 15 - November 1, 2002).
Waterbird Flight Paths
BWTE: blue-winged teal
CAGO: Canada goose
GWFG: greater white-fronted goose
HERG: herring gull
MALL: mallard
Perched Bird Locations
CAGO: Canada goose
GBHE: great blue heron
MALL: mallard
1/2 Mile Avian Use Buffer
Avian Use Survey Points
Tentative Turbine and Met Tower Locations
permanent met tower
turbine
approximate project boundary
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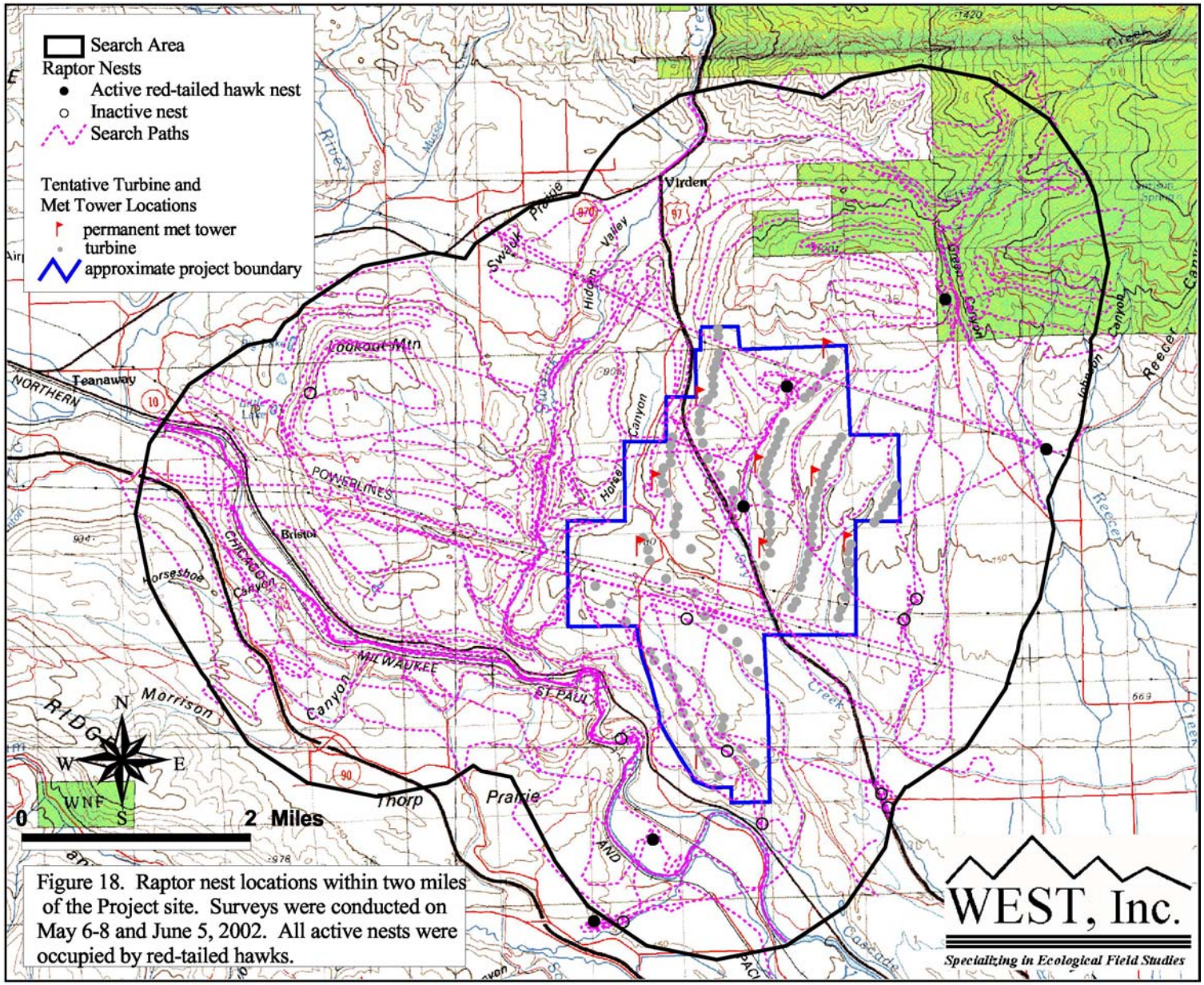

Figure 18. Raptor nest locations within two miles of the Project site. Surveys were conducted on May 6-8 and June 5, 2002. All active nests were occupied by red-tailed hawks.

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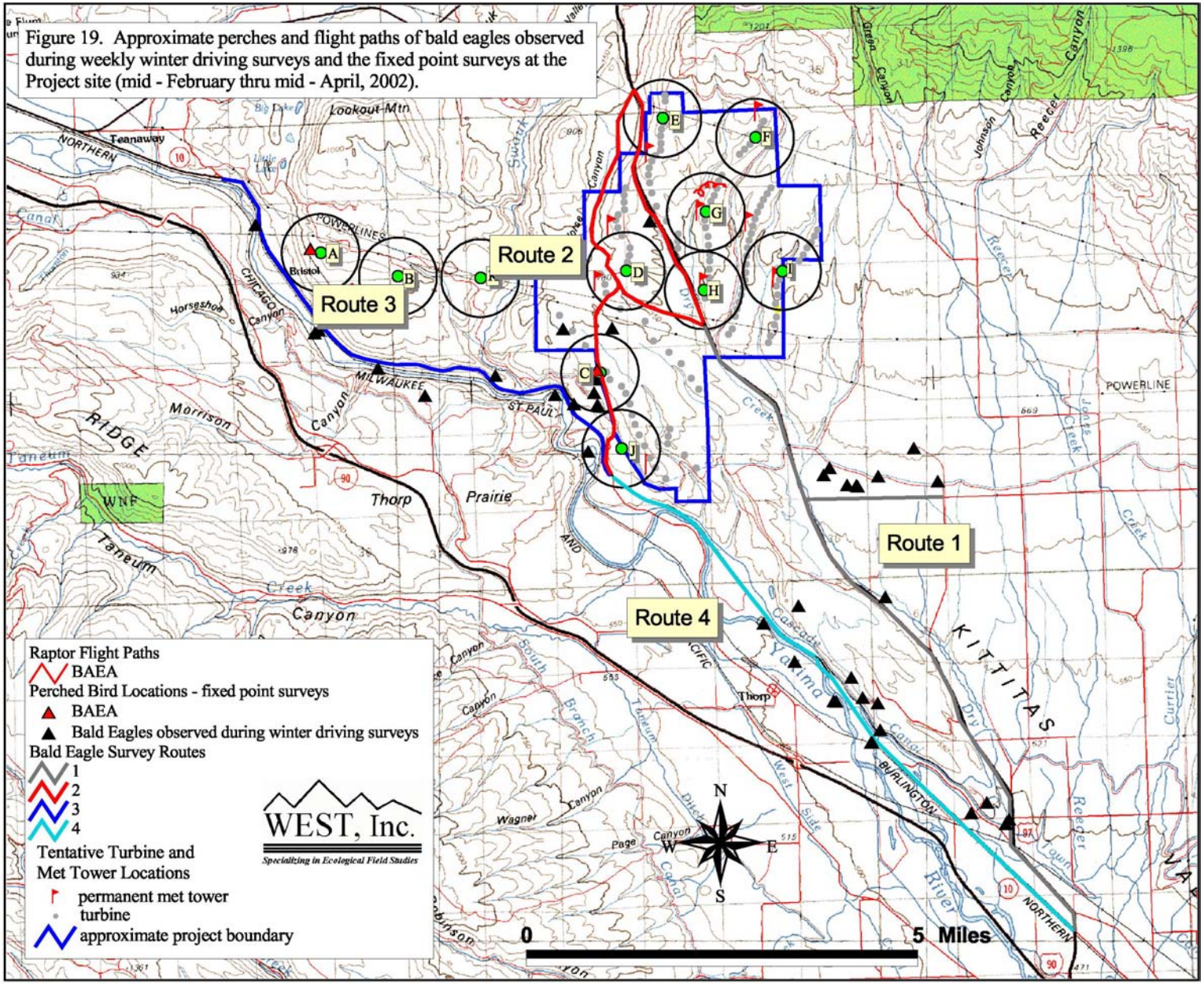
Figure 19. Approximate perches and flight paths of bald eagles observed during weekly winter driving surveys and the fixed point surveys at the Project site (mid - February thru mid - April, 2002).
Route 1
Route 2
Route 3
Route 4
Raptor Flight Paths
BAEA
Perched Bird Locations - fixed point surveys
BAEA
Bald Eagles observed during winter driving surveys
Bald Eagle Survey Routes
1
2
3
4
Tentative Turbine and Met Tower Locations
permanent met tower
turbine
approximate project boundary
WEST, Inc.
Specializing in Ecological Field Studies
0
5 Miles
N
S
E
W