

APPENDIX K: BIOLOGICAL REPORTS (REVISED)

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ENVIRONMENTAL & STATISTICAL CONSULTANTS

415 West 17th Street, Suite 200, Cheyenne, WY 82001
Phone: 307-634-1756 ♦ www.west-inc.com ♦ Fax: 307-637-6981

DATE: August 17, 2017

TO: Horse Heaven Wind Farm, LLC

FROM: Erik Jansen, Western Ecosystems Technology, Inc.

RE: 2017 Raptor Nest Survey Report for the proposed Horse Heaven Wind Project, Benton County, Washington.

Introduction

Horse Heaven Wind Farm, LLC (Horse Heaven) is developing the proposed Horse Heaven Wind Project (Project) in Benton County, Washington. Western Ecosystems Technology, Inc. (WEST) was contracted by Horse Heaven to conduct aerial raptor nest surveys within the Project and surrounding area. Surveys for nests of all raptor species were conducted within a 2-mile (mi; 3.2-kilometer [km]) buffer of the Project, while surveys specifically for bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) nests were conducted within a 10-mi (16-km) buffer of the Project (Survey Area). The initial aerial survey was conducted in late March, 2017, with a follow-up survey completed in early May. This memorandum summarizes the characteristics of the Survey Area, survey methodology, and results of the 2017 raptor nest surveys at the Project.

Survey Area

The Survey Area was developed by buffering the Project boundary by 2-mi and 10-mi in a Geographic Information System (GIS). The Survey Area consisted of the Project and surrounding buffers, which included portions of Benton and Franklin Counties, Washington (Figure 1). The Project is located within the Horse Heaven Hills which is an anticline ridge of the Yakima Folds within the larger Columbia Plateau Ecoregion (Clarke and Bryce 1997). Topography within the Project is composed primarily of rolling to incised hills with a broad northeast-facing rampart along the northern perimeter of the Project boundary (Figure 2). The highly-eroded drainages along the rampart expose basalt cliffs and ledges that are suitable for nesting raptors. Isolated trees and small tree stands are found along drainage bottoms also provide nesting habitat. On the southern side of the rampart, the landscape transitions to relatively rolling topography with shallow, meandering canyons that drain south into the Columbia River. The Yakima River and Columbia River are located along the edges of the Survey Area and contain trees and cliffs suitable for nesting raptors.

Land cover within the Survey Area is a mosaic of dryland and irrigated agriculture, shrub-steppe grasslands, and rural/urban development (Figure 2). Agriculture crop is the dominate land cover throughout the Project and surrounding Survey Area. Shrub-steppe grasslands are found in

topographically steep areas where agriculture was not possible. A third of the Survey Area contains rural/urban development including portions of the tri-cities metro area (Richmond, Kennewick and Pasco), Benton City and unincorporated rural areas. Much of the Survey Area is privately owned and actively managed for agriculture and livestock grazing. The 63 wind turbine Nine Canyon Wind Project is located directly to the east of the proposed Project.

Methods

Prior to aerial surveys, WEST conducted a literature search (Kalasz and Buchanan 2016) and coordinated with Washington Department of Fish and Wildlife (WDFW) biologists to identify previously documented raptor nests in the Survey Area and to review survey protocol.

Two rounds of double-observer (i.e., a primary and secondary observer) aerial nest surveys, flown/completed at least 30 days apart, were conducted in a Robinson R-44 Raven II helicopter with bubble windows that provided excellent visibility (Pagel et al. 2010, USFWS 2013). The first aerial survey was conducted by two qualified WEST biologists on March 31, 2017 and a follow-up survey occurred on May 10, 2017. The initial survey was conducted during a time period that overlapped the primary early nesting period of eagles in the Pacific Northwest, when breeding pairs are exhibiting courtship, nest-building, and/or incubation behaviors. The follow-up survey was performed at a time when eagles and other raptors are actively engaged in mid- to late breeding season reproductive activities (e.g., incubating, brooding, feeding nestlings), and when raptors engaged in ongoing nesting activities would be reliably on or around nests.

During the first survey, coverage included the 10-mi buffer around the Project and utilized an intuitive controlled survey method. Intuitive controlled surveys focused on areas with the highest potential to support raptor nests including cliffs, rock outcrops, incised drainages and canyons, and large trees. During the second survey, WEST biologists revisited previously located raptor nests to evaluate reproductive nesting status and revisited high-quality nesting habitat to search for new nests and later nesting raptor species (e.g., Swainson's hawk [*Buteo swainsoni*]).

During surveys, the helicopter was positioned to allow thorough visual inspection of all appropriate habitat features. In general, the helicopter maintained a distance of at least 20 meters (m; 66 feet [ft]) from cliff faces and nests (Pagel et al. 2010). When nests were located, the helicopter reduced speed and adjusted flight track to allow for a clear view of the nest for documentation and photographing. For each nest or group of nests, a Global Positioning System (GPS) location was recorded, a photograph was taken, and nest attribute data were collected (Table 1). A group of nests was defined as two or more nests that occurred on the same tree, shelf, or cliff face within close proximity to one another (e.g., approximately 25 m [80 ft]).

WEST categorized basic nesting territories and nest use following Steenhof and Newton (2007). Nesting territories were classified as occupied if any of the following were observed at the nest structure: (1) an adult in an incubating position, (2) eggs, (3) nestlings or fledglings, (4) occurrence of an adult (or, sometimes sub-adult), (5) a newly constructed or refurbished stick nest in the area where territorial behavior of an eagle had been observed early in the breeding

season, or (6) a recently repaired nest with fresh sticks (clean breaks) or fresh boughs on top, and/or droppings and/or molted feathers on its rim or underneath. A nesting territory that is not occupied is termed unoccupied. Nests within occupied territories were further classified as “active” if an egg or eggs had been laid or nestlings were observed, or “inactive” if no eggs or chicks were present. Although territories considered occupied often have active nests, nests that were once active may become inactive due to abandonment or nest failure (i.e., territory status may change from unoccupied to occupied, but may not change from occupied to unoccupied in a season; however, nest status may change from inactive to active or vice versa in a season). If an adult was on the nest during the first survey but the previously-occupied nest was vacant during the second survey, the nest status was defined as “unknown.”

Results

A total of 21 raptor nests were located within the Survey Area in 2017. One bald eagle (Nest 18) was located at the confluence of the Yakima River and Columbia River and adjacent to State Highway 240 and several nature preserves approximately 7.7 miles northeast of the Project (Photo 1). The nest contained one chick approximately 21 days old at the time of the second survey (April 30).

Of the 21 nests documented, 11 had territory occupancy and eight (72 percent) had signs of active nesting. Two occupied ferruginous hawk (*B. regalis*) nests were documented during surveys, of which, one adult was sitting on Nest 3 during both surveys and is assumed active. Nest 3 was located in a [REDACTED] 13 [REDACTED]. The occupied inactive ferruginous hawk nest (Nest 8) had one adult standing on top of the nest during the first survey and was in good condition (Table 1, Photo 2). Seven additional unoccupied inactive nests were characteristic of nests built by ferruginous hawks and found within two miles of the Project. These unoccupied, inactive nests were located on the ground ($n = 6$ nests) and cliff ledge ($n = 1$ nest) and had the size and form typical of ferruginous hawk construction. Five of the nests were in poor to fair condition, indicating no recent maintenance or nesting activities had occurred and were most likely old territories (Photo 3). An adult ferruginous hawk was flushed from the ground and observed in flight, but could not be attributed to a particular nest (Photo 4).

Of the four red-tailed hawks (*B. jamaicensis*) that were observed on the nest during the first survey, three nests contained one to two chicks between 14–21 days old during the second survey (Nest 1, Nest 9, and Nest 12). The fourth nest observed with a red-tailed hawk during the first survey did not contain sign of nesting during the second survey and was considered occupied inactive.

Two great-horned owls (*Bubo virginianus*) were observed nesting within 2 miles of the Project. One of the nests (Nest 14) had an adult incubating on the nest during the first survey and two owlets standing adjacent to the nest during the second survey. One additional nest (Nest 2) had an adult owl sitting on the nest during the first survey with two red-tailed hawks perched on an adjacent tree. The nest was abandoned by the second survey with no sign of nesting activity.

One occupied active Swainson's hawk nest was observed during the second survey near the center of the Project. The nest was vacant during the first survey and is presumed the adult arrived between the first and second surveys. No eggs or young were observed but the adult remained sitting tight on the nest.

While not a raptor per se, one common raven (*Corvus corax*) nest (Nest 6) was recorded because ravens and raptors are known to use similar-sized nests. The nest was located in the center of the Project on top of an old windmill and had an adult on the nest during the first and second surveys.

The remaining 3 unoccupied nests (Nest 5 and Nest 20) were located in trees within the Project. Two nests were located within the tree at Nest 5 and one at Nest 20. Neither nest(s) location had sign of territory occupancy or nesting activity during either survey.

In Washington, the bald eagle is considered a federal and state species of concern¹ (USFWS 2008, WDFW 2013) and protected by the Migratory Bird Treaty Act (MBTA)² and Bald and Golden Eagle Protection Act (BGEPA)³. Similarly, in Washington the ferruginous hawk is considered a federal species of concern (USFWS 2008) but is also listed as state threatened⁴ due to population declines (WDFW 2013). The red-tailed hawk, great-horned owl, Swainson's hawk and common raven are species protected under the MBTA.

¹ In Washington, a sensitive species is defined as a native species that is vulnerable or declining and is likely to become endangered or threatened in a significant portion of its range within the state without cooperative management or removal of threats (Washington Administrative Code [WAC] 232-12-011).

² As defined in 50 Code of Federal Regulation (CFR) §20.11

³ As defined in 50 CFR §21.11

⁴ In Washington, a threatened species is defined as a native species that is likely to become endangered within the foreseeable future throughout a significant portion of its range within the state without cooperative management or removal of threats (WAC 232-12-011).

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Figure 1. Survey area and raptor nest locations documented during aerial surveys of Horse Heaven, March and April, 2017.



Figure 2. Aerial photograph and raptor nest locations documented during aerial surveys of Horse Heaven, March and April, 2017.

Table 1. Final 2017 raptor nest results for aerial surveys conducted February 22 and April 30 at the proposed Horse heaven Wind Project, Washington. Coordinates UTM Z11N.

Nest ID	Species	Territory Status	Breeding Status	Nest Substrate	Easting	Northing	Comment
01	Red-tailed Hawk	Occupied	Active	Tree	324523	5111950	Adult on nest first survey; one chick approximately 14-day old chick on nest second survey
02	Great-horned Owl	Occupied	Unknown	Tree	321773	5110230	Adult GHOW on nest first survey, two RTHA perched on adjacent tree; No sign of nesting or adults second survey
03	Ferruginous Hawk	Occupied	Active	Tree	13		Adult perched on nest first survey; adult sitting in nest second survey
04	Unknown Raptor	Unoccupied	Inactive	Ground	13		Characteristic of ferruginous hawk nest; large nest in fair condition; no sign of nesting either survey
05	Unknown Raptor	Unoccupied	Inactive	Tree	13		Two nests located in one tree; no sign of nesting either survey
06	Common Raven	Occupied	Active	Windmill	319062	5111850	Adult on nest first and second survey
07	Red-tailed Hawk	Occupied	Inactive	Tree	318508	5112510	Adult on nest first survey; no sign of nesting of adult observed second survey
08	Ferruginous Hawk	Occupied	Inactive	Ground	13		Adult on nest first survey; no sign of nesting of adult observed second survey
09	Red-tailed Hawk	Occupied	Active	Tree	319067	5116690	Adult on nest first survey; two chicks approximately 21-day old second survey; cottonwood tree

Table 1. Final 2017 raptor nest results for aerial surveys conducted February 22 and April 30 at the proposed Horse heaven Wind Project, Washington. Coordinates UTM Z11N.

Nest ID	Species	Territory Status	Breeding Status	Nest Substrate	Easting	Northing	Comment
10	Unknown Raptor	Unoccupied	Inactive	Ground	13		Characteristic of ferruginous hawk nest; nest poor condition, no recent maintenance
11	Unknown Raptor	Unoccupied	Inactive	Ground	13		Characteristic of ferruginous hawk nest; nest poor condition, no recent maintenance
12	Red-tailed Hawk	Occupied	Active	Cliff	313710	5121070	Adult on nest first survey; one chick approximately 21-day old second survey
13	Unknown Raptor	Unoccupied	Inactive	Ground	13		Characteristic of ferruginous hawk nest; nest poor condition, no recent maintenance
14	Great-horned Owl	Occupied	Active	Tree	313047	5121670	Adult on nest first survey; two young owls (branchlets) standing in tree adjacent to nest second survey
15	Unknown Raptor	Unoccupied	Inactive	Cliff	13		Characteristic of ferruginous hawk nest; nest poor condition, no recent maintenance
16	Unknown Raptor	Unoccupied	Inactive	Ground	13		Characteristic of ferruginous hawk nest; nest fair condition, no recent maintenance
17	Unknown Raptor	Unoccupied	Inactive	Ground	13		Characteristic of ferruginous hawk nest; nest good condition, no recent maintenance
18	Bald Eagle	Occupied	Active	Tree	326296	5124520	Adult on nest first survey, mate perched in tree adjacent to river; One chick approximately 21-day old second survey

Table 1. Final 2017 raptor nest results for aerial surveys conducted February 22 and April 30 at the proposed Horse heaven Wind Project, Washington. Coordinates UTM Z11N.

Nest ID	Species	Territory Status	Breeding Status	Nest Substrate	Easting	Northing	Comment
19	Swainson's Hawk	Occupied	Active	Tree	319290	5111630	Not observed first survey; adult on nest second survey
20	Unknown Raptor	Unoccupied	Inactive	Tree	13		Not observed first survey; no sign of nesting or adults observed second survey

¹ Occupied = a nest used for breeding in the current year by a pair of eagles. Presence of an adult, eggs, or young, freshly molted feathers or plucked down, or current year's mutes (whitewash) suggest site occupancy; Unoccupied = no sign of nesting or territory occupancy in the current nesting season; DNLO = did not locate during surveys

² Active = eggs or young observed within nest at the time of survey; Inactive = no adults, eggs or young observed within nest at time of survey; Unknown = unknown breeding status



Photo 1. Bald eagle on Nest 18 along the Columbia River. Adult on nest. Photo March 30, 2017.

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Photo 2. Occupied inactive ferruginous hawk Nest 8. Adult observed standing on nest during second survey. Photo March 30, 2017.

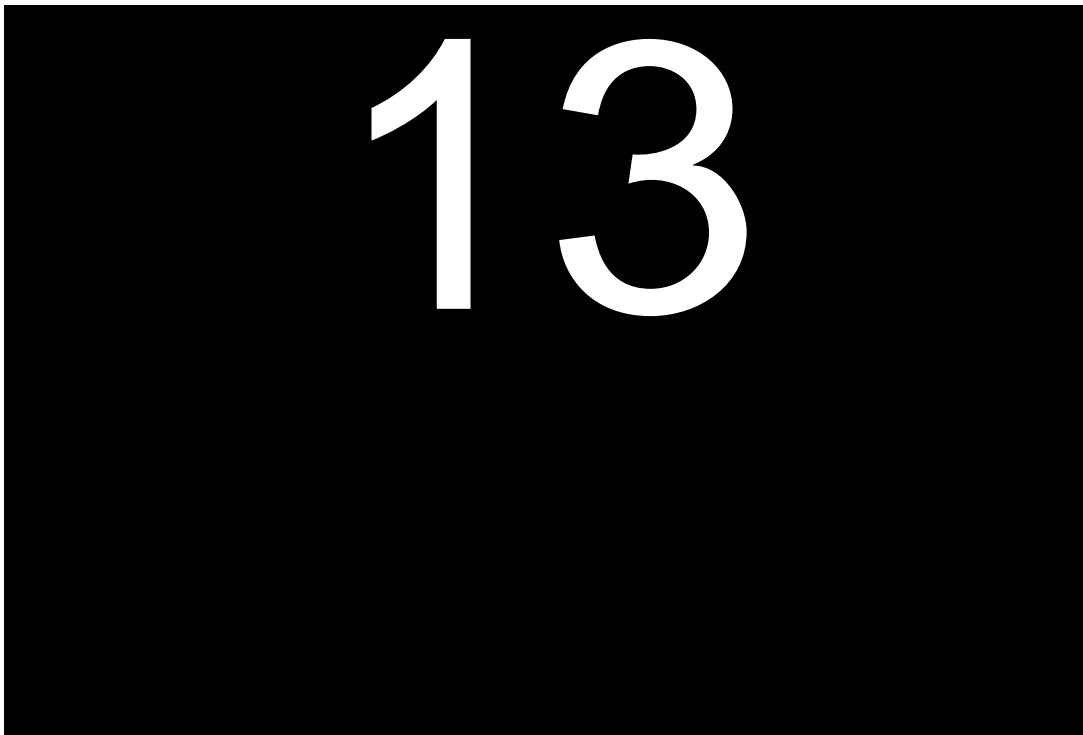


Photo 3. Example of an unoccupied inactive nest, characteristic of a ferruginous hawk. Nest 4 was in fair condition with slumping around the nest bowl and no sign of nesting during either survey. Photo March 30, 2017.



Photo 4. Adult ferruginous hawk in flight, flushed from ground during the first survey March 30, 2017.

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Wildlife Survey Report for the Horse Heaven Wind Project Benton County, Washington

**Final Report
August 2017 – July 2018**



Prepared for:
Horse Heaven Wind Farm, LLC
4865 Sterling Drive, Suite 200
Boulder, Colorado 80301

Prepared by:
Erik W. Jansen and Samantha R. Brown
Western EcoSystems Technology, Inc.
2725 NW Walnut Blvd.
Corvallis, Oregon 97330

**October 2018
(Revised)**



EXECUTIVE SUMMARY

Horse Heaven Wind Farm, LLC is developing the proposed Horse Heaven Wind Energy Project (Horse Heaven and/or Project) in Benton County, Washington. Western EcoSystems Technology, Inc. (WEST) was contracted to conduct biological baseline studies at the Project which included avian use surveys, raptor nest surveys, and a landcover assessment. Additionally, observations of rare and sensitive species were documented incidental to protocol wildlife surveys. This report summarizes the methodology and results of field surveys conducted at Horse Heaven during 2017–2018. Research at the Project was designed to help address the questions posed under Tier 3 of the US Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines and Stage 2 of the Eagle Conservation Plan Guidance document. The principal objective of the study was to provide site-specific bird and landcover data that would be useful to evaluate potential impacts from the proposed wind energy facility. Field surveys included 1) fixed-point surveys for small and large birds, 2) raptor nest surveys, and 3) landcover mapping.

The Project is located in the Columbia Plateau Ecoregion and comprised predominantly of agriculture (73%) followed by grassland (25%), and shrub-steppe (2%). Fixed-point bird surveys estimated the seasonal, spatial, and temporal use patterns of birds within the Project. Fixed-point surveys were conducted at 13 points twice a month for one full year (August 11, 2017 – July 16, 2018). Point counts included 10-minute surveys for small birds within a 100-m radius plot followed by 60-minute surveys large birds within an 800-meter radius plot. Raptor nest surveys were conducted within 10 miles of the Project from helicopter and by ground during the 2017 and 2018 nesting seasons. Dominant landcover within the Project was classified and mapped using remotely sensed data and field-verified.

A total of 322 surveys of each survey type (i.e., small bird and large bird) were conducted during 25 survey rounds. Passerines comprised the majority of avian use during small bird use surveys, which was highest during winter (10.85 birds/100-m plot/10-min) similar between spring and fall (5.17 and 5.14 birds/100-m plot/10-min, respectively) and were lowest during summer with 4.87 birds/100-m plot/10-min. Horned lark and western meadowlark accounted for 85.8% of the 2,205 total birds observed. One observation of a sagebrush sparrow, a state candidate species for listing, was documented during spring.

Observations of waterbirds, specifically sandhill crane, had the greatest influence on overall large bird use which was highest in spring (11.69 birds/800-m plot/60-min survey), followed by fall (9.03 birds/800-m plot/60-min survey), winter (8.56 birds/800-m plot/60-min survey), and lowest in summer (2.48 birds/800-m plot/60-min survey). Sandhill crane was the most frequently observed waterbird which consisted of 8 groups of 552 individuals that was highest during spring (5.03 birds/800-m/60-min) followed by fall (1.56 birds/800-m/60-min). No cranes were observed landing in the Project and typically flew above the RSH (90%). Avoidance behaviors by cranes at operational wind facilities suggest that collision risk would be low. In addition to sandhill crane, several sensitive large bird species were documented during surveys and

include American white pelican, bald and golden eagle, and ferruginous hawk. Based on low use and flight behavior (e.g., exposure rate), collision risk for these species is thought to be low.

Based on species composition of the most common raptor fatalities at other wind energy facilities and species composition of raptors observed at the Project during the surveys, the majority of the fatalities of diurnal raptors may consist of Swainson's hawk, red-tailed hawk, American kestrel and northern harrier. It is expected that risk to raptors would be unequal across seasons, with the highest risk during spring and summer.

Three golden eagles were observed flying within the 800-m survey plot and below 200-m above ground level (AGL) for a total of 35 eagle minutes. A fourth golden eagle was observed outside the survey plot (approximately 1–2 km) and was recorded as an incidental observation. One of the three eagle observations was of an adult for 30 eagle minutes. The individual was circling low and calling; likely influenced by the presence of the surveyor. Golden eagles were documented during the spring and fall migration. Two bald eagles were observed flying with the 800-m survey plot and below 200-m AGL for six eagle minutes. Bald eagles were documented only during winter. No roosts or concentrations of eagles were noted during surveys. Based on low eagle use at the Project (2–3 observations during 322 survey hours), intermittent sources of prey and no nesting habitat in proximity to the project, collision risk to bald and golden eagles appears low.

Of the 33 raptor nests documented within 10-miles of the Project in 2018, 21 nests were previously documented during aerial surveys conducted in 2017. The difference in the number of nests among years was attributed primarily to an increase of red-tailed hawk and Swainson's hawk nests within and adjacent to the Project; of which several nests were discovered later in the year after aerial surveys were completed. Species of note included a nesting bald eagle located approximately 7.7 miles northeast of the Project and a ferruginous hawk nesting in a tree within the Project during both survey years. Nesting habitat within the project consists of small, isolated tree stands along drainage bottoms and associated with buildings/farmsteads. Steep, rocky drainages bisect the broad escarpment that borders the Project to the northeast and contains suitable ferruginous hawk nest habitat.

Landcover at the Project is consistent with the matrix of agriculture and grasslands commonly found in the region. Native shrub-steppe was highly fragmented with small patches scattered throughout the Project.

STUDY PARTICIPANTS

Western EcoSystems Technology, Inc.

Erik Jansen	Project Manager
Samantha Brown	Report Writer
Ray Tupling	Statistician
Jean Paul Wilson	Data Analyst
Carissa Goodman	Data Manager
Kori Hutchinson	Field Supervisor
Joshua Parrot	Field Biologist
Kelsey Lotz	Field Biologist

REPORT REFERENCE

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Appendix A. Summary of the Number of Observations and Groups Recorded by Species and Bird Type for 10-minute Small Bird Use Surveys (Appendix A1) and 60-minute Large Bird Use Surveys (Appendix A2) at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

Appendix B. Mean Use, Percent of Use, and Frequency of Occurrence for Small Bird (Appendix B1) and Large Bird (Appendix B2) Types and Species Observed during Fixed-Point Surveys at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

Appendix C. Species Exposure Indices for Large Birds during Fixed-Point Bird Use Surveys at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

Appendix D. Mean Use by Point for Small Birds (Appendix D1) and Large Birds (Appendix D2) during Fixed-Point Bird Use Surveys at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

Appendix E. Large Bird Flight Paths Observed at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

Appendix F. 2017 (Appendix F1) and 2018 (Appendix F2) Raptor Nest Survey Results from Aerial and Ground Surveys conducted at the Horse Heaven Wind Project.

Appendix G. Landcover at the Project from field mapping (Appendix G1) and the National Landcover Database (Appendix G2) at the Horse Heaven Wind Project.

Appendix H. Oregon and Washington Raptor Use and Fatality Rate Summary Table.

Appendix I. Estimated Raptor Nest Densities at Other Regional Proposed and Existing Wind Projects Located in Comparable Columbia Plateau Ecoregion Environments.

NOTES ON UNITS

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

Unit Conversions

Imperial	Metric
1 foot	0.3048 meter
3.28 feet	1 meter
1 mile	1.61 kilometer
0.621 mile	1 kilometer
1 acre	0.40 hectare
2.47 acre	1 hectare
Common Conversions	
Imperial	Metric
0.06 miles	100 meters
0.12 miles	200 meters
0.5 miles	800 meters
10 miles	16.1 kilometers

INTRODUCTION

Horse Heaven Wind Farm, LLC is developing the proposed Horse Heaven Wind Energy Project (Horse Heaven and/or Project) in Benton County, Washington. Western EcoSystems Technology, Inc. (WEST) was contracted to conduct biological baseline studies at the Project starting in August 2017 which included avian use surveys, raptor nest surveys, and a landcover assessment. Additionally, observations of rare and sensitive species were documented incidental to protocol wildlife surveys. This report summarizes the methodology and results of field surveys conducted at Horse Heaven during August 2017 through July 2018.

Research at the Project was designed to comply with recommendations described by the Washington Department of Fish and Wildlife (WDFW) Wind Power Guidelines (WDFW 2009), Tier 3 of the US Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (USFWS 2012), Stage 2 of the Eagle Conservation Plan Guidance (USFWS 2013) and associated Final Eagle Rule (USFWS 2016).

The principal objectives of the study were to: 1) provide site-specific bird data that would be useful to evaluate potential impacts from the proposed wind energy facility, and 2) identify and delineate landcover within the Project to identify potentially suitable habitat for state or federally-listed threatened, endangered or sensitive species, and inform potential WDFW mitigation calculations (WDFW 2009).

PROJECT AREA

The 25,815 acre (40.3 mi²) Project area is located in Benton County, Washington, located within the Horse Heaven Hills which is an anticline ridge of the Yakima Folds within the larger Columbia Plateau Ecoregion (Clarke and Bryce 1997). Topography within the Project is composed primarily of rolling to incised hills with a broad northeast-facing rampart along the northern perimeter of the Project boundary (Figure 1). The highly-eroded drainages along the rampart create numerous canyons that bisect the Project (Badger Canyon, Coyote Canyon, Taylor Canyon) and expose basalt cliffs and ledges. On the southern side of the rampart, the landscape transitions to relatively rolling topography with shallow, meandering canyons that drain south into the Columbia River.

Land cover within the Project area is a mosaic of dryland and irrigated agriculture, shrub-steppe grasslands, and rural/urban development (Figure 1). Agriculture crop is the dominate land cover throughout the Project and surrounding area. Shrub-steppe grasslands are found in topographically steep areas where agriculture was not possible. Much of the Project area is privately owned and actively managed for dryland agriculture and livestock grazing. The 63 wind turbine Nine Canyon Wind Project is located directly to the east of the proposed Project.

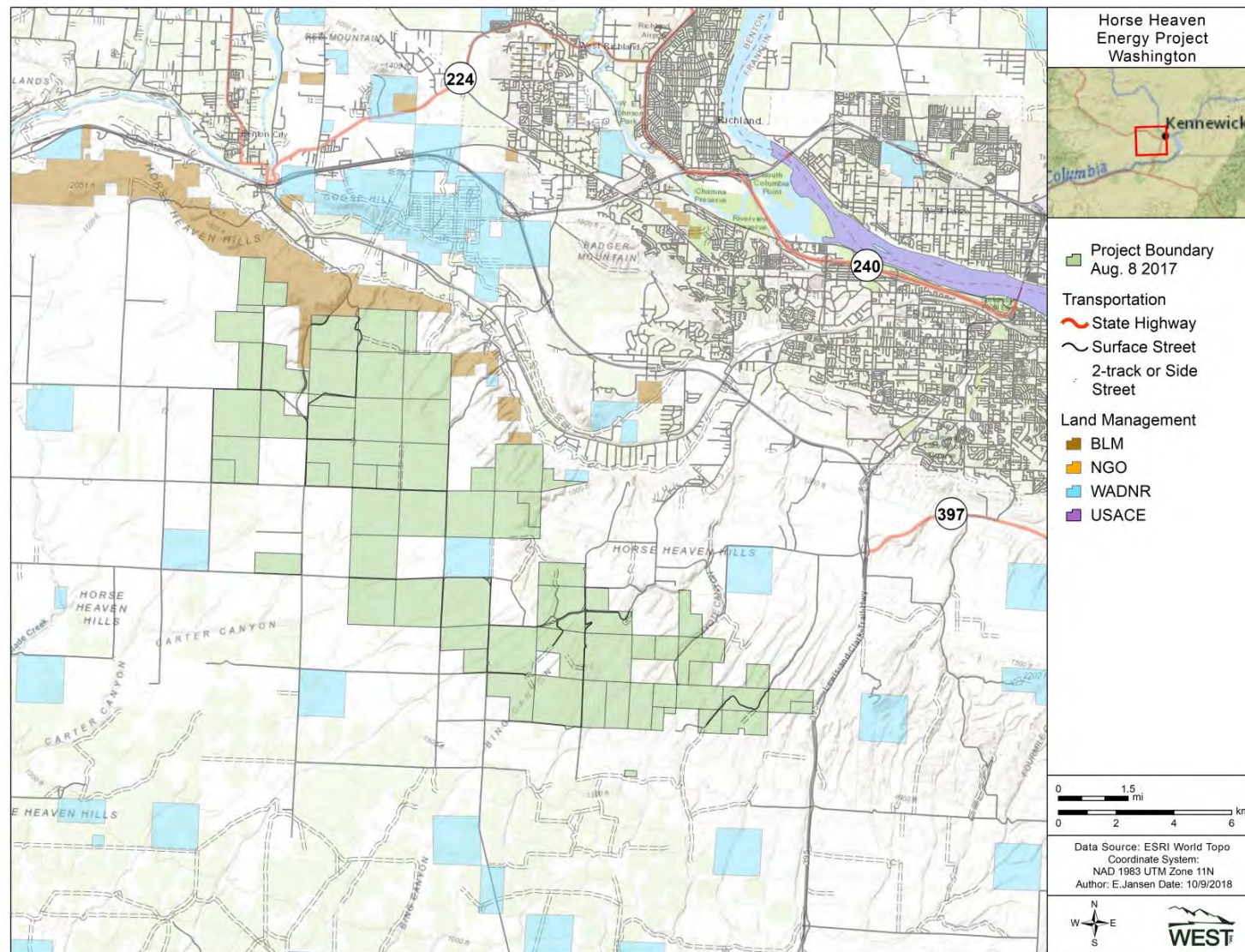


Figure 1. Regional features surrounding the Horse Heaven Wind Project, Benton County, Washington.

METHODS

The study at the Project consisted of the following: 1) fixed-point avian use surveys, 2) aerial raptor nest surveys, 3) landcover mapping, and 4) incidental wildlife observations. Prior to surveys, field survey protocols were reviewed with biologists from the WDFW and USFWS at an in-person meeting in Portland, Oregon on September 19, 2017 and through written comments on September 21, 2017.

Fixed-Point Bird Use Surveys

Survey Design

The USFWS describes survey guidelines in the Eagle Conservation Plan Guidance (ECPG; USFWS 2013), and has codified those guidelines into standards in the recent Final Rule (USFWS 2016; 50 CFR Parts 13 and 22, §22.26). The standards specify the protocols for station establishment, level of survey effort, and data collection related to bald and golden eagles. Because of their specificity, these standards were used to structure the survey design and sampling effort, to the extent possible, for all avian surveys. Data collection for all surveys used commonly-used survey methods (Ralph et al. 1993) and followed protocols specified in USFWS 2016 for eagles, specifically.

Fixed-point count stations were established by placing a point nearest to the farthest western proposed turbine location, then picking from a list of randomly-generated numbers that corresponded to a proposed turbine location. Numbers were discarded and redrawn if 800-m radius survey plots substantially overlapped (e.g., >50%). Point placement was microsituated (e.g., minor shifts of approximately 100 m) in the field to maximize the surrounding viewshed and were placed on publically accessible roads. A total of 13 survey points were established within the proposed Project area to comply with ECPG recommended survey coverage of 30% of the area within one kilometer (km) of turbines to be covered by 800-m radius observation plot (Figure 2). A full survey round was completed every two weeks (e.g., twice per month) and the order which points were surveyed was rotated each round so points were surveyed at different times of the day.

Two types of surveys were conducted at each of the 13 survey points: a 10-minute small bird survey followed by 60-minute large bird survey to maximize the detectability of focal species per USFWS (2016). Surveys were conducted by one observer; points were not surveyed concurrently to minimize the potential for duplicating individuals within a survey, allowing surveys to be considered independent samples from each other.

Survey Schedule

The survey schedule was designed to document bird use and behavior across seasons within the Project area. Surveys were conducted from August 11, 2017 to July 16, 2018. Surveys were conducted twice a month during all seasons which were defined as spring (March 03 to May 27), summer (May 28 to August 10), fall (August 11 to November 28), and winter (November 29 to March 02). A survey of all 13 points (e.g., a survey round) occurred over multiple days,

depending on the amount of available daylight which varied by season, accessibility, and weather conditions. Surveys were conducted during daylight hours.

Small Bird Use Surveys

The objective of small bird use surveys was to collect data on species occurrence, and the spatial and temporal patterns of avian use with a particular focus on passerines and other non-raptors. However, if sensitive species that were classified as large birds (e.g., sandhill crane [*Antigone canadensis*]) or raptors (e.g., eagles) were observed within 100-m survey plot, they were recorded and included as incidental observations. All auditory and visual bird observations within a 100-m circular plot were recorded for a 10-min sample period. For each observation, data recorded included:

- species or closest species group (e.g., unidentified passerine)
- sex
- age
- number of individuals
- distance (m)
- behavior
- flight height above ground level (max, min)
- flight direction
- habitat

Large Bird Use Surveys

The objective of large bird use surveys was to collect data on species occurrence and the spatial and temporal patterns of avian use with a particular focus on eagles, other raptors, and non-raptors such as sandhill crane. Large birds were defined as all raptor species and any bird larger than a common raven. Surveys for large birds were conducted at the same 13 points that were used for all bird surveys. All auditory and visual bird observations within an 800-m circular plot were recorded for a 60-min sample period. Consistent with the ECPG and Final Rule, WEST recorded all eagle observations, the total number of minutes an eagle was observed within the 800-m survey plot and whether the bird was flying above or below 200-m above ground level (AGL) or perched. A minute was tallied at the top of the full minute and rounded to the nearest minute in situations of partial time. A flight path of the large-bird observation was delineated on a topographic inset map and digitized into a Geographic Information System (GIS). In addition to the minute data and flight paths, similar data were collected during large bird survey as during the small bird surveys.

Percent survey coverage of thirteen 800-m survey plots within 1-km of the proposed turbines was calculated by dividing the area of the 800-m survey plot by the 1-km turbine buffer.

Bird Use Statistical Analyses

Bird Diversity and Species Richness

Bird diversity was illustrated by the total number of unique species observed. Species lists (with the number of observations and the number of groups) were generated by season and included all observations of birds detected within the survey plot. In some cases, the tally may represent repeated sightings of the same individual during separate visits. For example, a sum of 50

observations of prairie falcon (*Falco mexicanus*) may be 50 unique birds, or it may be one bird observed on 50 separate visits, or something in between. Species richness by season was calculated by averaging the total number of species observed within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season. Overall species richness was calculated as a weighted average of seasonal values by the number of days in each season. Species diversity and richness were compared among seasons for fixed-point bird use surveys.

Bird Use, Percent of Use and Frequency of Occurrence

For generating standardized fixed-point bird use estimates, small birds recorded within a 100-m survey radius at any time and large birds recorded within the 800-m radius plot at any time were used in the analysis. The metric used to measure mean bird use was the number of birds per survey per plot. These standardized estimates of mean bird use were used to compare differences between bird types and seasons. Mean use by season was calculated by summing the total number of birds seen within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season. Overall mean use was calculated as a weighted average of seasonal values by the number of days in each season.

Bird Flight Height and Behavior

Bird flight heights are important metrics to assess potential risk exposure. Flight height information was used to calculate the percentage of birds observed flying within the rotor-swept height (RSH) for turbines likely to be used at the Project. These analyses were conducted for large bird use surveys only. A RSH for potential collision with a turbine blade of 25 to 150 m (82 to 492 ft) AGL was used for the purposes of the analysis. The flight height recorded during the initial observation was used to calculate the percentage of birds flying within the RSH and mean flight height. The percentage of birds flying within the RSH at any time was calculated using the lowest and highest flight heights recorded.

Bird Exposure Index

The bird exposure index is used as a relative measure of species-specific risk of turbine collision and the species most likely to occur as fatalities at the wind energy facility. These analyses were conducted for large bird use surveys only. A relative index of bird exposure (R) was calculated for bird species observed during the large bird survey using the following formula:

$$R = A \times P_f \times P_t$$

Where A equals the mean relative use for species i averaged across all surveys, P_f equals the proportion of all observations of species i where activity was recorded as flying (an index to the approximate percentage of time species i spends flying during the daylight period), and P_t equals the proportion of all initial flight height observations of species i within the likely RSH. The exposure index does not account for other possible collision risk factors, such as avoidance probabilities or inter/intra-specific behaviors. The first flight height was selected because there was a concern about the observer biasing the flight height of the bird. The thought was the first flight height would be the most independent measurement of bias from the observer that exists.

Spatial Use

Flight paths from large bird use surveys were used to identify patterns of spatial use based on topography surrounding each point count station. If identified, species-specific patterns of concentrated use could be used to identify potential areas of increased risk of turbine collision during the operation of the Project. Flight paths delineated in the field and digitized in GIS were compared to the underlying topographic features which included the broad escarpment, associated draws, and the adjacent side slopes. In addition, patterns of spatial use were compared across seasons to determine whether patterns of spatial use coincided with specific time periods.

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. Potentially erroneous data was identified using a series of database queries. Irregular codes or data suspected as being questionable were discussed with the observer and/or Project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

Data Compilation and Storage

A Microsoft® Structured Query Language (SQL) Server database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined protocol to facilitate subsequent QA/QC and data analysis. All data forms and electronic data files were retained for reference.

Raptor Nest Surveys

Survey Preparation and Consultation

Prior to aerial surveys in 2017, WEST conducted a literature search (Kalasz and Buchanan 2016) and coordinated with Washington Department of Fish and Wildlife (WDFW) biologists to identify previously documented raptor nests in the Survey Area and to review survey protocol. During each survey year, the Project boundary was buffered by 2-miles and 10-miles to create the Survey Area. Compared to 2017, the Project boundary expanded in 2018 to the northwest. WEST developed a survey plan by plotting previously-identified eagle and non-eagle nests on maps and digital tablets (LG, Seoul, South Korea) with navigational software (Gaia GPS) that was used during aerial surveys.

Aerial Survey Methods

Each survey year, two rounds of double-observer (i.e., a primary and secondary observer) aerial nest surveys were conducted at least 30 days apart in a Robinson R-44 Raven II helicopter with bubble windows that provided excellent visibility (Pagel et al. 2010, USFWS 2013). The first survey was conducted during a time period that overlapped the primary early nesting period of

eagles in the Pacific Northwest, when breeding pairs are exhibiting courtship, nest-building, and/or egg-laying and incubation behaviors (Isaacs 2018). A second survey was conducted when eagles are actively engaged in mid- to late breeding season reproductive activities (e.g., incubating, brooding, feeding nestlings), and when eagles engaged in ongoing nesting activities would be reliably on or around nests (Watson 2010, Isaacs 2018).

During the first survey round, coverage included the 2-mi and 10-mi radius survey area around the Project. All stick nests that could be constructed by any raptor species were documented within the 2-mi survey area, whereas only stick nests constructed by golden eagle or bald eagles were documented within 10 miles of the Project. Surveys utilized an intuitive controlled survey method which focused on areas with the highest potential to support raptor nests including cliffs, rock outcrops, incised drainages and canyons, and large trees. During the second survey, WEST biologists revisited previously located raptor nests to evaluate reproductive nesting status and revisited high-quality nesting habitat to search for new nests and later nesting raptor species (e.g., Swainson's hawk [*Buteo swainsoni*]).

During aerial surveys, the helicopter was positioned to allow thorough visual inspection of all appropriate habitat features. In general, the helicopter maintained a distance of no closer than 66 feet (20 m) from cliff faces and nests. When a nest was located, the helicopter reduced speed and adjusted the flight track to allow for a clear view of the nest for documentation and photographing. The amount of time spent circling/searching a particular area or the distance to which a nest was approached was adjusted when raptors, particularly eagles, were present on/near the nest to minimize survey-related disturbance (e.g., flushing). In the event of nestlings, deference was provided and survey of nests directly adjacent to the nestlings (e.g., within 200 m) were aborted.

For each nest or group of nests (e.g., nest site), a Global Positioning System (GPS) location was recorded, a photograph was taken, and nest attribute data were collected. A nest site was defined as two or more nests that occurred on the same shelf, cliff face or tree within close proximity to one another (e.g., approximately 80 feet [25 m]).

WEST categorized nest occupancy following Steenhof et al. (2017) which builds on the research described below. As recommended by Steenhof et al. (2017) the terms "active" and "inactive" to describe nest occupancy or the reproductive status of raptors (particularly eagles) at a particular nest is avoided due to the inconsistent use of the ambiguous term throughout research and technical documents. Associated nest "activity" can be inferred from the observations of nest maintenance, presence of adult or young. The definitions of terms used in this report include:

- **Occupied Nest:** an occupied nest may contain (1) an adult eagle in an incubating position, (2) eggs, (3) nestlings or fledglings, (4) occurrence of an adult (or, sometimes sub-adult), (5) a newly constructed or refurbished stick nest in the area where territorial behavior of an eagle was observed early in the breeding season, or (6) a recently repaired nest with fresh sticks (clean breaks) or fresh boughs on top, and/or droppings and/or molted feathers on its rim or

underneath. A nesting territory that is not occupied is termed unoccupied (Postupalsky 1974, Millsap et al. 2015).

- **Unoccupied Nest:** No sign of adults, young, nest tending or other behavior that indicates nest occupancy during the raptor nesting period.

Landcover Assessment and Mapping

Dominant vegetation types at the Project were mapped to identify potentially suitable habitat for sensitive plant and wildlife species, to help guide surveys for sensitive species within development corridors, or to inform mitigation requirements for temporary and permanent impacts to habitat resulting from Project development. Vegetation types were identified using 2017 and 2018 aerial imagery and remotely sensed data that included the National Landcover Dataset (USGS 2011), National Wetland Inventory (USFWS 2017), and portions of the Project was field-verified. Landcover types were defined as the following:

- Shrub-steppe – synonymous with shrub/scrub in the NLCD (Homer et al. 2015) Areas dominated by shrubs; less than 5-m tall with shrub canopy typically greater than 20% of total vegetation. This class includes true shrubs, young trees in an early successional stage or trees stunted from environmental conditions.
- Grassland – synonymous with grassland/herbaceous in the NLCD (Homer et al. 2015). Areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. Grasslands enrolled in the Conservation Reserve Program (CRP) are included in this classification. These areas are not subject to intensive management such as tilling, but may be utilized for grazing.
- Developed – synonymous with developed/open space in the NLCD (Homer et al. 2015). Includes areas with a mixture of some constructed materials, but mostly vegetation in the form of lawn grasses. Impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
- Agriculture – areas used for the production of annual crops, such as wheat, other grain crops, and also perennial woody crops such as orchards and vineyards. Crop vegetation accounts for greater than 20% of total vegetation. This class also includes all land being actively tilled.

Incidental Observations

Incidental wildlife observations provide records of wildlife seen outside of the standardized surveys. All listed or sensitive species, unusual or unique birds, mammals, reptiles, or amphibians were recorded in a similar fashion to standardized surveys. The date, species, number of individuals, behavior, and height above ground (for bird species) were recorded.

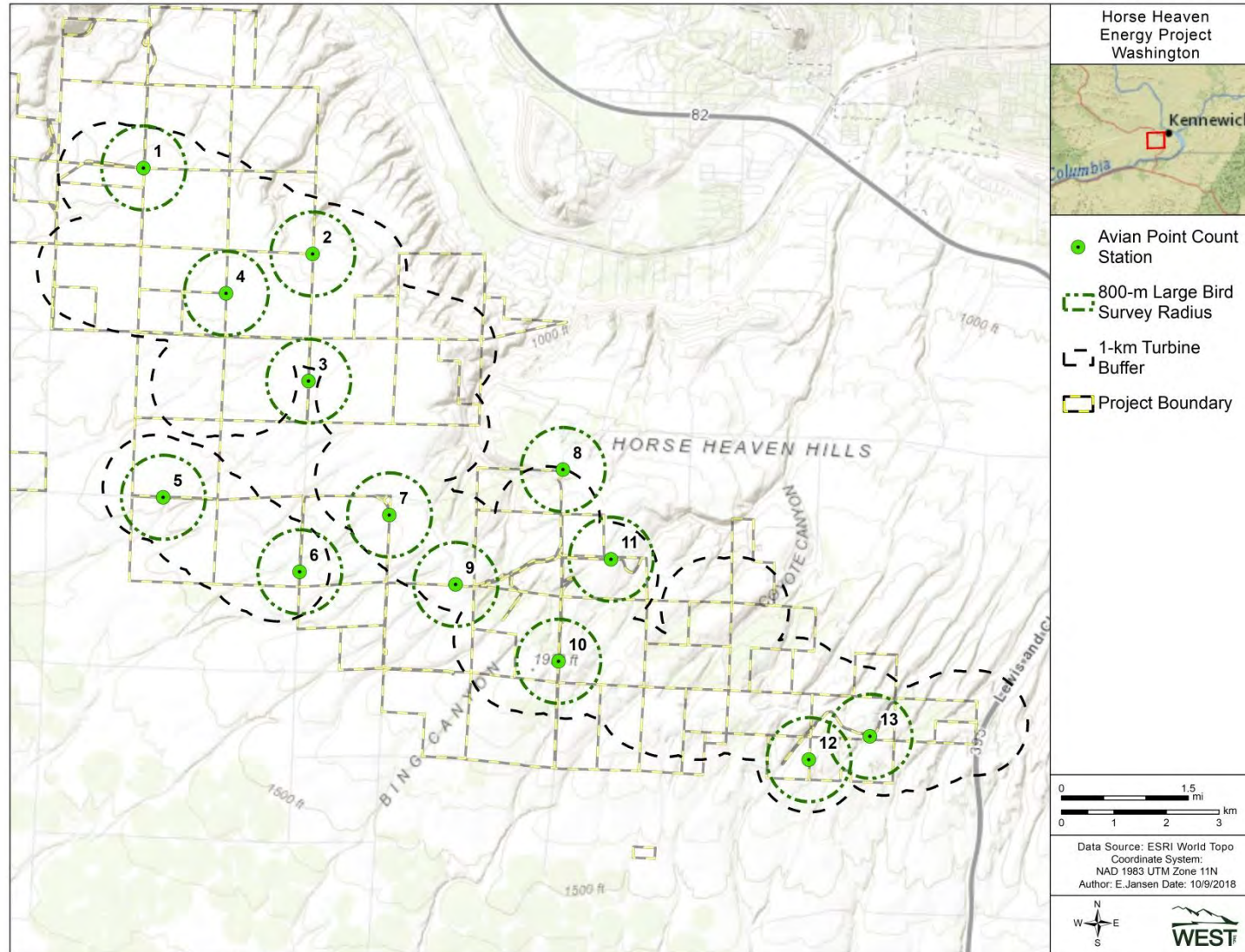


Figure 2. Avian point count survey locations and 800-m radius plots for large bird use surveys at the Horse Heaven Wind Energy Project, Benton County, Washington. 100-m small bird use surveys were conducted at the same points.

RESULTS

Fixed-Point Bird Use Surveys

Survey Coverage and Effort

In a 2-dimensional plane, the survey coverage of the 800-m survey plots within 1-km of the proposed boundary was approximately 31% coverage, slightly over the suggested coverage by the USFWS (USFWS 2016).

Twenty five rounds of small-bird and 25 rounds of large-bird use surveys for a total of 322 surveys of each type were conducted at the Project from August 11, 2017 – July 16, 2018. Survey effort varied across seasons due to inaccessibility during certain times throughout the survey year and a construct of how seasons were delineated (Tables 1a and 1b).

Bird Diversity and Species Richness

During small bird surveys, 20 unique species were observed within 100-m radius plot during the year-long survey effort (Table 1a). Bird diversity (the number of unique species observed) was highest during the fall (15 species), followed by spring (10 species), summer (8 species), and lowest during winter (6 species). Seasonally, species richness small-bird species richness was highest during spring (1.22 species/100-m plot/10-min survey) and decreased over the course of the year and was lowest in winter (0.74 species/100-m plot/10-min survey).

Table 1a. Summary of species richness (species/100-m plot/10-min survey), and sample size by season and overall during the fixed-point small bird use surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Season	Number of Visits	# Surveys Conducted	# Unique Species	Species Richness Small Birds
Spring	6	77	10	1.22
Summer	4	52	8	1.21
Fall	8	104	15	1.09
Winter	7	89	6	0.74
Overall	25	322	20	1.06

During large bird use surveys, 24 unique species were observed within 800-m radius plots during the year-long survey effort (Table 1b). Large bird diversity was highest during spring (18 species), followed by fall (13 species), winter (12 species) and lowest during summer (8 species). Overall, species richness was 1.85 (species/800-m plot/60-min survey) with the highest species richness observed in spring (2.44 species/800-m plot/60-min survey), and lowest during summer (1.27 species/800-m plot/60-min survey; Table 1b).

Table 1b. Summary of species richness (species/800-m plot/60-min survey), and sample size by season during the fixed-point large bird use surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Season	Number of Visits	# Surveys Conducted	# Unique Species	Species Richness
				Large Birds
Spring	6	77	18	2.44
Summer	4	52	8	1.27
Fall	8	104	13	1.95
Winter	7	88	12	1.66
Overall	25	322	24	1.85

Bird Use, Percent of Use, and Frequency of Occurrence

Mean bird use, percent of use, and frequency of occurrence were calculated by season for small bird and large bird types (Table 2a and 2b) and species (Appendix A1-2 and B1-2). The following summarizes results of each survey type and describes characteristics for each bird group; relevant species-specific results are then presented for each species group.

During small bird use surveys, a total of 2,205 individuals were recorded within 799 separate groups (Appendix A1). Overall small bird use was 3.62 birds/100-m plot/10-min with the highest use in winter (10.85 birds/100-m plot/10-min). Small bird mean use in the remaining seasons were similar between spring and fall (5.17 and 5.14 birds/100-m plot/10-min, respectively) and were lowest during summer with 4.87 birds/100-m plot/10-min (Table 4a). Passerines comprised the majority of observations during all seasons and were observed most frequently during spring (85.9% of all surveys) and least frequently during winter (62.4% of all surveys). High small bird use during winter although observed less frequently indicates larger bird groups (e.g., flocking behavior) during this time of year (Appendix A). Unidentified small birds and woodpeckers were observed less often with unidentified small birds being observed fall and winter with 0.40 and 0.37 birds/100-m plot/10-min, respectively, and woodpeckers (northern flicker [*Colaptes auratus*]) only observed during fall (0.03 bird/100-m plot/10-min; Table 4a).

During large bird use surveys, a total of 2,740 individuals were recorded within 941 separate groups (Appendix A2). Of the 24 species observed, three species (13% of all species) composed 54% ($n = 1,481$ individuals) of all observations: sandhill crane (*Antigone canadensis*; $n = 552$ individuals), rock pigeon (*Columba livia*; $n = 477$ individuals), and common raven ($n = 452$ individuals; Appendix A2). Large bird use was highest in spring (11.69 birds/800-m plot/60-min survey), followed by fall (9.03 birds/800-m plot/60-min survey), winter (8.56 birds/800-m plot/60-min survey), and lowest in summer (2.48 birds/800-m plot/60-min survey; Table 1b). Higher large bird use during spring was attributed to large groups of waterbirds primarily sandhill cranes, as well as a consistent use of corvids (Table 2b). Overall low summer use was attributed to marked decrease in species abundance across all species groups compared to other seasons, with the exception of Swanson's hawk (*Buteo swainsoni*; Appendix B2).

Passerines

Despite the higher use by passerines during winter, species diversity and richness was low and comprised primarily of two species of passerines (10% of all species) that composed approximately 86% ($n = 1,894$ individuals) of all observations: horned lark (*Eremophila alpestris*; $n = 1,797$ individuals), and western meadowlark (*Sturnella neglecta*; $n = 97$ individuals; Appendix A1). Horned lark had the highest use by any one species during all seasons of the study (4.51, 3.65, 3.32, and 10.18 birds/100-m plot/10-min, respectively), and the western meadowlark followed with the highest use occurring during spring and fall with 0.36 birds/100-m plot/10-min for both seasons.

Waterbirds

Waterbirds had the highest use during spring with 5.03 birds/800-m plot/60-min, followed by fall, summer, and winter (1.56, 0.02, and 0.00 birds/800-m/60-min, respectively; Appendix B2). Observations of waterbirds, specifically sandhill crane, had the greatest influence on overall large bird use. High spring observations of sandhill cranes consisted of two groups of 390 individuals (Appendix A2), followed by fall observations of six groups of 162 individuals, and no observations during summer and winter. American white pelican was the only other waterbird observed with only a summer use of 0.02 birds/800-m plot/60-mins.

Waterfowl

Waterfowl had the highest use during the winter (3.65 birds/800-m plot/60-min), followed by fall (1.68 birds/800-m/60-min), and spring and summer with no use. Canada goose use was highest during winter (3.65 birds/800-m plots/60-min) consisting of nine observations of approximately 214 total individuals followed by fall with four observations of 175 individuals (Appendix A2). An observation of one group of snow goose (*Chen caerulescens*) comprised of approximately 100 individuals was also documented during the winter for a mean use of 1.3 birds/800-m plot/60-mins.

Shorebirds

Long-billed curlew (*Numenius americanus*) was the only shorebird species observed during large bird use surveys and were only documented during spring surveys when two groups of two individuals total were observed (0.03 birds/800-m plot/60-min survey).

Diurnal Raptors

Seasonal and species-specific variability in diurnal raptor use were observed during large bird use surveys. Diurnal raptor use were similar throughout the study with high use occurring during fall (2.22 raptors/800-m plot/60-min; Table 2b), followed by summer, spring, and winter (1.67, 1.54, and 1.43 raptors/800-m plot/60-min, respectively). Relatively higher use during fall was influenced by increased observations of northern harrier (*Circus cyaneus*) where there were 100 observations of 110 total individuals (Appendix A2). During the survey period, eagles had relatively low use compared to other species where use during fall and winter was 0.02 eagles/800-m plot/60-min, 0.01 eagles/800-m plot/60-min during the spring and no eagles were observed during summer.

Table 2a. Mean bird use (number of birds/plot^a/10-min survey), percent of total use (%), and frequency of occurrence (%) for each bird type and species by season during the fixed-point small bird use surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Type/Species	Mean Use				% of Use				% Frequency			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Passerines	5.71	4.87	4.71	10.48	100	100	91.6	96.6	85.9	82.7	66.3	62.4
Woodpeckers	0	0	0.03	0	0	0	0.6	0	0	0	1.9	0
Unidentified Birds	0	0	0.4	0.37	0	0	7.9	3.4	0	0	8.7	1.1
Overall	5.71	4.87	5.14	10.85	100	100	100	100				

^a 100-m radius plot for all bird use surveys.

Table 2b. Mean bird use (number of birds/plot^a/60-min survey), percent of total use (%), and frequency of occurrence (%) for each bird type and species by season during the fixed-point large bird use surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Type/Species	Mean Use				% of Use				% Frequency			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Waterbirds	5.03	0.02	1.56	0	43	0.8	17.3	0	2.7	1.9	4.8	0
Waterfowl	0	0	1.68	3.65	0	0	18.6	42.7	0	0	2.9	9.0
Shorebirds	0.03	0	0	0	0.2	0	0	0	2.6	0	0	0
Gulls/Terns	2.31	0	0	0	19.7	0	0	0	10.3	0	0	0
Diurnal Raptors	1.54	1.67	2.22	1.43	13.2	67.4	24.6	16.8	71.3	63.5	73.1	60.0
<u>Accipiters</u>	0.03	0	0.04	0	0.2	0	0.4	0	2.6	0	3.8	0
<u>Buteos</u>	0.98	1.29	0.76	0.57	8.4	51.9	8.4	6.6	60.8	59.6	36.5	31.7
<u>Northern Harrier</u>	0.42	0.17	1.05	0.66	3.6	7.0	11.6	7.7	29.9	11.5	49	38.2
<u>Eagles</u>	0.01	0	0.02	0.02	0.1	0	0.2	0.3	1.3	0	1	1.1
<u>Falcons</u>	0.08	0.21	0.29	0.16	0.7	8.5	3.2	1.9	7.7	9.6	18.3	13.2
<u>Other Raptors</u>	0.03	0	0.07	0.02	0.2	0	0.7	0.3	2.6	0	6.7	2.2
Owls	0	0	0	0.01	0	0	0	0.2	0	0	0	1.3
Upland Game Birds	0.03	0.06	0	0	0.2	2.3	0	0	2.7	3.8	0	0
Doves/Pigeons	0.94	0.35	2	2.01	8.1	14.0	22.2	23.5	29.9	11.5	9.6	8.9
Large Corvids	1.82	0.38	1.57	1.45	15.6	15.5	17.4	16.9	72.9	21.2	52.9	53.5
Overall	11.69	2.48	9.03	8.56	100	100	100	100				

^a 800-meter radius plot for large birds.

Eagles

A total of four golden eagle observations were documented during large bird use surveys for a total of 35 eagle minutes (Table 3). On April 9, 2018 an adult golden eagle was observed at Point 13 circling below 200 m AGL and within 800-m of the observer for 30 minutes of the 60 minute survey (Table 3, Appendix E). The eagle flew out of the 800-m survey plot during the survey but repeatedly returned and circle soared over the observer while calling. On the same day, an additional observation of an adult golden eagle was recorded at Point 12 for four minutes below 200 m AGL but at a distance of 1,000–1,200 m from the observer and was considered an incidental observation and not included in the eagle minute tally. It is likely the second observation was of the same individual based on the territorial behavior of the eagle and the flight direction of the eagle toward Point 13 during the second observation. On November 18, 2017, a pair of juvenile golden eagles was observed hunting at Point 8. One eagle was first observed perched in a field and subsequently flew between 10–60m AGL with the second eagle for a total of five minutes within the 800-m survey plot (Table 3, Appendix E). Together, golden eagles were recorded for 66 minutes total and 35 minutes within the 800-m survey plot and flying below 200-m AGL (Table 3, Appendix E).

A total of two bald eagle observations were documented during large bird use surveys for a total of six eagle minutes (Table 3). On February 5, 2017, one adult bald eagle was observed at Point 8 flying approximately 150 m AGL 675–800 m from the observer for a total of three eagle minutes. Forty four minutes after the eagle flew out of the survey plot and exited the area, another observation of an adult eagle was recorded flying 100-180 m AGL at the edge of the 800m survey plot for an additional three eagle minutes. It is likely both eagle observations were of the same individual based on the adult plumage observed in both eagles. Together, bald eagles were recorded for nine minutes total and six minutes within the 800-m survey plot and flying below 200-m AGL (Table 3, Appendix E).

Table 3. Eagle observations at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

	Spring	Summer	Fall	Winter
Total Surveys (hrs.)	77	52	104	88
Golden Eagle				
# Observations	1 ^a	0	2	0
# Minutes Observed	60	0	6	0
Minutes < 800-m, < 200-m AGL	30	0	5	0
Bald Eagle				
# Observations	0	0	0	2 ^b
# Minutes Observed	0	0	0	9
Minutes < 800-m, < 200-m AGL	0	0	0	6

^a One additional eagle was observed during spring > 800-m from Point 12 and was considered an incidental observation. The incidental observation is most likely the same individual that was observed at Point 13 for 60 minutes.

^b The two bald eagle observations are likely of the same individual.

Bird Flight Height and Behavior

Flight height characteristics, based on initial flight height observations and estimated use, were estimated for large bird groups (Table 4) and species (Appendix C). During fixed-point bird use

surveys, 825 groups of large birds were observed flying within the 800-m plot, totaling 2,417 individuals. Overall, 43.5% of large birds were recorded flying within the RSH, 35.1% were below the RSH, and 21.4% were flying above the RSH. Waterbirds, which exhibited the highest overall use, were observed flying primarily (90%) above the RSH although had a mean flight height of 133-m AGL (Table 4). Less than half (39%) of all raptors were observed flying within the RSH, which was influenced by the number of northern harrier and falcons that typically flew below the RSH (84–96% of observations). Considering *Buteos* only (e.g., red-tailed hawk, Swainson's hawk, and rough-legged hawk), 71% of all individuals were observed flying within the RSH at a mean flight height of 40-m AGL. Individuals observed within the waterfowl group had the largest percent of individuals flying in the RSH (90%) which were primarily attributed to Canada geese.

Table 4. Flight height characteristics by bird type^a and raptor subtype during fixed-point large bird use surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Bird Type	# Groups Flying	# Obs Flying	Mean Flight Height (m)	% Obs Flying	% within Flight Height Categories		
					0 - 25 m	25 - 150 m ^b	> 150 m
Waterbirds	8	503	133.75	91	0	9.9	90.1
Waterfowl	14	489	110.36	100	0	90.2	9.8
Shorebirds	0	0	0	0	0	0	0
Gulls/Terns	10	180	60	100	2.8	90	7.2
Diurnal Raptors	468	494	24.65	87.4	61.1	38.5	0.4
<i>Accipiters</i>	6	6	13.17	100	83.3	16.7	0
<i>Buteos</i>	220	236	39.61	86.8	29.2	70.8	0
<i>Northern Harrier</i>	195	205	6.41	98.1	96.1	3.9	0
<i>Eagles</i>	4	4	115	80	0	75	25
<i>Falcons</i>	32	32	13.06	51.6	84.4	15.6	0
<i>Other Raptors</i>	11	11	55.91	100	36.4	54.5	9.1
Owls	0	0	0	0	0	0	0
Upland Game Birds	0	0	0	0	0	0	0
Doves/Pigeons	43	334	16.98	69.6	59.3	40.7	0
Large Corvids	282	417	16.51	92.1	82.3	17.3	0.5
Large Birds Overall	825	2,417	24.41	88.6	35.1	43.5	21.4

^a 800-meter (m) radius plot for large bird use surveys.

^b The likely "rotor-swept height" for potential collision with a turbine blade, or 25 to 150 m (82 to 492 ft) above ground level.

Bird Exposure Index

A relative exposure index, which is a function of initial flight height and relative abundance (defined as the use estimate), was calculated for each large bird species. Those species that had exposure to the RSH are listed in Table 5, and a complete list of all species is presented in Appendix C. Canada goose had the highest exposure index of 0.98 which was over twice as high than any other large bird species. Despite only 13 observations of Canada goose groups in-flight, approximately 90% of observed flight occurred in the RSH which resulted in a relatively high exposure index. Rock pigeon had the second highest exposure index (0.4), which was influenced by large group sizes and high number of individuals within observed groups. Despite having the highest total number of observations and highest observed use, sandhill crane had a relatively low exposure index (0.15) due to the percentage of groups flying within the RSH when

first observed (9.8%, Table 5). Of the raptor species, Swainson's hawk had the highest exposure index (0.24) followed by red-tailed hawk (0.14).

Table 5. Relative exposure index and flight characteristics for bird species^a during fixed-point large bird use surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH ^b based on Initial obs	Exposure Index	% Within RSH at Anytime
Canada goose	13	1.11	100	87.7	0.98	94.3
rock pigeon	41	1.41	69.6	41.0	0.40	52.4
California gull	6	0.40	100	88.7	0.36	88.7
snow goose	1	0.33	100	100	0.33	100
Swainson's hawk	78	0.36	83.7	79.3	0.24	93.1
common raven	279	1.34	92.0	17.4	0.21	32.2
sandhill crane	7	1.65	90.9	9.8	0.15	82.5
red-tailed hawk	59	0.22	84.7	72.1	0.14	85.2
unidentified gull	4	0.14	100	93.6	0.13	93.6
rough-legged hawk	71	0.23	92.5	59.5	0.13	78.4
unidentified <i>Buteo</i>	9	0.04	84.6	81.8	0.03	81.8
northern harrier	195	0.62	98.1	3.9	0.02	9.3
unidentified raptor	11	0.03	100	54.5	0.02	81.8
American kestrel	29	0.18	50.9	17.2	0.02	27.6
golden eagle	2	<0.01	66.7	100	<0.01	100
American white pelican	1	<0.01	100	100	<0.01	100
ferruginous hawk	3	<0.01	100	33.3	<0.01	66.7
Cooper's hawk	3	<0.01	100	33.3	<0.01	33.3
bald eagle	2	<0.01	100	50.0	<0.01	100

^a Only includes species with exposure index values; see Appendix C for full listing.

^b The likely "rotor-swept height" for potential collision with a turbine blade, or 25 to 150 m (82 to 492 ft) above ground level.

Spatial Use

Substantially higher small bird use was observed at three survey points and included Point 3 (15.9 birds/100-m plot/10-min survey), Point 4 (15.2 birds/100-m plot/10-min survey), and Point 7 (12.0 birds/100-m plot/10-min survey; Figures 3 and 5). Points 3 and 4 are located in the middle to western end of the Project, and Point 7 is located in the center of the Project area. High annual mean use of horned lark, particularly of larger groups during winter, was observed at these survey points (Appendix D). Landcover surrounding high use survey points were composed primarily of agriculture (dryland wheat) which did not represent a unique habitat type on the landscape.

Large birds were observed at each point in the Project; use was highest at Point 7 (26.1 birds/800-m plot/ 60-min; Figures 4 and 5). Overall higher avian use at Points 7 was influenced primarily by large groups of waterbirds, particularly sandhill cranes, which flew over the Project during spring and fall (Appendix D). Common raven, northern harriers and the *Buteo* group had relatively higher use at Point 7 compared to other points (Appendix D) and were often observed flying through the survey plot or hunting within the wheat fields and along the county road.

Diurnal raptors were observed throughout the Project with higher use at points within the center (Points 6, 7, and 8) and east (Points 12 and 13) of the Project (Appendix D). Points 6, 7, and 8 had slightly higher diurnal raptor use than other survey points (2.48, 2.88, and 2.68 birds/ 800-m plot/60-mins, respectively; Appendix D). Despite the occurrence of an occupied Swainson's hawk nest within or adjacent to the 800-m survey plot at Points 6, 8, 11, and 13, higher avian use at those Points resulted from observations of doves (Points 6 and 13), gulls (Point 8) and waterfowl (Point 11). Points 1 and 2, which were located nearest to the northern escarpment which could be used as updrafts, did not show a noticeable increase in diurnal raptor use (Figure 5). The inconsistent pattern of use throughout the Project area could be a result of the overall homogeneity of the landcover, seasonal variability of foraging resources, or lack of topographic complexity within the Project.

The majority of sandhill cranes were observed at Points 3 and 7 and only during spring and fall (Appendix B2). No other areas of consistent use or concentrated flight paths were noted (Appendix E). Suitable stopover habitat (large wetland/agricultural matrix or inundated agricultural fields) were not present during surveys.

Bald and golden eagles were recorded at Points 8 and 13 with higher use occurring at points 8 and 13 (0.04 and 0.16 eagles/ 800-m plot/60-min, respectively). With a limited number of eagle observations, no obvious flyways or areas of concentration were observed and occurrence within the Project was likely associated with seasonal movements and foraging behavior.

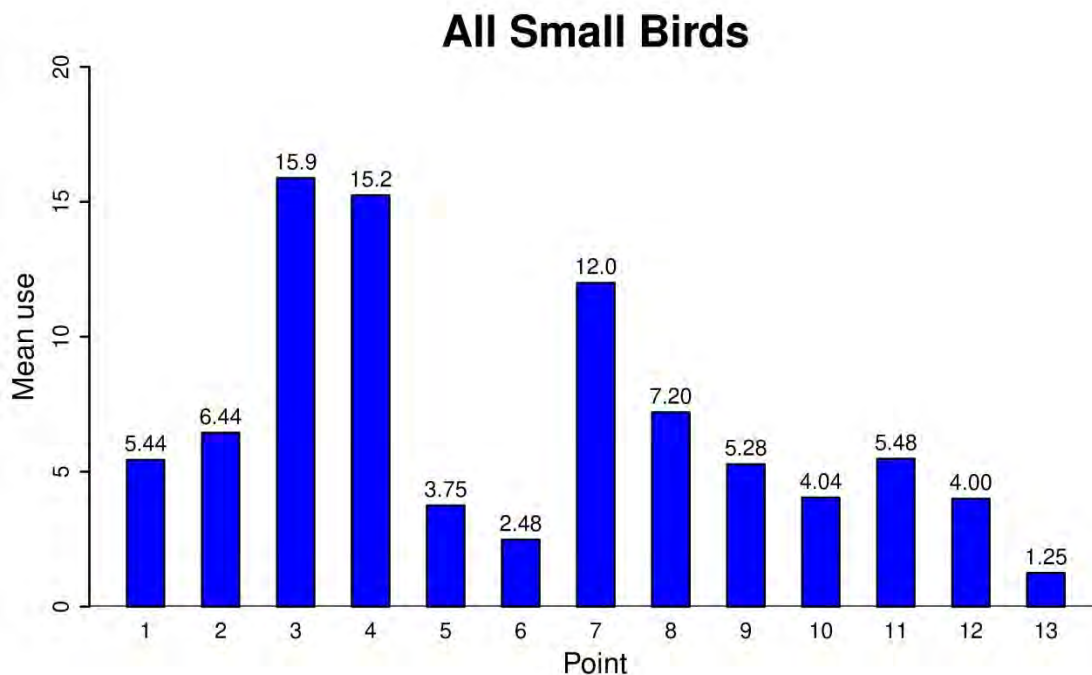


Figure 3. Mean use by point by all small birds at the Horse Heaven Wind Project during small bird use surveys from August 11, 2017 to July 16, 2018.

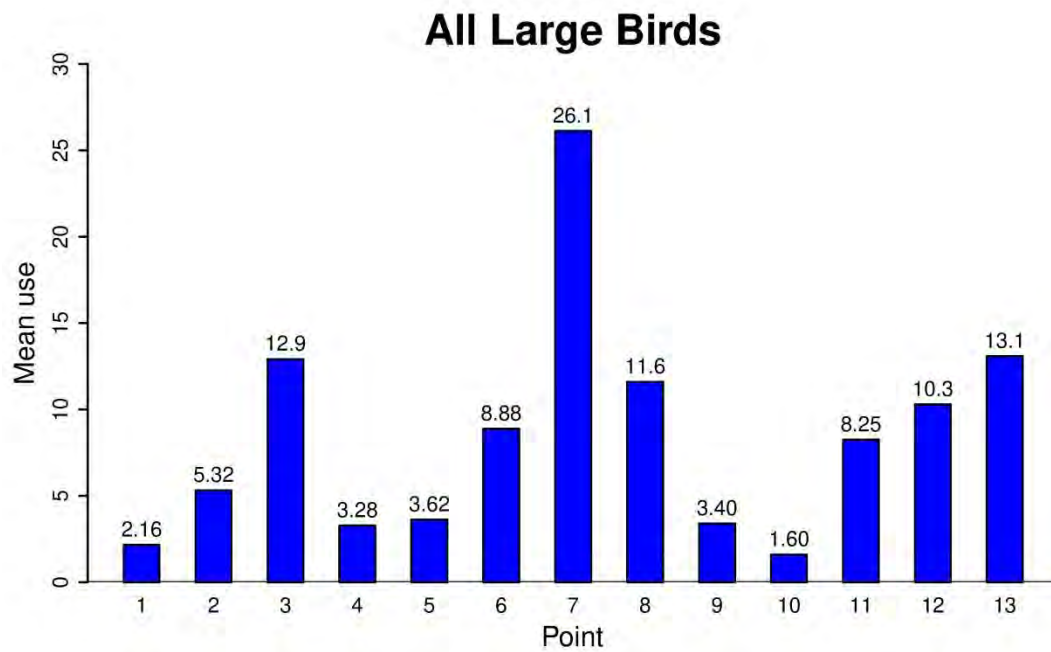


Figure 4. Relative large bird use by observation point during fixed-point bird use surveys at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

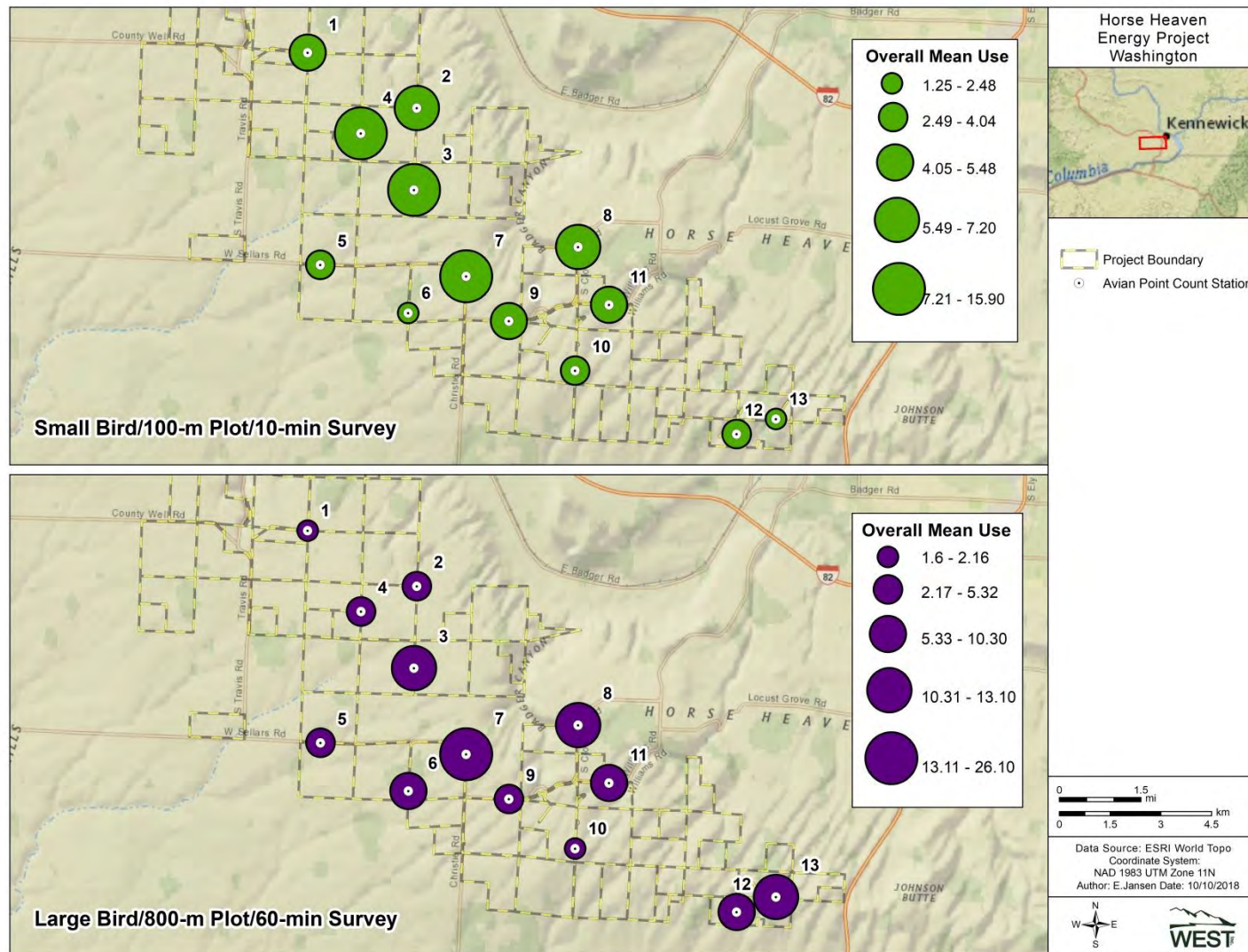


Figure 5. Overall avian use by point count observed during fixed-point surveys at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018. Note the varying scales of the graduated symbology between the two figure panes.

Sensitive Species Observations

Six sensitive bird species and one sensitive mammal species was recorded during 2017–2018 wildlife surveys (Table 6). Bald eagle and golden eagle are listed under the Bald and Golden Eagle Protection Act of 1940 and have a permit process available to cover incidental take for otherwise lawful activities (USFWS 2016). Due to population increases, the American white pelican was recently down listed to state threatened (Stinson 2016) whereas the sandhill crane is listed as state endangered (Stinson 2017). No longer considered a federal candidate species for the Endangered Species Act, the Washington ground squirrel remains a candidate species for state listing.

Table 6. Summary of sensitive species observed during avian use survey and as incidental wildlife observations from August 11, 2017 – July 16, 2018.

Species	Scientific Name	Status	Point Count		Incidental		Total	
			# of grps	# of obs	# of grps	# of obs	# of grps	# of obs
American white pelican	<i>Pelecanus erythrorhynchos</i>	WA-T	1	1	0	0	1	1
bald eagle	<i>Haliaeetus leucocephalus</i>	BCC	2	2	1	1	3	3
ferruginous hawk	<i>Buteo regalis</i>	WA-T	3	3	0	0	3	3
golden eagle	<i>Aquila chrysaetos</i>	BCC	3	3	1	1	4	4
sagebrush sparrow	<i>Arremoniospiza nevadensis</i>	WA-C	1	1	0	0	1	1
sandhill crane	<i>Antigone canadensis</i>	WA-E	8	552	0	0	8	552
Washington ground squirrel	<i>Uroditellus washingtoni</i>	WA-C	--*	--	5*	5*	--*	--
Total	7 species		18	562	7	7	20	564

BCC = Migratory Birds of Conservation Concern designated by USFWS 2008 and related regulations (e.g., Migratory Bird Treaty Act 1918, Bald and Golden Eagle Act of 1940).

WA-E = Washington state endangered species designated by WA Administrative Code (WAC) 220-610-010

WA-T = Washington state threatened species designated by WAC 220-200-010

WA-C = Washington state candidate species designated by WAC 220-610-110

Washington state monitored species are not included (WDFW 2005, 2015)

Sources:

Federal: USFWS 2017 (<https://ecos.fws.gov/ipac/>). BCC list derived from iPaC and Project boundary

State: WDFW 2017 (https://wdfw.wa.gov/conservation/endangered/state_listed_species.pdf)

* observed incidentally in-between point count surveys but stopped keeping track of WAGS because activity was so prevalent in spring 2017.

Raptor Nest Surveys

2017 Aerial Surveys

A total of 21 raptor nests were located within the Survey Area in 2017 during aerial surveys conducted March 31 and May 10 (Jansen 2017). Of the 21 nests documented, 11 nests (55%) were occupied; of the 11 occupied nests, eight nests had adults incubating or young observed in the nest (Appendix F). A total of 6 different species were recorded during the nest surveys, red-tailed hawk was the most prevalent species in the Survey Area followed by ferruginous hawk and great-horned owl.

A pair of bald eagles was observed near Nest 18 which was located at the confluence of the Yakima River and Columbia River and adjacent to State Highway 240 and several nature preserves approximately 7.7 miles northeast of the Project. The nest contained one chick approximately 21 days old at the time of the second survey (April 30). Two nests (Nest 3 and 8) were occupied by ferruginous hawk of which, one adult was sitting on Nest 3 during both surveys and is assumed active. Nest 3 was located in a [REDACTED] 13 [REDACTED]. The occupied inactive ferruginous hawk nest (Nest 8) had one adult standing on top of the nest during the first survey and was in good condition (Appendix F1). Seven additional unoccupied inactive nests were characteristic of nests built by ferruginous hawks and found within two miles of the Project. These unoccupied, inactive nests were located on the ground ($n = 6$ nests) and cliff ledge ($n = 1$ nest) and had the size and form typical of ferruginous hawk construction. Five of the nests were in poor to fair condition, indicating no recent maintenance or nesting activities had occurred and were most likely old territories. One adult ferruginous hawk was flushed from the ground and observed in flight, but could not be attributed to a particular nest.

Of the four red-tailed hawks that were observed on the nest during the first survey, three nests contained one to two chicks between 14–21 days old during the second survey (Nest 1, Nest 9, and Nest 12). The fourth nest observed with a red-tailed hawk during the first survey did not contain signs of nesting during the second survey and was considered occupied inactive.

Two great-horned owls were observed nesting within two miles of the Project. One of the nests (Nest 14) had an adult incubating on the nest during the first survey and two owlets standing adjacent to the nest during the second survey. One additional nest (Nest 2) had an adult owl sitting on the nest during the first survey with two red-tailed hawks perched on an adjacent tree. The nest was abandoned by the second survey with no sign of nesting activity.

One occupied active Swainson's hawk nest was observed during the second survey near the center of the Project. The nest was vacant during the first survey and is presumed the adult arrived between the first and second surveys. The adult was observed sitting in an incubating position.

While not a raptor per se, one common raven (*Corvus corax*) nest (Nest 6) was recorded because ravens and raptors are known to use similar-sized nests. The nest was located in the

center of the Project on top of an old windmill and had an adult on the nest during the first and second surveys.

The remaining 3 unoccupied nests (Nest 5 and Nest 20) were located in trees within the Project. Two nests were located within the tree at Nest 5 and one at Nest 20. Neither nest(s) location had signs of nesting activity during either survey.

2018 Aerial Surveys

A total of 33 nests were observed in the Survey Area during the 2018 raptor nest surveys conducted March 5 and May 10. Of the 33 nests, 19 (58%) were occupied; of the 19 occupied nests, 14 contained eggs or young and the remaining five nests had an adult incubating during the last survey (Appendix F). Similar to 2017 surveys, a total of 6 different species were recorded during the nest surveys. Red-tailed hawk was the most prevalent species in the Survey Area followed by Swainson's hawk and great-horned owl (Table 7).

The occupied bald eagle nest in 2017 (Nest 18) was reoccupied in 2018 and contained 2 chicks approximately 21 days old during the second survey (May 10). Similarly, the occupied ferruginous hawk nest (Nest 3) that was previously documented in 2017 was reoccupied and contained an incubating adult during the second survey.

Six of the eight red-tailed hawk nests documented in 2018 were previously undocumented with the majority of nests located to the north of the Project, along an old railroad grade (Appendix F, Figure 7). All red-tailed hawk nests were occupied with either eggs or young in the nest during the second survey.

Of the six Swainson's hawk nests occupied in 2018, two were discovered during point count surveys, after aerial surveys concluded. Four of the six occupied Swainson's hawk nests contained eggs or young during the second survey (Appendix F).

Two nests occupied by great-horned owl were observed during the 2018 nest surveys. Nest 7 contained an adult with one egg in the nest bowl; however during the second survey the nest bowl was empty with no sign of adults or young. Nest 20 contained at least one egg and one adult owl during the second survey; one owlet was observed on the nest during the second survey.

The same common raven nest that was occupied in 2017 was reoccupied in 2018 and located on top of an old windmill. One adult was observed incubating during the second survey.

Of the 14 unoccupied nests, 11 were located on the ground or cliff and were indicative of ferruginous hawk construction. Based on the poor to fair condition of the 11 nests in 2017 and 2018, these nests have not been used for three or more years.

2017–2018 Nest Survey Comparison

In 2017 there were a total of 21 nests found within the Survey Area and in 2018 an additional 12 nests were located. The increase in the number of nests between years was due to the construction of *Buteo* nests; red-tailed hawks in deciduous trees along an old railroad grade located north of the Project and Swainson's hawks in isolated trees scattered throughout the Project. The number of occupied red-tailed hawk and Swainson's hawk nests increased between 2017 and 2018 and contributed to the majority of the raptor nest use (73%) in 2018 (Table 7).

Eight nests were occupied in 2017 were re-occupied again in 2018 (Nests 2, 3, 6, 7, 9, 14, 18, and 19; Appendix F1 and F2). Of the eight nests occupied in successive years, five (62.5%) contained the same species. Nest 18 was a reoccurring bald eagle nest that had two young approximately 21 days old during the second survey in 2017 and 2018. A ferruginous hawk was observed on Nest 3 each year in an incubating posture during the second survey. A Swainson's hawk occupied a tree nest (Nest 19) in the middle of the Project, adjacent to a common raven nest (Nest 6) on a windmill which was also occupied each survey year. Nest 9 was occupied by a red-tailed hawk and contained at least one young on the second survey each year. Occupied nests with a different species between years typically had a great-horned owl during one of the two survey years.

Although more nests were documented within 2-miles of the Project in 2018 compared to 2017, nest density decreased because the Survey Area was over twice as large in 2018 (Table 7). Nest density decreased for all species in 2018, except for Swainson's hawk which tripled and red-tailed hawk which remained relatively stable between years (Table 7).

Table 7. Raptor nest results within 2-miles of the proposed Horse Heaven Wind Project, Washington. Aerial surveys conducted March 31 and May 10 2017 and March 05 and May 10 2018. Supplemental ground surveys were conducted during summer 2018.

Species Obs. On Nest	2017		2018	
	# Nests	Nest Density (#/mi ²) ^a	# Nests	Nest Density (#/mi ²) ^a
Bald Eagle ^b	1	0.000	1	0.000
Ferruginous Hawk	2	0.027	1	0.007
Swainson's Hawk	1	0.013	6	0.039
Red-tailed Hawk	4	0.054	8	0.052
Great-horned Owl	2	0.027	2	0.013
Common Raven	1	0.013	1	0.007
Unoccupied	10	0.134	14	0.090
Total	21	0.268	33	0.210

^a Nest Density = # Nests within 2-mi of Project / (Project Area + 2-mi All Raptor Survey Area). 2017 = 74.66 mi²; 2018 = 152.60 mi²

^b Located outside the two-mile Survey Area.

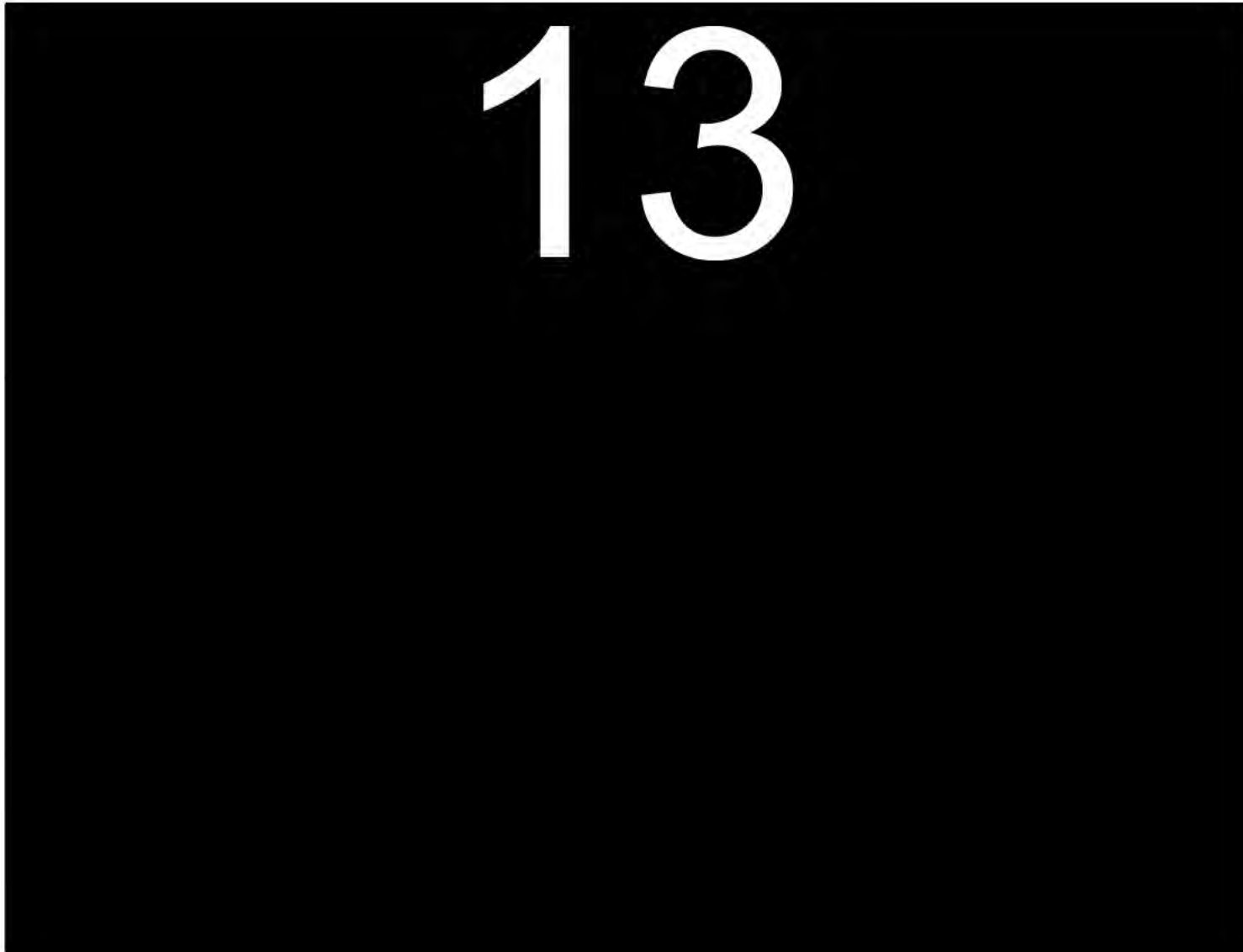


Figure 6. Raptor nest locations documented during aerial surveys of the Horse Heaven Wind Project, March 31 and May 10, 2017.

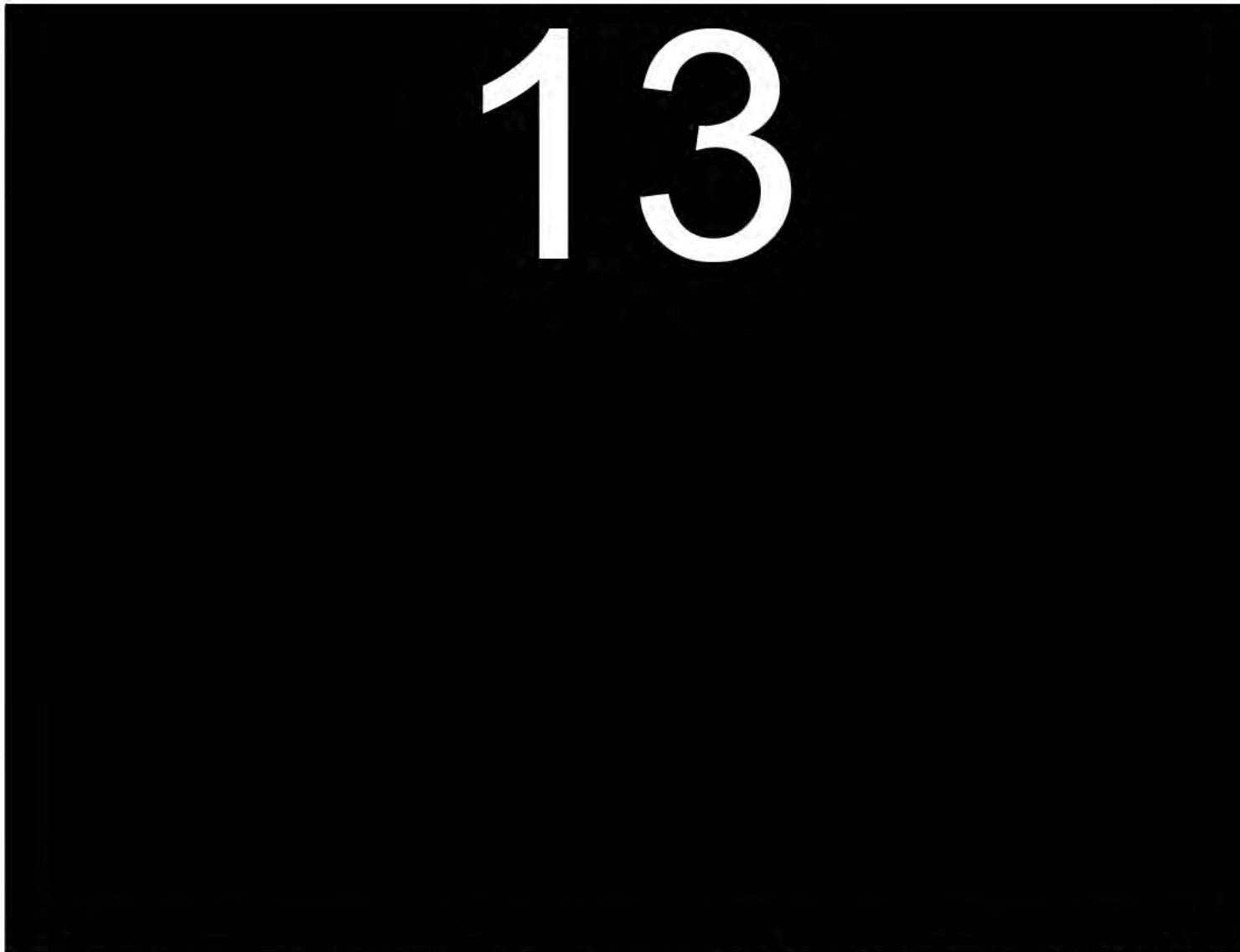


Figure 7. Raptor nest locations documented during aerial surveys of the Horse Heaven Wind Project, March 5 and May 10, 2018.

Landcover Assessment and Mapping

Four landcover types were found within the 25,815 acre Project boundary (Appendix G). The predominant landcover type within the Project was agriculture (73%) followed by grassland (25%), and shrub-steppe (2%; Table 8). Digitized landcover data showed concurrence with landcover classes from the NLCD (Appendix G). Shrub/scrub and grassland (e.g., shrub-steppe) habitat are important breeding, nesting, and foraging habitats for a number of sensitive wildlife species, including several observed during avian use surveys (e.g., sagebrush sparrow, grasshopper sparrow, long-billed curlew). Shrub-steppe is classified as a priority habitat in Washington and has various mitigation ratios for temporary and permanent impacts (WDFW 2009). Except in a small number of areas, shrub-steppe habitat was only present in isolated patches across the Project area that was primarily in ravines with steep sides where agricultural practices were too difficult to perform. The majority of these areas were more common on the eastern side of the Project area. Although public records are not available, many grasslands were enrolled in CRP.

Table 8. Digitized landcover types found at the Project. August 2018.

Landcover Type	Area (ac)	Area (mi ²)	% Comp
Agriculture	18,911	29.5	73.3%
Grassland	6,333	9.9	24.5%
Shrub-steppe	537	0.8	2.1%
Developed	34	0.1	0.1%
Total	25,815	40.3	100.0%

Incidental Observations

Seven bird species and one bird group were observed incidentally at the Project, totaling 29 individuals (Table 9). All species except the short-eared owl were observed ($n = 2$) during point count surveys which were documented in-transit between points. One bird species was considered listed or sensitive species and is discussed in the sensitive species section. Although there were large numbers of sandhill cranes observed during protocol surveys they were not observed incidentally between surveys.

Four mammal species were observed at the Project (Table 9). Of note, solitary pronghorn antelope were observed in mid-May 2017 and early September 2018; the age and sex of the animal was unknown. While not considered a listed or sensitive species, pronghorn population numbers in Washington are very low (e.g., < 300 individuals) and reintroduction efforts are currently underway (WDFW 2018). Washington ground squirrels were observed burrowing along road margins while the surveyor traveled between points and is considered a state candidate species for listing. Two additional mammal species, the black-tailed deer and coyote were documented in the Project and are common throughout the area.

Table 9. Incidental wildlife observed while conducting all surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Species	Scientific Name	# grps	# obs
bald eagle*	<i>Haliaeetus leucocephalus</i>	1	1
red-tailed hawk	<i>Buteo jamaicensis</i>	1	1
Swainson's hawk	<i>Buteo swainsoni</i>	1	2
great horned owl	<i>Bubo virginianus</i>	1	1
short-eared owl	<i>Asio flammeus</i>	2	2
bank swallow	<i>Riparia riparia</i>	1	20
Say's phoebe	<i>Sayornis saya</i>	1	1
unidentified hummingbird	N/A	1	1
Avian Subtotal	7 species 1 group	9	29
Washington ground squirrel	<i>Urocitellus washingtoni</i>	5	5
black-tailed deer	<i>Odocoileus hemionus columbianus</i>	1	5
coyote	<i>Canis latrans</i>	2	4
pronghorn	<i>Antilocapra americana</i>	2	2
Mammal Subtotal	4 species	10	16

* Also a listed/sensitive species.

DISCUSSION

The bird species observed in the Project during the study were typical to those commonly found in agricultural, shrub-steppe and grasslands within the Columbia Plateau. Bird use was highest for species common and widespread in the region and the bird community observed coincided with the assemblage expected based on habitat in the Project and surrounding area. For example, horned lark were wide spread in the Project and were predominantly observed during winter where individuals likely utilized the agricultural lands for foraging. Sandhill cranes were only observed during spring and fall when individuals were likely moving between their summer and winter ranges.

Seasonal patterns of use were observed for small birds. Small bird use was highest in winter which likely reflected the increase in abundance of horned lark. With the exception of horned lark, small bird use was typically higher during spring and fall and lower in winter. Horned lark was the most prevalent small bird species observed during the survey year and influenced the small bird seasonal patterns observed at Horse Heaven.

Overall large bird use was higher during spring and fall, likely due to the Project's location in the Pacific Flyway and the stopover habitat available in the surrounding area. Sandhill crane had the highest mean use of all birds due to the large flock numbers that flew over the Project. The region surrounding the Project contains various agricultural and crop lands that could provide valuable stopover locations for migrating sandhill cranes; however based on high flight heights and patterns it is likely the species is predominantly passing over the Project area rather than utilizing resources in the area. Certain areas within the Project (primarily in ravines and small sections of non-cultivated lands) provided some suitable nesting habitat for raptors (e.g., cliff, escarpments or trees). Overall diurnal raptor use was generally consistent across the Project

area with and overall large bird use concentrated in the center of the Project. Several large bird groups of interest for the Project are discussed separately, below.

Waterbirds

The waterbird group accounted for the highest mean use but contained only two species both of which are of conservation interest; American white pelican (state threatened) and sandhill crane (state endangered). Only one American white pelican was observed during summer despite the fact in Washington, the largest breeding colony of American white pelicans is on Badger Island, located 12 miles northeast of the Project near Kennewick (Stinson 2016). No large bodies of water that provide suitable pelican foraging habitat is present in the Project.

As discussed, sandhill crane was the majority of large bird observations at the Project and had the highest use during spring and fall. Higher crane use was at the center of the Project (Point 7), but there does not appear to be a strong association for the observed sandhill crane use at that particular survey point and the surrounding area. This suggests individuals observed during surveys were likely passing over the Project. Despite the pattern of high use at the Project, sandhill cranes do not seem especially vulnerable to turbine collisions. This is based primarily on the observed flight height behavior which was a little over 90% of individuals that flew above the RSH zone. This flight behavior is supported by studies that have shown sandhill cranes are likely to avoid wind turbines (Nagy et al. 2013, Derby et al. 2013, Pearse et al. 2016). Due to the observed numbers of cranes, continued use of the Project during spring and fall is anticipated. However, due to the absence of roosting sites or foraging habitat within and directly adjacent (e.g., <1 mile) to the Project, combined with avoidance behavior of turbines by cranes, collision risk to cranes appears low.

Considering the Project does not contain open water or foraging habitat for waterbirds, it is presumed that birds are traveling over the Project between stopover habitat (e.g., potholes and agricultural fields) located to the north, south, and east of the Project. Based on stable populations of waterbirds and the potential to avoid the proposed wind project, it is likely direct impacts or displacement of waterbird species would not have population-level effects.

Waterfowl

Canada goose and snow goose were the two species that comprised the waterfowl group. Mean use was highest in winter which was primarily attributed to Canada goose use during that time. Although Canada goose was observed at relatively low numbers they did show to have the highest exposure risk out of all large bird species for turbine collisions at 0.98 when the next closest exposure risk was at 0.40 (rock pigeon). Most observations of Canada goose were on the far west and east side of the Project, illustrating little use in the middle of the project. Despite relatively higher use of waterfowl compared to other species groups, waterfowl do not seem especially vulnerable to turbine collisions. In an analysis of 116 studies of bird mortality at over 70 operating wind facilities, waterfowl composed 2.7% of 4,975 fatalities found (Erickson et al. 2014).

Considering the Project does not contain open water or foraging habitat for waterfowl, it is presumed that birds are traveling over the Project between stopover habitat (e.g., potholes and agricultural fields) located to the north, south, and east of the Project. However, wheat fields that become inundated with water in the spring or fall provide suitable foraging habitat and are found in the northwestern Project area (Appendix G). Birds that utilize this type of resource are at greater risk of turbine collision as bird use in these agricultural habitats may be higher.

Diurnal Raptors

Diurnal raptor use was highest during the fall and summer periods when northern harrier, red-tailed hawks, Swainson's hawks and American kestrel use increased. Summer coincides with the post-fledging period when juveniles begin to increase their home range and adults decrease their fidelity to nesting territories. Swainson's hawk and American kestrels accounted for the majority of use during summer. American kestrels are typically less at risk to turbine strikes because of their lower flight behavior. In contrast, Swainson's hawk had greater risk of turbine strikes given that of the 78 groups of Swainson's hawks observed in-flight, 79.3% were within the RSH at initial observation making them somewhat more susceptible to turbine collisions. Generally, Swainson's hawk and red-tailed hawk use was higher at points in proximity to occupied nests (Appendix E). It has been shown that individuals, particularly juveniles, exhibiting kiting and other hunting behavior have an increased risk of collision with turbines (Watson et al. 2018).

Fall migration coincides with the large-scale movement of many raptor species to more southern latitudes where they over-winter. Observations of red-tailed hawks and northern harriers increased during fall migration; Swainson's hawk use peaked in summer post nesting but is considered a highly migratory species. Based on the higher relative use of *Buteos* and harriers during fall and summer, and flight behavior which results in a higher exposure index, there is higher potential for Swainson's hawk and red-tailed hawk fatalities compared to other raptor species. Fatalities of all three raptor species (Swainson's hawk, red-tailed hawk, and northern harrier) have been documented at operating wind projects.

Ferruginous hawks were observed during large bird surveys and during raptor nest surveys. In general, overall use was low when compared to other diurnal raptor use in the area. Ferruginous hawks were only observed during spring with very low mean use which translated into a very low exposure index for turbine collisions (<0.01). The number of unoccupied nests whose construction was indicative of ferruginous hawk suggests higher nest occupancy in the Horse Heaven Hills prior to 2017 nest surveys. A 2010 survey of 192 ferruginous hawk territories in Washington resulted in the lowest number of occupied territories (19%) over a 14-year period, which indicates a persistent population decline in Washington (WDFW 2012).

Use Comparison

Diurnal raptors occur in most areas with the potential for wind energy development (National Research Council [NRC] 2007). Annual mean raptor use at the Project was scaled to 20-minute to compare with other wind energy facilities in Washington and Oregon that implemented similar protocols and had data for three or four seasons. Of the 24 wind projects with publically

available data, raptor use at the Project (0.795 raptors/800-m/20-min) was in the upper tail of the range of raptor use estimates (0.25–1.1 raptors/800-m/20-min; Figure 8). The Project's raptor use level was similar to that documented at the Klondike II and Leaning Juniper Projects in Oregon (NWC and WEST 2007, Gritski et al. 2008). The coinciding raptor fatality estimates at the two Projects were 0.6 and 0.16 raptors/MW/year, respectively, which were low compared to the highest raptor fatality estimate at the White Creek Project in Washington (0.47 raptors/MW/year; Appendix H).

Raptor nest density has been used as a metric to inform potential fatality rates post-construction (Watson et al. 2018); however, the evidence from the nest density/fatality relationship has been mixed (Marques et al. 2014). In the CPE, several studies show that raptor fatalities occur more often of species with higher nest densities (Johnson and Erickson 2011, Kolar 2013). Compared to raptor nest densities at proposed or operating wind projects within the CPE, nest density of within and surrounding the Project was near the median both survey years (Appendix I). Of the 15 wind energy studies in Washington and Oregon that reported nesting density (NWC and ABR 2009), the Project was ranked sixth in 2017 (0.268 nests/mi²) and ninth in 2018, which was tied with Juniper Canyon and Stateline (0.21 nests/mi²; range = 0.03–0.45 nests/mi²; Appendix I).

Bald and Golden Eagles

Two adult bald eagles were observed during large bird use surveys for a total of nine eagle minutes. Observations of bald eagles within the Project may be associated with the occupied bald eagle nest along the Columbia River that was documented during spring 2017 and 2018 aerial surveys. Bald eagles were observed during winter when individuals typically range widely to migrate or in search of food (Kalasz and Buchanan 2016). No open water or typical bald eagle foraging resource is found in the Project; the nearest being the Columbia River, located approximately 5-miles northwest. In eastern Washington, the risk of bald eagle collision with wind turbines may be lower compared to other regions due to lower population densities (Kalasz and Buchanan 2016). Based on the distance of the Project to the nearest nest, absence of typical foraging resources (e.g., open water) and low use during 2017–2018 surveys, collision risk to bald eagles appears low.

Four golden eagles were observed during large bird use survey during the year-long survey. Of the four individuals documented, three individuals were within the survey plot. During fall 2017, two juvenile golden eagle were observed at survey Point 8, located in the north central side of the Project for a total of 6 eagle minutes. In the spring of 2018, one adult golden eagle was observed at survey Point 12 (incidental observation) and Point 13, both of which are located at the most eastern side of the Project. In total, golden eagles accounted for 66 minutes, of which, 35 were considered eagle minutes (USFWS 2013). The majority of eagle minutes consisted of one individual circling the observer for the entire survey. The adult eagle was flying low, consistently calling for the duration of the survey. No nest or young were observed and it is unknown if there was carrion in the area. Bird attraction to surveyors has been discussed as a potential source of data bias (Buckland et al. 2001, Thompson 2002); however, this behavior has not been well documented in the literature for golden eagles. The large number of eagle

minutes observed from one individual, seemingly attracted to the surveyor, may disproportionately increase the risk profile of golden eagle at the Project.

Using a nine-year study of 17 golden eagles within the Columbia Plateau that found golden eagle use correlated with the proximity to nests, terrain complexity, and prey abundance researchers were able to create conservative estimates to caution wind development within 8 miles of an active golden eagle nest (Watson et al. 2014). No golden eagle nests were observed within 10 miles of the Project during aerial nest survey conducted in spring 2017 and 2018. Based on the absence of eagle nests within 10 miles of the Project, intermittent sources of prey and low use (three golden eagle observations with 36 eagle minutes documented during 2017-2018), golden eagle collision risk with turbines appears low.

Landcover

Based on the WDFW Wind Power Guidance, no mitigation is required for impacts (temporary or permanent) to agriculture (cropland or pasture) or developed/disturbed areas which are considered Class IV habitats and have generally low value to wildlife and native plants (WDFW 2009). The remaining two habitat types, shrub-steppe and grassland (including CRP lands), are considered Class III cover types requiring a 0.1:1 mitigation ratio for temporary impacts (in addition to restoring the temporarily impacted habitat) and a 1:1 ratio for permanent impacts. Shrub-steppe and grassland vegetation communities provide important breeding and foraging habitat for a number of sensitive wildlife species, and shrub-steppe is classified as a priority habitat in Washington (WDFW 2009). Grasslands within the Project area are likely classified into one of two categories: 1) areas along the margins of tilled agricultural fields or along drainages which are too steep to be cultivated or 2) parcels that are currently enrolled in the CRP. In general, it is unknown which non-cultivated grassland parcels are CRP lands as this information is not publicly available; however, for the purposes of habitat mitigation, CPR lands and grasslands are functionally similar and are both considered Class III habitats (WDFW 2009).

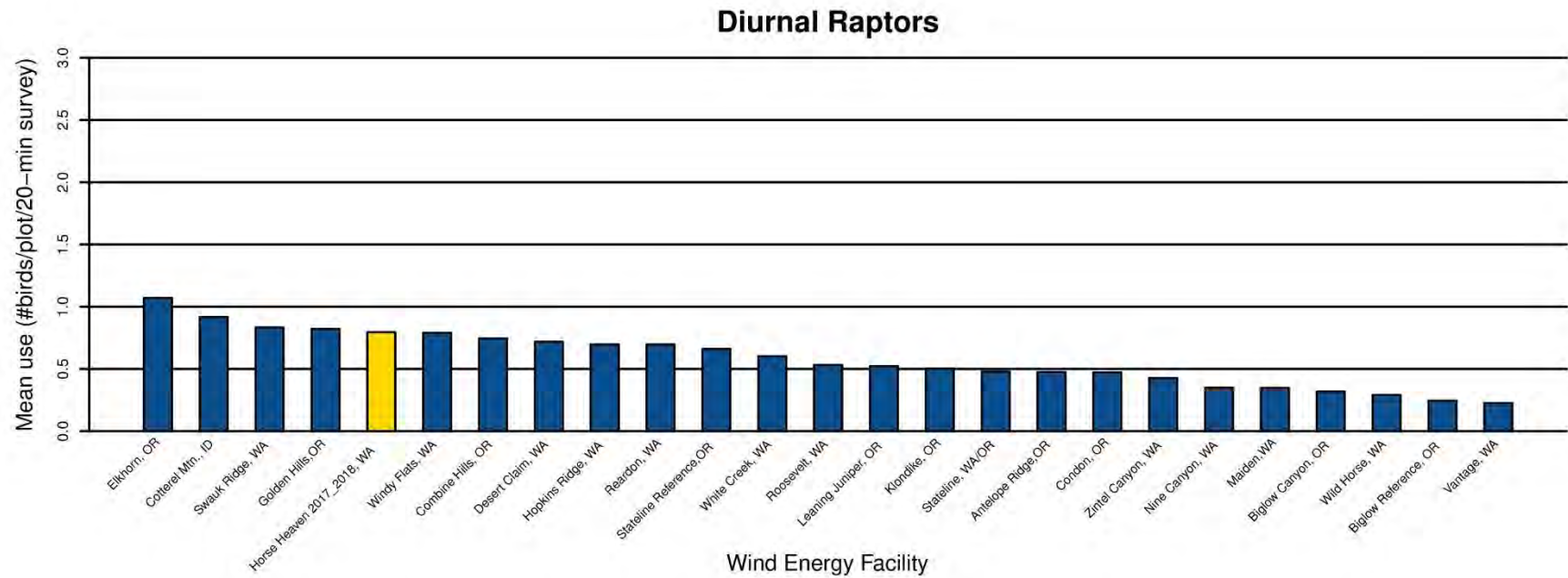


Figure 8. Comparison of estimated annual diurnal raptor use during fixed-point large bird use surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018 and diurnal raptor use at other Oregon and Washington Wind Resource Areas with three or four seasons of raptor use data.

CONCLUSIONS

Tier 3 studies are used to address questions regarding impacts that could not be sufficiently addressed using available literature (i.e., during Tier 1 and 2 desktop analyses). These studies provide additional data that, when combined with available literature reviewed in previous tiers, allow for a better-informed assessment of the risk of significant adverse impacts to species of concern at the Project. Strong seasonal patterns of occurrence and use were observed in many of the species documented during the year-long survey. For example, many small bird species were only observed during the spring and/or fall migratory period with low use observed during summer which suggests limited breeding bird diversity at the Project. Horned lark was the most abundant small bird species observed in all seasons and accounted for nearly 94% of all small bird use in winter which suggests a robust year-long presence at the Project. Increased large bird use during the spring breeding season was influenced by large groups of sandhill cranes which flew over the Project, the majority of the time (90%) above the height of the rotor swept area (25-150 m AGL). Collision risk of sandhill crane may be reduced by flying over the Project and above RSH; however, some species such as the migratory Swainson's hawk may be at greater risk because of the local nesting population (six occupied nests in 2018), and their tendency to fly within the RSH. Accounting for the seasonal occurrence of bird species and areas where use may increase due to nesting may be an effective measure to minimize potential impacts to birds at the Project (Watson et al. 2018).

Collision risk was highest for Canada goose, an abundant species throughout its range, and relatively low for some raptors and other species of concern (e.g., American pelican, sandhill crane, ferruginous hawk, and long-billed curlew). Based on data from other publically available wind projects in Oregon and Washington, diurnal raptor fatality rates are expected to be within the range of fatality rates observed at other facilities. To date, overall fatality rates for birds at wind energy facilities have been consistently low, and the most recent, comprehensive, and robust studies of overall bird fatality rates at US wind facilities have produced fatality rate estimates ranging from 2.96–4.11 birds per MW, and no Project data suggests the Project would fall outside this range.

This study also was designed to document use of bald and golden eagles, following the ECPG survey recommendations and the final rule (USFWS 2013, 2016). During the year of surveys, two bald eagles were observed flying within the risk cylinder for six minutes and three golden eagles were observed flying in the risk cylinder for 35 minutes. Golden eagle collision risk appears high based on the number of golden eagle minutes; however, the risk profile consisted of two golden eagle observations, of which one observation was likely influenced by the presence of the surveyor and may overestimate golden eagle collision risk at the Project. Washington ground squirrels exist along the Project roads; however, no raptors were observed actively and consistently hunting squirrel colonies during over 320 hours of large bird survey. This may be due to the smaller size of the squirrel or because of the limited amount of time squirrels spend above ground (WDFW, per comm.). Together, the distance of eagle nests from the Project, lack of suitable prey base and low use during 322 hours of observation suggests

collision risk to eagles is low. An additional year of large bird surveys is currently underway (2018–2019) will provide additional information on eagle use and risk at the Project.

Landcover at the Project is consistent with the matrix of agriculture and grasslands commonly found in the region. Native shrub-steppe was highly fragmented with small patches scattered throughout the Project. Many of the grasslands delineated in the landcover classification were enrolled in CRP and may be converted back to agriculture in the future if contracts expire or financial conditions change.

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Acts and Regulation

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Appendix A. Summary of the Number of Observations and Groups Recorded by Species and Bird Type for 10-minute Small Bird Use Surveys (Appendix A1) and 60-minute Large Bird Use Surveys (Appendix A2) at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

Appendix A1. Summary of individuals and group observations by bird type and species for 10-minute fixed-point small bird use surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Type/Species	Scientific Name	Spring		Summer		Fall		Winter		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Passerines		274	440	181	253	175	491	154	942	784	2126
bank swallow	<i>Riparia riparia</i>	1	20	7	18	1	2	0	0	9	40
barn swallow	<i>Hirundo rustica</i>	3	10	2	3	5	28	0	0	10	41
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	3	6	1	1	1	5	0	0	5	12
chipping sparrow	<i>Spizella passerina</i>	0	0	0	0	1	1	0	0	1	1
cliff swallow	<i>Petrochelidon pyrrhonota</i>	0	0	2	3	2	5	0	0	4	8
dark-eyed junco	<i>Junco hyemalis</i>	0	0	0	0	1	1	0	0	1	1
European starling	<i>Sturnus vulgaris</i>	5	19	0	0	1	2	1	1	7	22
golden-crowned sparrow	<i>Zonotrichia atricapilla</i>	0	0	0	0	0	0	1	1	1	1
grasshopper sparrow	<i>Ammodramus savannarum</i>	0	0	1	1	0	0	0	0	1	1
horned lark	<i>Eremophila alpestris</i>	233	348	147	190	121	345	137	914	638	1797
house sparrow	<i>Passer domesticus</i>	0	0	0	0	0	0	1	1	1	1
sagebrush sparrow	<i>Artemisospiza nevadensis</i>	1	1	0	0	0	0	0	0	1	1
Savannah sparrow	<i>Passerculus sandwichensis</i>	2	2	0	0	1	2	0	0	3	4
Say's phoebe	<i>Sayornis saya</i>	1	1	0	0	0	0	0	0	1	1
song sparrow	<i>Melospiza melodia</i>	0	0	0	0	1	3	0	0	1	3
spotted towhee	<i>Pipilo maculatus</i>	0	0	0	0	1	1	0	0	1	1
unidentified sparrow	NA	0	0	0	0	1	1	0	0	1	1
unidentified swallow	NA	0	0	2	6	0	0	0	0	2	6
western kingbird	<i>Tyrannus verticalis</i>	0	0	8	18	1	3	0	0	9	21
western meadowlark	<i>Sturnella neglecta</i>	24	27	11	13	24	38	11	19	70	97
white-crowned sparrow	<i>Zonotrichia leucophrys</i>	1	6	0	0	13	54	3	6	17	66
Woodpeckers		0	0	0	0	3	3	0	0	3	3
northern flicker	<i>Colaptes auratus</i>	0	0	0	0	3	3	0	0	3	3
Unidentified Birds		0	0	0	0	11	42	1	34	12	76
unidentified bird (small)	NA	0	0	0	0	11	42	1	34	12	76
Overall		274	440	181	253	189	536	155	976	799	2,205

Appendix A2. Summary of individuals and group observations by bird type and species for 60-minute fixed-point large bird use surveys at the Horse Heaven Wind Project from April 11, 2017 – July 16, 2018.

Type/Species	Scientific Name	Spring		Summer		Fall		Winter		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Waterbirds		2	390	1	1	6	162	0	0	9	553
American white pelican	<i>Pelecanus erythrorhynchos</i>	0	0	1	1	0	0	0	0	1	1
sandhill crane	<i>Antigone canadensis</i>	2	390	0	0	6	162	0	0	8	552
Waterfowl		0	0	0	0	4	175	10	314	14	489
Canada goose	<i>Branta canadensis</i>	0	0	0	0	4	175	9	214	13	389
snow goose	<i>Chen caerulescens</i>	0	0	0	0	0	0	1	100	1	100
Shorebirds		2	2	0	0	0	0	0	0	2	2
long-billed curlew	<i>Numenius americanus</i>	2	2	0	0	0	0	0	0	2	2
Gulls/Terns		10	180	0	0	0	0	0	0	10	180
California gull	<i>Larus californicus</i>	6	133	0	0	0	0	0	0	6	133
unidentified gull	NA	4	47	0	0	0	0	0	0	4	47
Diurnal Raptors		120	120	84	87	205	235	125	128	534	570
Accipiters		2	2	0	0	4	4	0	0	6	6
Cooper's hawk	<i>Accipiter cooperii</i>	1	1	0	0	2	2	0	0	3	3
sharp-shinned hawk	<i>Accipiter striatus</i>	1	1	0	0	2	2	0	0	3	3
Buteos		76	76	64	67	69	82	47	50	256	275
ferruginous hawk	<i>Buteo regalis</i>	3	3	0	0	0	0	0	0	3	3
red-tailed hawk	<i>Buteo jamaicensis</i>	22	22	10	10	29	31	9	9	70	72
rough-legged hawk	<i>Buteo lagopus</i>	21	21	0	0	21	22	35	37	77	80
Swainson's hawk	<i>Buteo swainsoni</i>	26	26	50	52	18	28	0	0	94	106
unidentified buteo	NA	4	4	4	5	1	1	3	4	12	14
Northern Harrier		32	32	9	9	100	110	59	59	200	210
northern harrier	<i>Circus cyaneus</i>	32	32	9	9	100	110	59	59	200	210
Eagles		2	2	0	0	2	2	2	2	6	6
bald eagle	<i>Haliaeetus leucocephalus</i>	0	0	0	0	0	0	2	2	2	2
golden eagle	<i>Aquila chrysaetos</i>	2	2	0	0	2	2	0	0	4	4
Falcons		6	6	11	11	23	30	15	15	55	62
American kestrel	<i>Falco sparverius</i>	6	6	11	11	21	28	12	12	50	57
prairie falcon	<i>Falco mexicanus</i>	0	0	0	0	2	2	1	1	3	3
unidentified falcon	NA	0	0	0	0	0	0	2	2	2	2
Other Raptors		2	2	0	0	7	7	2	2	11	11
unidentified raptor	NA	2	2	0	0	7	7	2	2	11	11
Owls		2	2	0	0	0	0	3	3	5	5
great horned owl	<i>Bubo virginianus</i>	2	2	0	0	0	0	3	3	5	5

Appendix A2. Summary of individuals and group observations by bird type and species for 60-minute fixed-point large bird use surveys at the Horse Heaven Wind Project from April 11, 2017 – July 16, 2018.

Type/Species	Scientific Name	Spring		Summer		Fall		Winter		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Upland Game Birds		2	2	3	3	0	0	0	0	5	5
ring-necked pheasant	<i>Phasianus colchicus</i>	2	2	3	3	0	0	0	0	5	5
Doves/Pigeons		26	72	6	18	12	208	9	182	53	480
mourning dove	<i>Zenaida macroura</i>	3	3	0	0	0	0	0	0	3	3
rock pigeon	<i>Columba livia</i>	23	69	6	18	12	208	9	182	50	477
Large Corvids		99	141	16	20	111	165	83	130	309	456
American crow	<i>Corvus brachyrhynchos</i>	2	3	0	0	0	0	0	0	2	3
black-billed magpie	<i>Pica hudsonia</i>	0	0	0	0	0	0	1	1	1	1
common raven	<i>Corvus corax</i>	97	138	16	20	111	165	82	129	306	452
Overall		263	909	110	129	338	945	230	757	941	2,740

Appendix B. Mean Use, Percent of Use, and Frequency of Occurrence for Small Bird (Appendix B1) and Large Bird (Appendix B2) Types and Species Observed during Fixed-Point Surveys at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

Appendix B1. Mean small bird use (number of all birds/100-meter plot/10-min survey), percent of total use (%), and frequency of occurrence (%) for each bird type and species by season during the fixed-point surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Type/Species	Mean Use				% of Use				% Frequency			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Passerines	5.71	4.87	4.71	10.48	100	100	91.6	96.6	85.9	82.7	66.3	62.4
bank swallow	0.26	0.35	0.02	0	4.5	7.1	0.4	0	1.3	11.5	1.0	0
barn swallow	0.13	0.06	0.27	0	2.2	1.2	5.2	0	3.8	3.8	4.8	0
Brewer's blackbird	0.08	0.02	0.05	0	1.3	0.4	0.9	0	2.6	1.9	1.0	0
chipping sparrow	0	0	<0.01	0	0	0	0.2	0	0	0	1.0	0
cliff swallow	0	0.06	0.05	0	0	1.2	0.9	0	0	3.8	1.9	0
dark-eyed junco	0	0	<0.01	0	0	0	0.2	0	0	0	1.0	0
European starling	0.25	0	0.02	0	4.3	0	0.4	0	6.5	0	1.0	0
golden-crowned sparrow	0	0	0	0.01	0	0	0	0.1	0	0	0	1.1
grasshopper sparrow	0	0.02	0	0	0	0.4	0	0	0	1.9	0	0
horned lark	4.51	3.65	3.32	10.18	79.0	75.1	64.5	93.8	80.7	69.2	54.8	60.2
house sparrow	0	0	0	0.01	0	0	0	0.1	0	0	0	1.1
sagebrush sparrow	0.01	0	0	0	0.2	0	0	0	1.4	0	0	0
Savannah sparrow	0.03	0	0.02	0	0.4	0	0.4	0	2.6	0	1.0	0
Say's phoebe	0.01	0	0	0	0.2	0	0	0	1.3	0	0	0
song sparrow	0	0	0.03	0	0	0	0.6	0	0	0	1.0	0
spotted towhee	0	0	<0.01	0	0	0	0.2	0	0	0	1.0	0
unidentified sparrow	0	0	<0.01	0	0	0	0.2	0	0	0	1.0	0
unidentified swallow	0	0.12	0	0	0	2.4	0	0	0	3.8	0	0
western kingbird	0	0.35	0.03	0	0	7.1	0.6	0	0	9.6	1.0	0
western meadowlark	0.36	0.25	0.36	0.21	6.2	5.1	6.9	2	20.9	15.4	16.3	8.1
white-crowned sparrow	0.08	0	0.52	0.07	1.5	0	10.1	0.6	1.4	0	10.6	2.2
Woodpeckers	0	0	0.03	0	0	0	0.6	0	0	0	1.9	0
northern flicker	0	0	0.03	0	0	0	0.6	0	0	0	1.9	0
Unidentified Birds	0	0	0.40	0.37	0	0	7.9	3.4	0	0	8.7	1.1
unidentified bird (small)	0	0	0.40	0.37	0	0	7.9	3.4	0	0	8.7	1.1
Overall	5.71	4.87	5.14	10.85	100	100	100	100				

Appendix B2. Mean large bird use (number of large birds/800-meter plot/60-min survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Type/Species	Mean Use				% of Use				% Frequency			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
Waterbirds	5.03	0.02	1.56	0	43.0	0.8	17.3	0	2.7	1.9	4.8	0
American white pelican	0	0.02	0	0	0	0.8	0	0	0	1.9	0	0
sandhill crane	5.03	0	1.56	0	43.0	0	17.3	0	2.7	0	4.8	0
Waterfowl	0	0	1.68	3.65	0	0	18.6	42.7	0	0	2.9	9
Canada goose	0	0	1.68	2.35	0	0	18.6	27.5	0	0	2.9	7.7
snow goose	0	0	0	1.30	0	0	0	15.2	0	0	0	1.3
Shorebirds	0.03	0	0	0	0.2	0	0	0	2.6	0	0	0
long-billed curlew	0.03	0	0	0	0.2	0	0	0	2.6	0	0	0
Gulls/Terns	2.31	0	0	0	19.7	0	0	0	10.3	0	0	0
California gull	1.71	0	0	0	14.6	0	0	0	7.7	0	0	0
unidentified gull	0.60	0	0	0	5.2	0	0	0	5.1	0	0	0
Diurnal Raptors	1.54	1.67	2.22	1.43	13.2	67.4	24.6	16.8	71.3	63.5	73.1	60
<u>Accipiters</u>	0.03	0	0.04	0	0.2	0	0.4	0	2.6	0	3.8	0
Cooper's hawk	0.01	0	0.02	0	0.1	0	0.2	0	1.3	0	1.9	0
sharp-shinned hawk	0.01	0	0.02	0	0.1	0	0.2	0	1.3	0	1.9	0
<u>Buteos</u>	0.98	1.29	0.76	0.57	8.4	51.9	8.4	6.6	60.8	59.6	36.5	31.7
ferruginous hawk	0.04	0	0	0	0.3	0	0	0	4.1	0	0	0
red-tailed hawk	0.28	0.19	0.30	0.10	2.4	7.8	3.3	1.2	23.3	13.5	21.2	8.3
rough-legged hawk	0.27	0	0.21	0.42	2.3	0	2.3	4.9	20.6	0	14.4	25.9
Swainson's hawk	0.33	1.0	0.25	0	2.9	40.3	2.8	0	21.8	46.2	9.6	0
unidentified buteo	0.05	0.1	0	0.05	0.4	3.9	0	0.6	5.1	7.7	0	3.5
<u>Northern Harrier</u>	0.42	0.17	1.05	0.66	3.6	7.0	11.6	7.7	29.9	11.5	49	38.2
northern harrier	0.42	0.17	1.05	0.66	3.6	7.0	11.6	7.7	29.9	11.5	49	38.2
<u>Eagles</u>	0.01	0	0.02	0.02	0.1	0	0.2	0.3	1.3	0	1.0	1.1
bald eagle	0	0	0	0.02	0	0	0	0.3	0	0	0	1.1
golden eagle	0.01	0	0.02	0	0.1	0	0.2	0	1.3	0	1.0	0
<u>Falcons</u>	0.08	0.21	0.29	0.16	0.7	8.5	3.2	1.9	7.7	9.6	18.3	13.2
American kestrel	0.08	0.21	0.27	0.13	0.7	8.5	3	1.5	7.7	9.6	17.3	9.9
prairie falcon	0	0	0.02	0.01	0	0	0.2	0.1	0	0	1.9	1.1
unidentified falcon	0	0	0	0.02	0	0	0	0.3	0	0	0	2.2

Appendix B2. Mean large bird use (number of large birds/800-meter plot/60-min survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Type/Species	Mean Use				% of Use				% Frequency			
	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter
<i>Other Raptors</i>	0.03	0	0.07	0.02	0.2	0	0.7	0.3	2.6	0	6.7	2.2
unidentified raptor	0.03	0	0.07	0.02	0.2	0	0.7	0.3	2.6	0	6.7	2.2
Owls	0	0	0	0.01	0	0	0	0.2	0	0	0	1.3
great horned owl	0	0	0	0.01	0	0	0	0.2	0	0	0	1.3
Upland Game Birds	0.03	0.06	0	0	0.2	2.3	0	0	2.7	3.8	0	0
ring-necked pheasant	0.03	0.06	0	0	0.2	2.3	0	0	2.7	3.8	0	0
Doves/Pigeons	0.94	0.35	2.00	2.01	8.1	14.0	22.2	23.5	29.9	11.5	9.6	8.9
mourning dove	0.04	0	0	0	0.3	0	0	0	1.3	0	0	0
rock pigeon	0.90	0.35	2.00	2.01	7.7	14.0	22.2	23.5	28.6	11.5	9.6	8.9
Large Corvids	1.82	0.38	1.57	1.45	15.6	15.5	17.4	16.9	72.9	21.2	52.9	53.5
American crow	0.04	0	0	0	0.3	0	0	0	2.6	0	0	0
black-billed magpie	0	0	0	0.01	0	0	0	0.1	0	0	0	1.1
common raven	1.78	0.38	1.57	1.44	15.2	15.5	17.4	16.8	71.6	21.2	52.9	53.5
Overall	11.69	2.48	9.03	8.56	100	100	100	100				

Appendix C. Species Exposure Indices for Large Birds during Fixed-Point Bird Use Surveys at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

Appendix C. Relative exposure index and flight characteristics for each bird species during the fixed-point 60-minute large bird use surveys at the Horse Heaven Wind Project from August 11, 2017 – July 16, 2018.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
Canada goose	13	1.11	100	87.7	0.98	94.3
rock pigeon	41	1.41	69.6	41.0	0.40	52.4
California gull	6	0.40	100	88.7	0.36	88.7
snow goose	1	0.33	100	100	0.33	100
Swainson's hawk	78	0.36	83.7	79.3	0.24	93.1
common raven	279	1.34	92.0	17.4	0.21	32.2
sandhill crane	7	1.65	90.9	9.8	0.15	82.5
red-tailed hawk	59	0.22	84.7	72.1	0.14	85.2
unidentified gull	4	0.14	100	93.6	0.13	93.6
rough-legged hawk	71	0.23	92.5	59.5	0.13	78.4
unidentified <i>Buteo</i>	9	0.04	84.6	81.8	0.03	81.8
northern harrier	195	0.62	98.1	3.9	0.02	9.3
unidentified raptor	11	0.03	100	54.5	0.02	81.8
American kestrel	29	0.18	50.9	17.2	0.02	27.6
golden eagle	2	<0.01	66.7	100	<0.01	100
American white pelican	1	<0.01	100	100	<0.01	100
ferruginous hawk	3	<0.01	100	33.3	<0.01	66.7
Cooper's hawk	3	<0.01	100	33.3	<0.01	33.3
bald eagle	2	<0.01	100	50.0	<0.01	100
ring-necked pheasant	0	0.02	0	0	0	0
mourning dove	2	<0.01	66.7	0	0	0
American crow	2	<0.01	100	0	0	0
sharp-shinned hawk	3	<0.01	100	0	0	33.3
prairie falcon	2	<0.01	66.7	0	0	0
long-billed curlew	0	<0.01	0	0	0	0
unidentified falcon	1	<0.01	50.0	0	0	0
great horned owl	0	<0.01	0	0	0	0
black-billed magpie	1	<0.01	100	0	0	0

RSH: The likely "rotor swept heights" for potential collision with a turbine blade, or 25-150 m (82-492 ft) above ground level (AGL).

Appendix D. Mean Use by Point for Small Birds (Appendix D1) and Large Birds (Appendix D2) during Fixed-Point Bird Use Surveys at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

Appendix D1. Mean use (number of birds/10-minute survey) by point for small birds^a, major bird types, observed at the Horse Heaven Wind Project during fixed-point bird use surveys from August 11, 2017 – July 16, 2018.

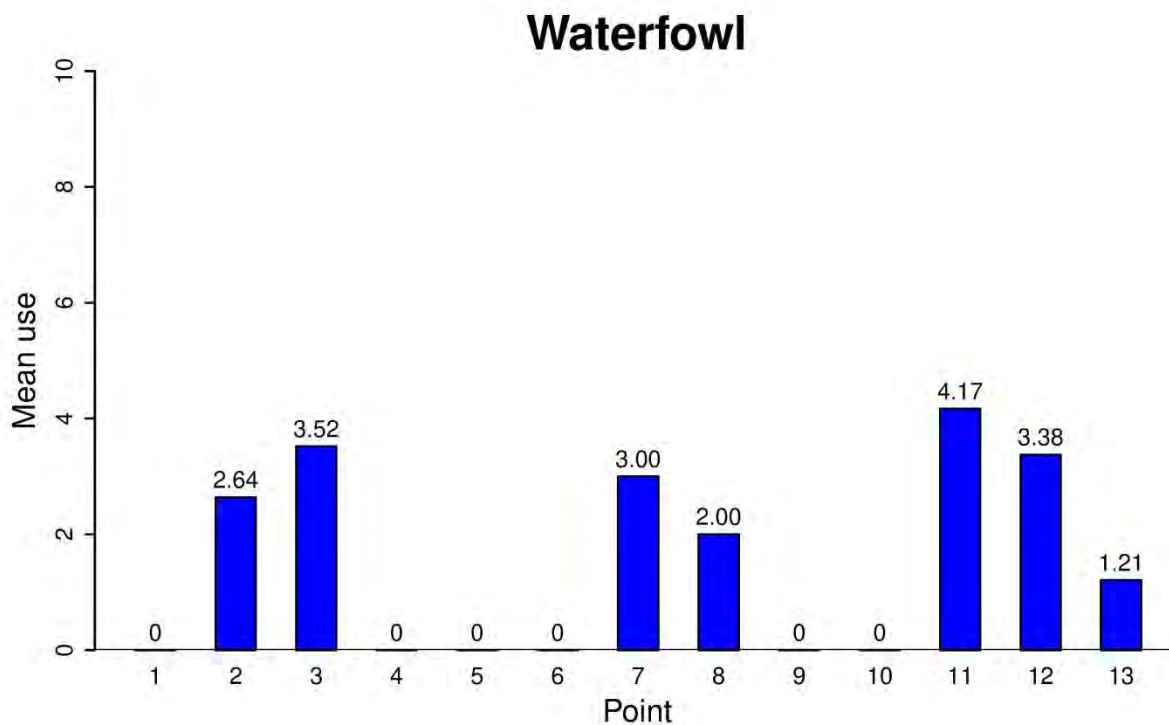
Bird Type	Survey Point												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Passerines	5.44	6.40	15.84	13.56	3.75	2.48	11.92	6.44	5.28	3.48	5.48	4.00	1.25
Woodpeckers	0	0	0	0	0	0	0	0.12	0	0	0	0	0
Unidentified Birds	0	0.04	0.04	1.68	0	0	0.08	0.64	0	0.56	0	0	0
All Small Birds	5.44	6.44	15.88	15.24	3.75	2.48	12.00	7.20	5.28	4.04	5.48	4.00	1.25

^a. 100-meter (m) radius plot for small birds.

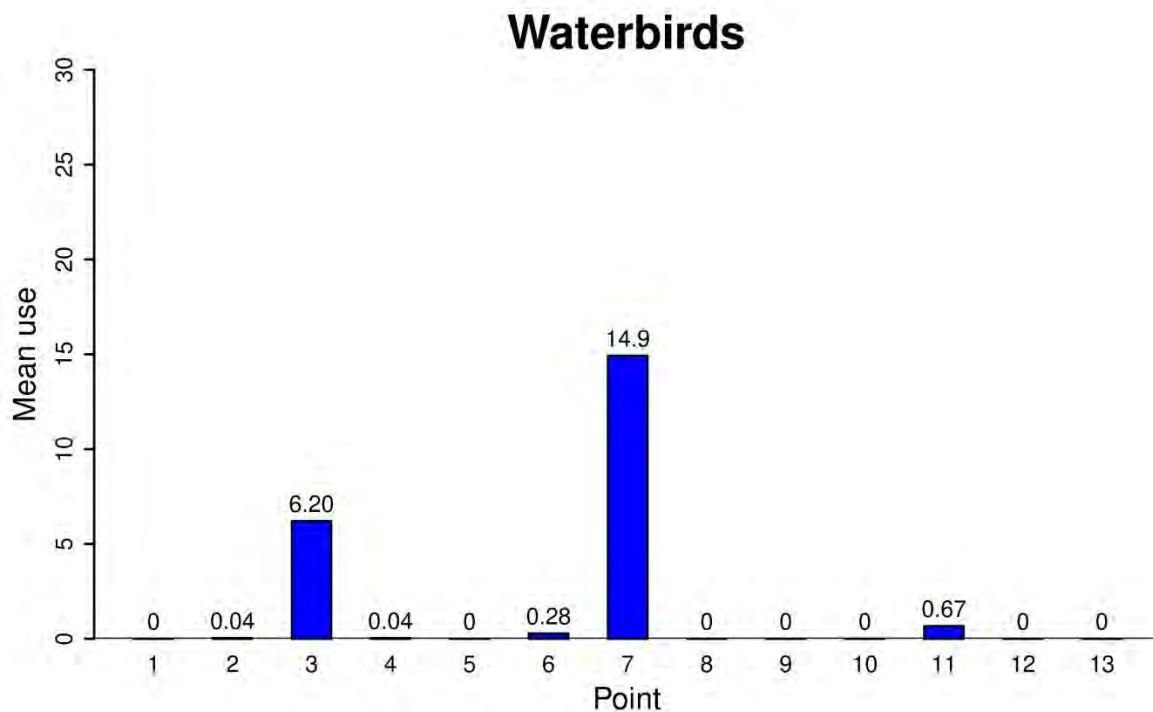
Appendix D2. Mean use (number of birds/60-minute survey) by point for all large birds^a, major bird types, and diurnal raptor subtypes observed at the Horse Heaven Wind Project during large bird use surveys from August 11, 2017 – July 16, 2018.

Bird Type	Survey Point												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Waterbirds	0	0.04	6.20	0.04	0	0.28	14.92	0	0	0	0.67	0	0
Waterfowl	0	2.64	3.52	0	0	0	3.00	2.00	0	0	4.17	3.38	1.21
Shorebirds	0	0	0.04	0.04	0	0	0	0	0	0	0	0	0
Gulls/Terns	0	0	0	0.52	0	0	0.52	4.76	0.12	0	1.25	0	0.08
Diurnal Raptors	1.08	1.24	1.52	1.84	1.46	2.48	2.88	2.68	1.44	0.64	1.21	2.17	2.25
<u>Accipiters</u>	0	0	0.04	0	0	0	0	0	0	0.04	0.04	0.08	0.04
<u>Buteos</u>	0.28	0.40	0.44	0.68	1.00	1.48	1.72	1.24	0.92	0.40	0.67	0.75	1.04
<u>Northern Harrier</u>	0.44	0.68	0.84	1.08	0.38	0.48	0.72	0.76	0.40	0.16	0.21	1.21	1.12
<u>Eagles</u>	0	0	0	0	0	0	0	0.16	0	0	0	0	0.04
<u>Falcons</u>	0.36	0.08	0.20	0.08	0	0.52	0.32	0.44	0.12	0	0.29	0.08	0
<u>Other Raptors</u>	0	0.08	0	0	0.08	0	0.12	0.08	0	0.04	0	0.04	0
Owls	0	0	0	0	0	0	0	0	0	0	0.04	0	0
Upland Game Birds	0	0	0	0	0	0	0.04	0.04	0	0.12	0	0	0
Doves/Pigeons	0.16	0	0.08	0	0	4.12	3.00	0.88	0.24	0	0.17	2.67	8.33
Large Corvids	0.92	1.40	1.56	0.84	2.17	2.00	1.76	1.24	1.60	0.84	0.75	2.08	1.21
All Large Birds	2.16	5.32	12.92	3.28	3.62	8.88	26.12	11.60	3.40	1.60	8.25	10.29	13.08

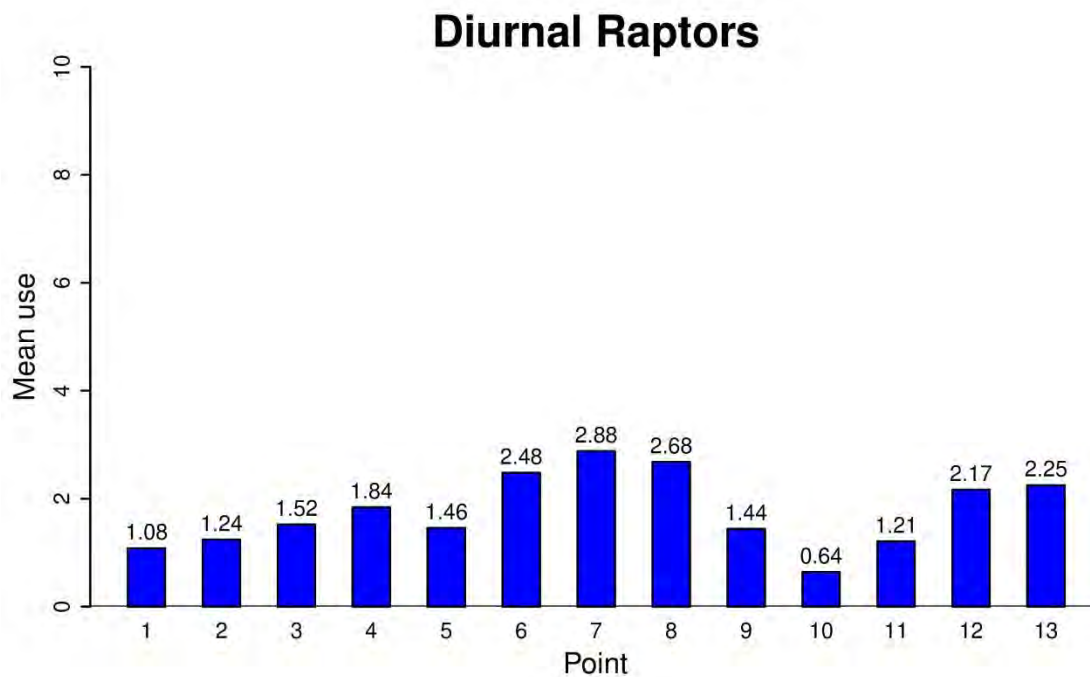
^a. 800-meter (m) radius plot for large birds.



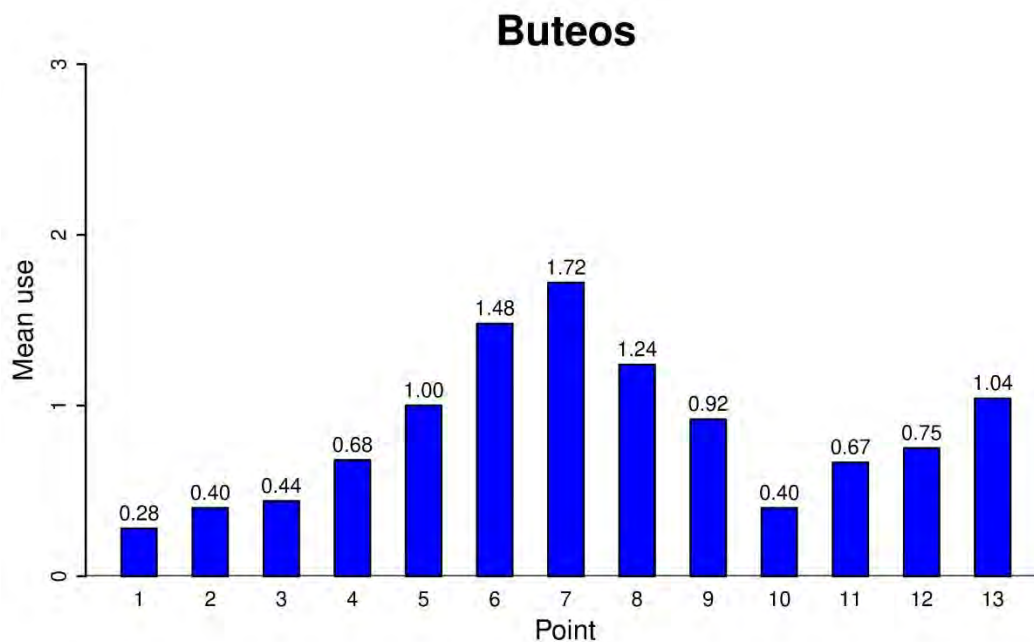
Appendix D3. Mean use by point by waterfowl at the Horse Heaven Wind Project during large bird use surveys from August 11, 2017 to July 16, 2018.



Appendix D4. Mean use by point by waterbird at the Horse Heaven Wind Project during large bird use surveys from August 11, 2017 to July 16, 2018. High mean use at point 7 represents large numbers of sandhill cranes.



Appendix D5. Mean raptor use by point during fixed-point large bird use surveys at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.



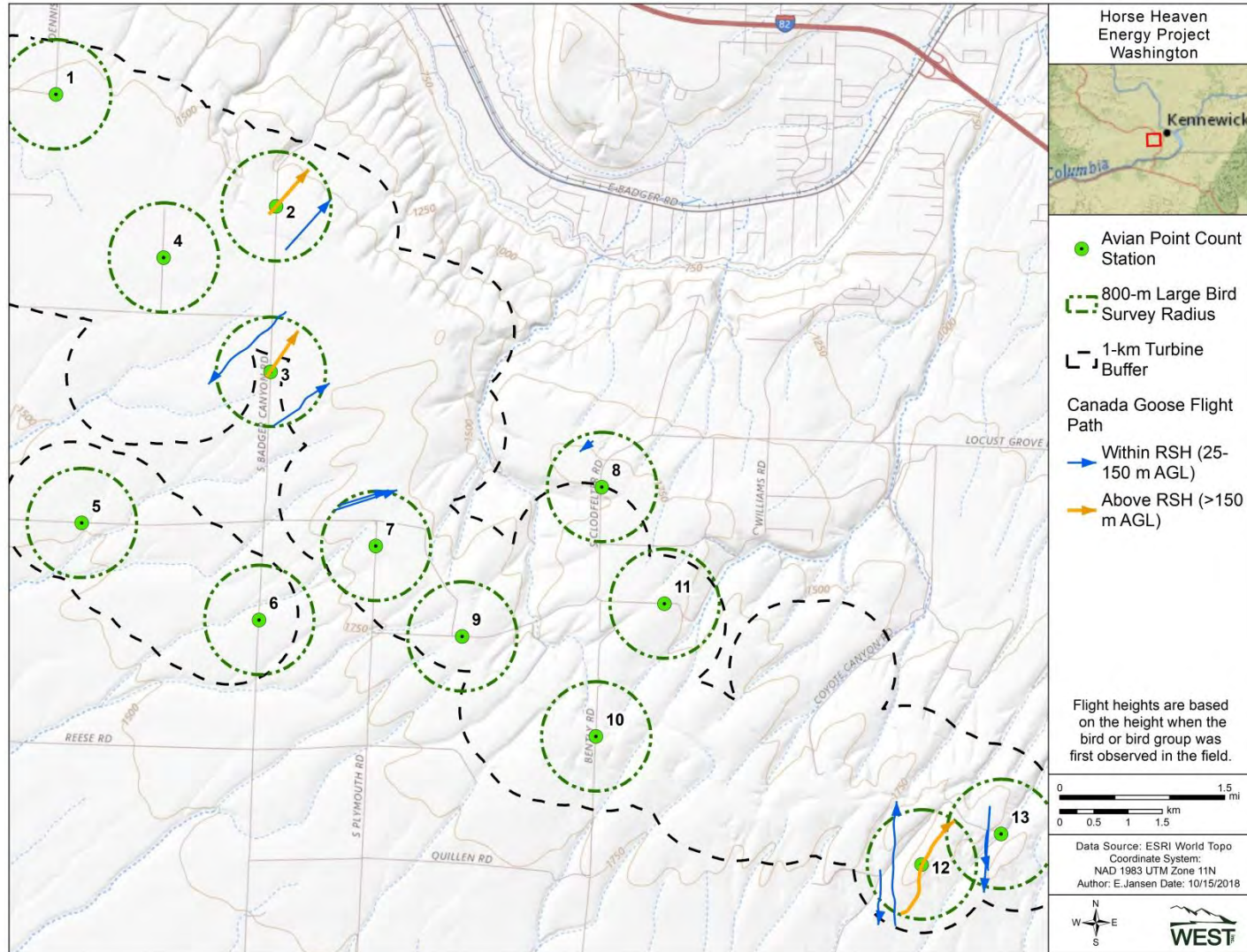
Appendix D6. Mean *Buteo* use by point during fixed-point large bird use surveys at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

Appendix E. Large Bird Flight Paths Observed at the Horse Heaven Wind Project from August 11, 2017 to July 16, 2018.

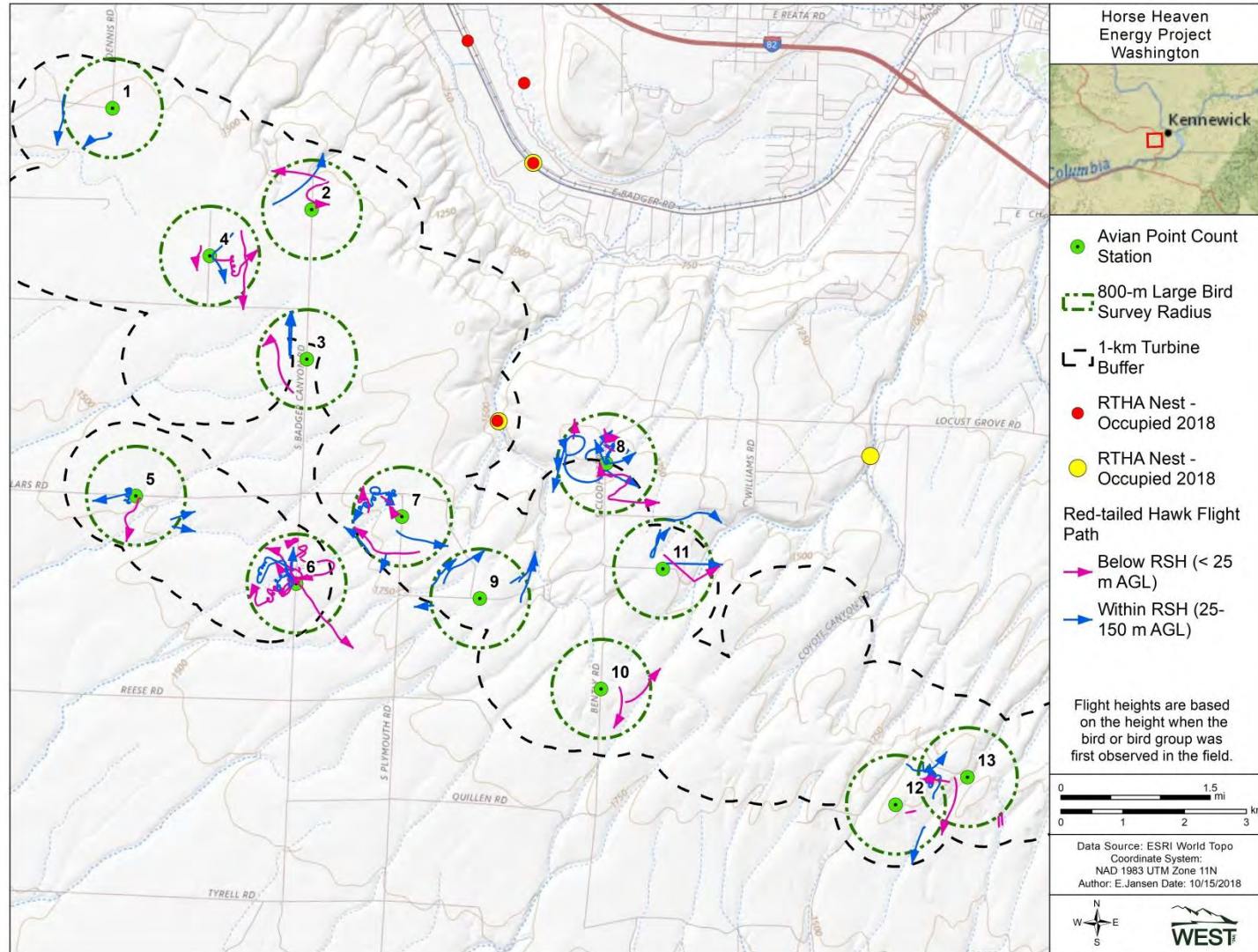
Select species* include:

- Canada goose (Appendix E1)
- Red-tailed hawk (Appendix E2)
- Swainson's hawk (Appendix E3)
- Sandhill crane (Appendix E4)
- Bald eagle (Appendix E5)
- Golden eagle (Appendix E6)

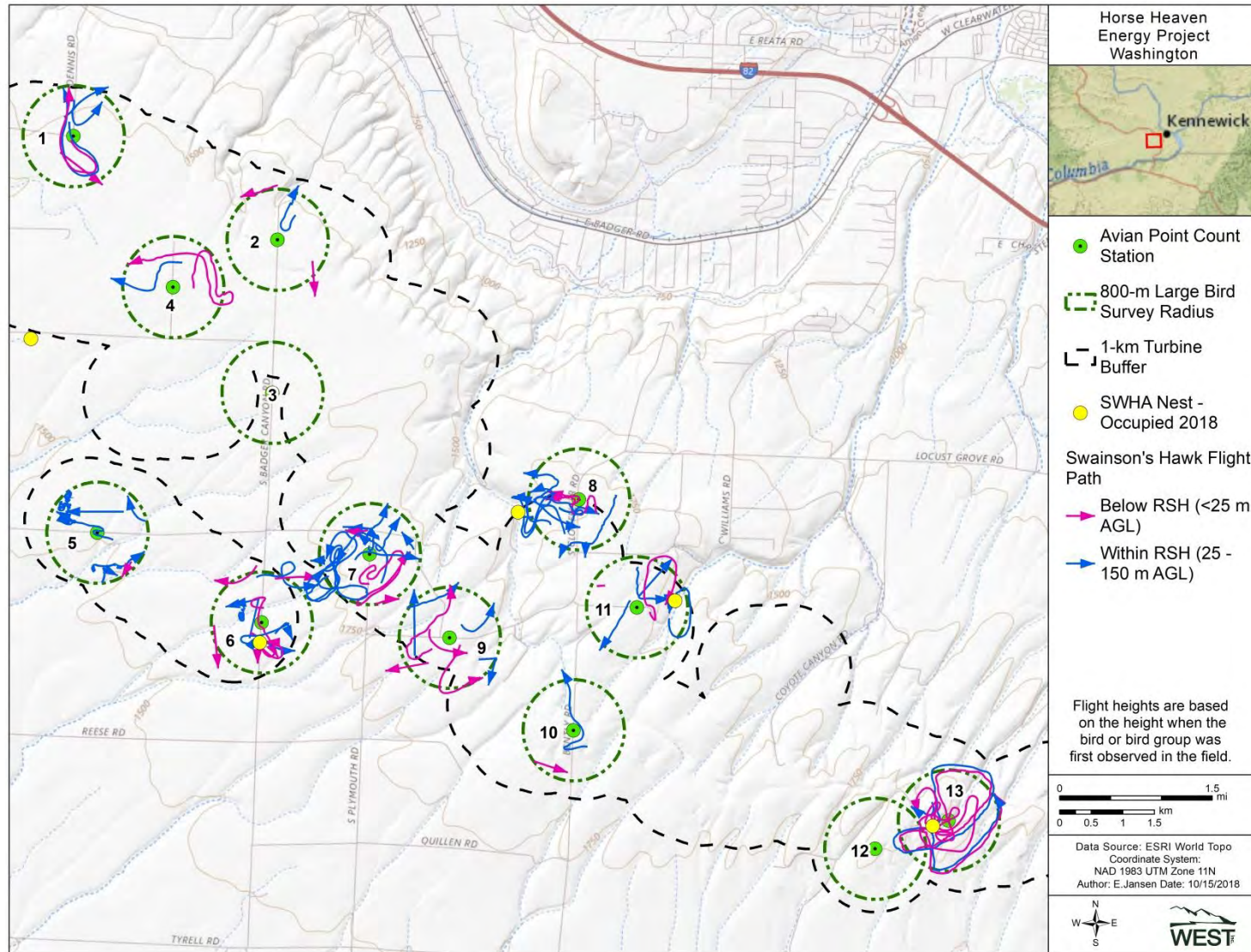
* Flight path data for all mapped large birds available upon request.



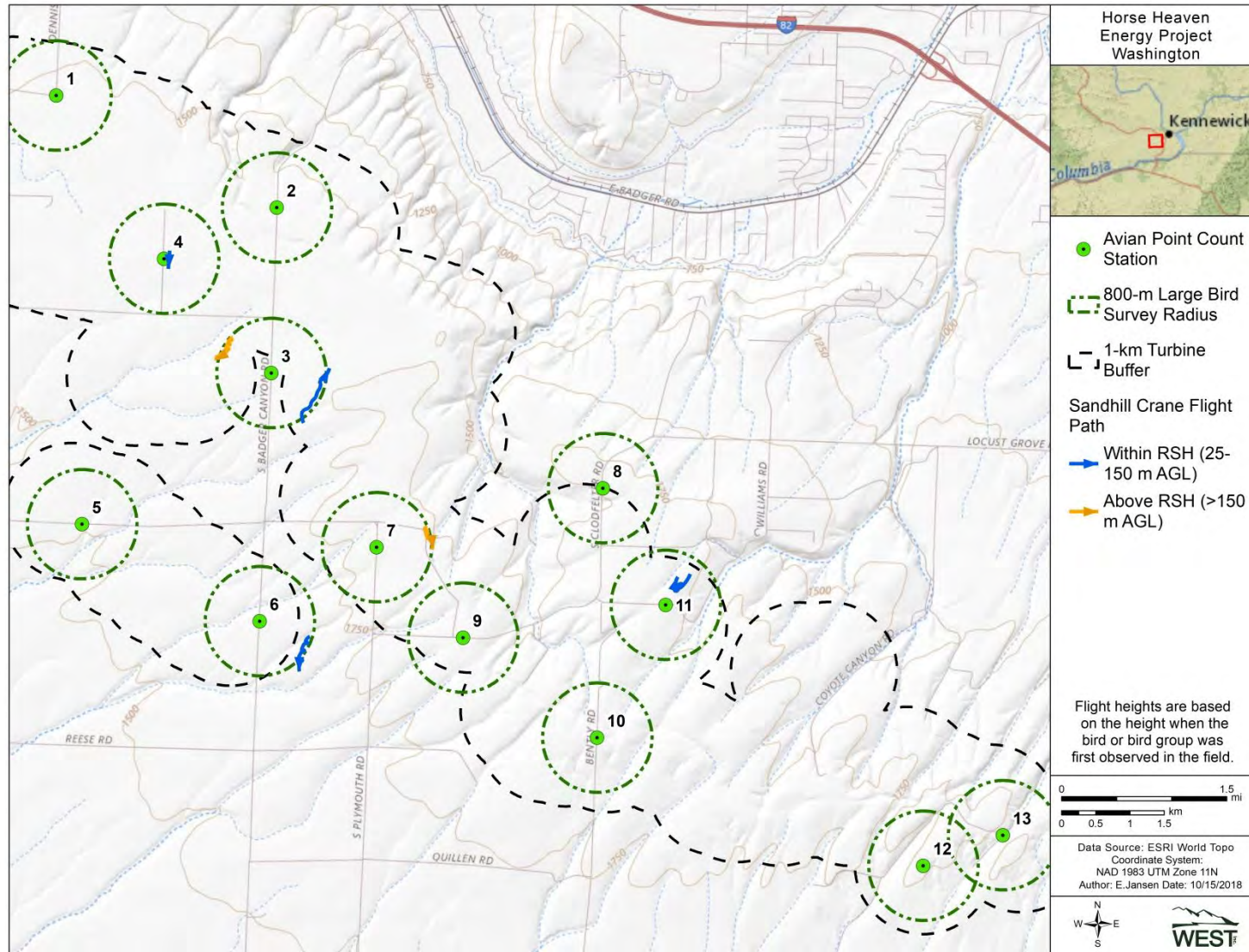
Appendix E1. Canada goose flight paths ($n = 13$) recorded at the Horse Heaven Wind Project during large bird use surveys conducted August 11, 2017 to July 16, 2018.



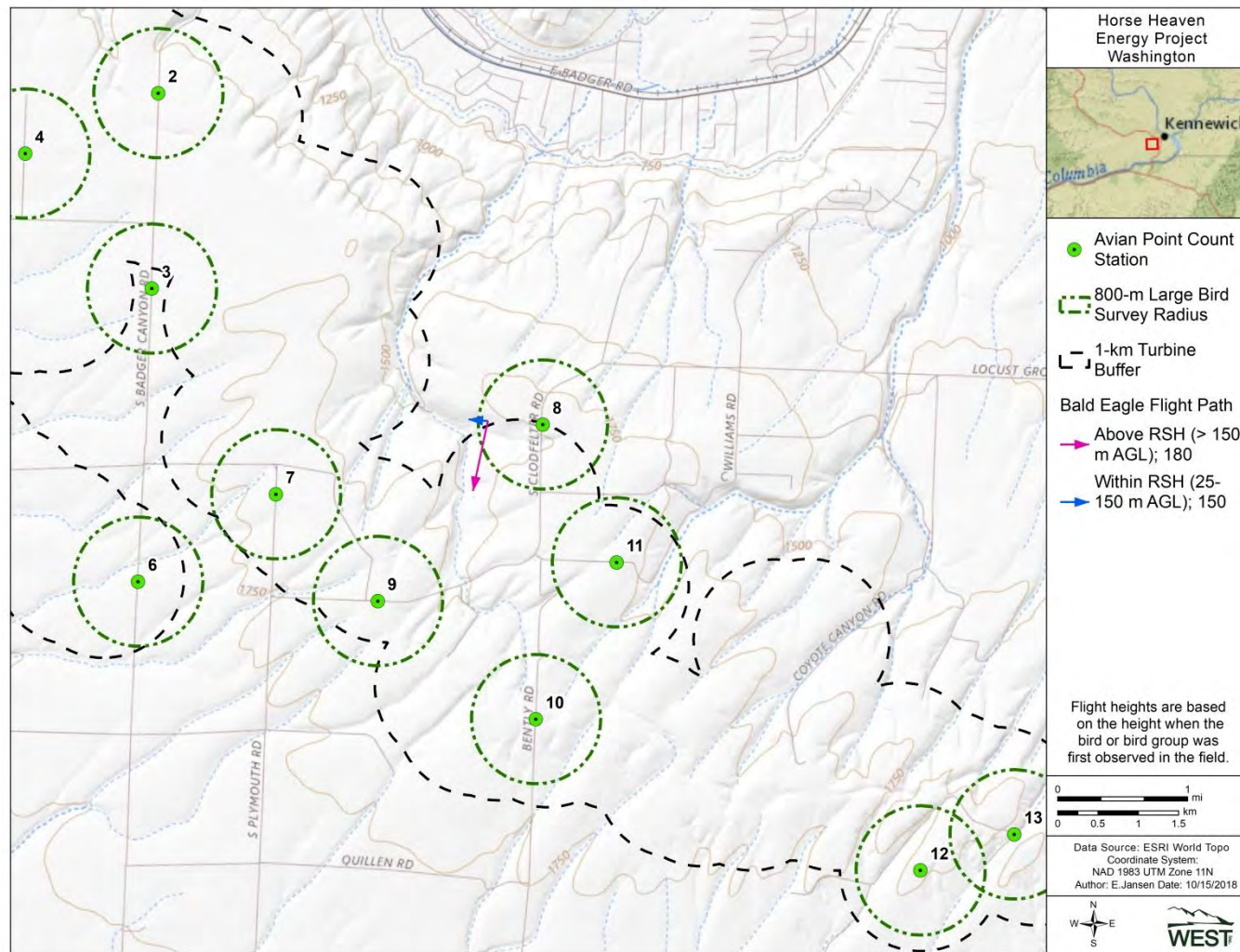
Appendix E2. Red-tailed hawk flight paths ($n = 67$) recorded at the Horse Heaven Wind Project during large bird use surveys conducted August 11, 2017 to July 16, 2018.



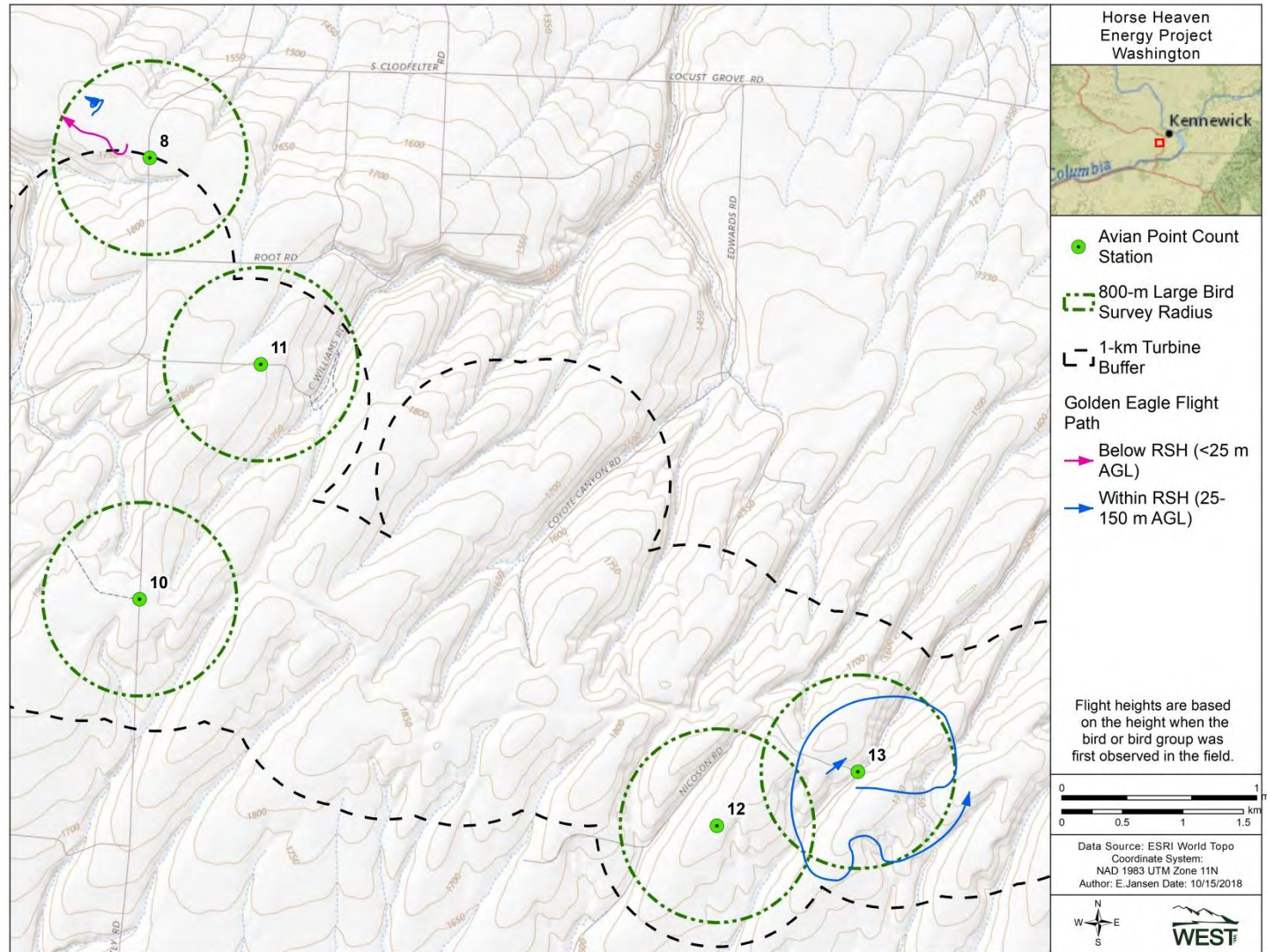
Appendix E3. Swainson's hawk flight paths ($n = 77$) recorded at the Horse Heaven Wind Project during large bird use surveys conducted August 11, 2017 to July 16, 2018.



Appendix E4. Sandhill crane flight paths ($n = 7$) recorded at the Horse Heaven Wind Project during large bird use surveys conducted August 11, 2017 to July 16, 2018.



Appendix E5. Bald eagle flight paths ($n = 2$) recorded at the Horse Heaven Wind Project during large bird use surveys conducted August 11, 2017 to July 16, 2018.



Appendix E6. Golden eagle flight path ($n = 4$) recorded at the Horse Heaven Wind Project during large bird use surveys conducted August 11, 2017 to July 16, 2018.

**Appendix F. 2017 (Appendix F1) and 2018 (Appendix F2) Raptor Nest Survey Results
from Aerial and Ground Surveys conducted at the Horse Heaven Wind Project.**

Appendix F1. 2017 raptor nest results for aerial surveys conducted March 31 and May 10 at the proposed Horse Heaven Wind Project, Washington.

Nest ID	Species	Nest Status	Nest Substrate	Comment
1	Red-tailed Hawk	Occupied	Tree	Adult on nest first survey; one chick approximately 14-day old chick on nest second survey
2	Great-horned Owl	Occupied	Tree	Adult GHOW on nest first survey, two RTHA perched on adjacent tree; No sign of nesting or adults second survey
3	Ferruginous Hawk	Occupied	Tree	Adult perched on nest first survey; adult sitting in nest second survey
4	Unknown Raptor	Unoccupied	Ground	Characteristic of ferruginous hawk nest; large nest in fair condition; no sign of nesting either survey
5	Unknown Raptor	Unoccupied	Tree	Two nests located in one tree ; no sign of nesting either survey
6	Common Raven	Occupied	Windmill	Adult on nest first and second survey
7	Red-tailed Hawk	Occupied	Tree	Adult on nest first survey; no sign of nesting of adult observed second survey
8	Ferruginous Hawk	Occupied	Ground	Adult on nest first survey; no sign of nesting of adult observed second survey
9	Red-tailed Hawk	Occupied	Tree	Adult on nest first survey; two chicks approximately 21-day old second survey; cottonwood tree
10	Unknown Raptor	Unoccupied	Ground	Characteristic of ferruginous hawk nest; nest poor condition, no recent maintenance
11	Unknown Raptor	Unoccupied	Ground	Characteristic of ferruginous hawk nest; nest poor condition, no recent maintenance
12	Red-tailed Hawk	Occupied	Cliff	Adult on nest first survey; one chick approximately 21-day old second survey
13	Unknown Raptor	Unoccupied	Ground	Characteristic of ferruginous hawk nest; nest poor condition, no recent maintenance
14	Great-horned Owl	Occupied	Tree	Adult on nest first survey; two young owls (branchlets) standing in tree adjacent to nest second survey

Appendix F1. 2017 raptor nest results for aerial surveys conducted March 31 and May 10 at the proposed Horse Heaven Wind Project, Washington.

Nest ID	Species	Nest Status	Nest Substrate	Comment
15	Unknown Raptor	Unoccupied	Cliff	Characteristic of ferruginous hawk nest; nest poor condition, no recent maintenance
16	Unknown Raptor	Unoccupied	Ground	Characteristic of ferruginous hawk nest; nest fair condition, no recent maintenance
17	Unknown Raptor	Unoccupied	Ground	Characteristic of ferruginous hawk nest; nest good condition, no recent maintenance
18	Bald Eagle	Occupied	Tree	Adult on nest first survey, mate perched in tree adjacent to river; One chick approximately 21-day old second survey
19	Swainson's Hawk	Occupied	Tree	Not observed first survey; adult on nest second survey
20	Unknown Raptor	Unoccupied	Tree	Not observed first survey; no sign of nesting or adults observed second survey

¹ Occupied = a nest used for breeding in the current year by a pair of eagles. Presence of an adult, eggs, or young, freshly molted feathers or plucked down, or current year's mutes (whitewash) suggest site occupancy; Unoccupied = no sign of nesting or territory occupancy in the current nesting season.

Appendix F2. 2018 raptor nest results for aerial surveys conducted March 5 and May 10 and ground surveys throughout summer 2018 at the proposed Horse Heaven Wind Project, Washington.

Nest ID	2018 Species	Nest Status	Nest Substrate	2017 Spp.	Comment
1	Unknown Raptor	Unoccupied	Tree	RTHA	
2	Swainson's Hawk	Occupied	Tree	GHOW	One adult sitting on the nest during second survey.
3	Ferruginous Hawk	Occupied	Tree	FEHA	One adult sitting on the nest during second survey; eggs observed.
4	Unknown Raptor	Unoccupied	Ground	UNRA	Large-sized nest
5	Unknown Raptor	Unoccupied	Tree	UNRA	Two nests located in one tree; no sign of nesting either survey. Nests in poor condition
6	Common Raven	Occupied	Windmill	CORA	One adult sitting on the nest; eggs observed
7	Great-horned Owl	Occupied	Tree	RTHA	Adult with eggs in nest during first survey; vacant second survey
8	Unknown Raptor	Unoccupied	Ground	FEHA	Characteristic ferruginous hawk nest. Good condition.
9	Red-tailed Hawk	Occupied	Tree	RTHA	One young observed during second survey
10	Unknown Raptor	Unoccupied	Ground	UNRA	Characteristic ferruginous hawk nest. Poor condition.
11	Unknown Raptor	Unoccupied	Ground	UNRA	Characteristic ferruginous hawk nest. Poor condition.

Appendix F2. 2018 raptor nest results for aerial surveys conducted March 5 and May 10 and ground surveys throughout summer 2018 at the proposed Horse Heaven Wind Project, Washington.

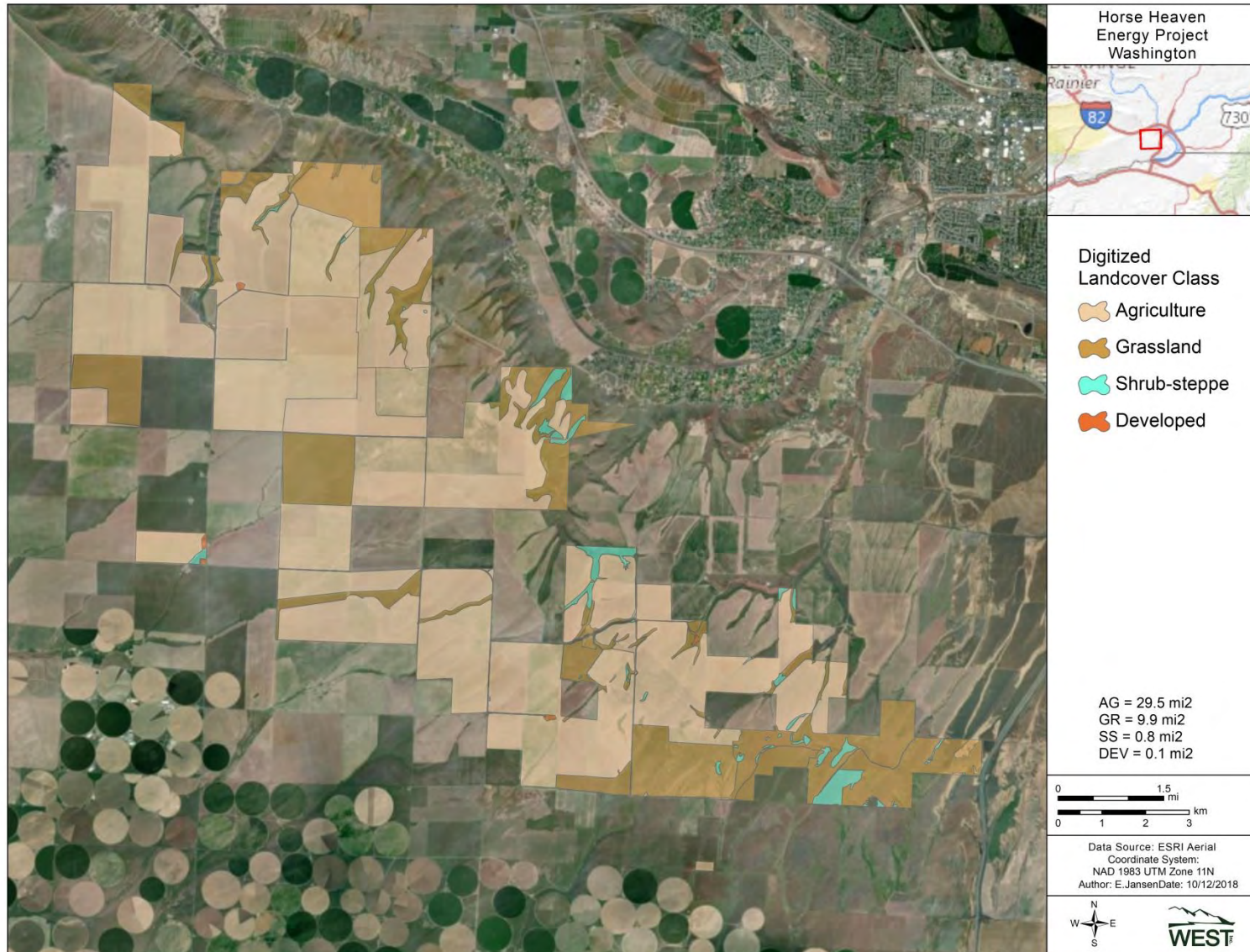
Nest ID	2018 Species	Nest Status	Nest Substrate	2017 Spp.	Comment
12	Unknown Raptor	Unoccupied	Cliff	RTHA	
13	Unknown Raptor	Unoccupied	Ground	UNRA	Characteristic ferruginous hawk nest. Poor condition.
14	Red-tailed Hawk	Occupied	Tree	GHOW	One chick observed second survey.
15	Unknown Raptor	Unoccupied	Ground	UNRA	Characteristic ferruginous hawk nest. Poor condition.
16	Unknown Raptor	Unoccupied	Ground	UNRA	Characteristic ferruginous hawk nest. Good condition.
17	Unknown Raptor	Unoccupied	Ground	UNRA	Characteristic ferruginous hawk nest. Good condition.
18	Bald Eagle	Occupied	Tree	BAEA	2 young approximately 21 days old on second survey
19	Swainson's Hawk	Occupied	Tree	SWHA	Adult incubating second survey.
20	Great-horned Owl	Occupied	Tree	UNRA	One young observed second survey
21	Red-tailed Hawk	Occupied	Tree	NA	New 2018 nest. One adult sitting on the nest during second survey.
22	Unknown Raptor	Unoccupied	Ground	NA	New 2018 nest.

Appendix F2. 2018 raptor nest results for aerial surveys conducted March 5 and May 10 and ground surveys throughout summer 2018 at the proposed Horse Heaven Wind Project, Washington.

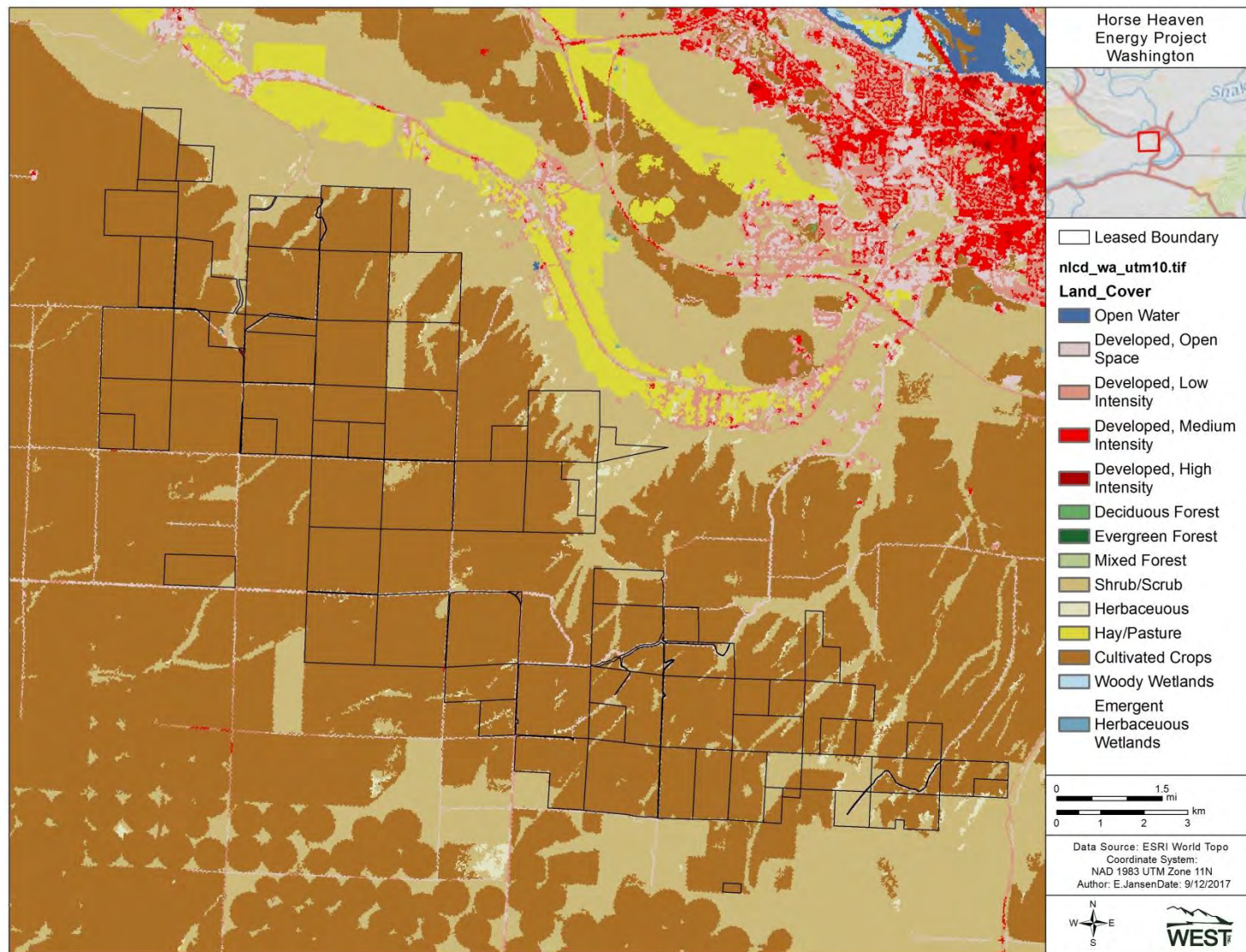
Nest ID	2018 Species	Nest Status	Nest Substrate	2017 Spp.	Comment
23	Red-tailed Hawk	Occupied	Tree	NA	New 2018 nest. Two young observed in nest second survey.
24	Red-tailed Hawk	Occupied	Tree	NA	New 2018 nest. One young observed second survey.
25	Red-tailed Hawk	Occupied	Tree	NA	New 2018 nest. One adult sitting on the nest during second survey.
26	Red-tailed Hawk	Occupied	Tree	NA	New 2018 nest. Two young observed during second nest survey.
27	Red-tailed Hawk	Occupied	Tree	NA	New 2018 nest. Two young observed during second nest survey.
28	Swainson's Hawk	Occupied	Tree	NA	New 2018 nest. Two fledglings observed in mid-July during point count surveys.
29	Swainson's Hawk	Occupied	Tree	NA	New 2018 nest. Three eggs observed during second nest survey.
30	Unknown Raptor	Unoccupied	Ground	NA	New 2018 nest. Characteristic ferruginous hawk nest. Poor condition.
31	Swainson's Hawk	Occupied	Tree	NA	New 2018 nest. Three fledglings in nest in late June. One juvenile flying with adult in mid-Aug. Remains of two fledglings found within 50-m of nest mid-Aug.
32	Swainson's Hawk	Occupied	Tree	NA	New 2018 nest. In pine tree adjacent to ranch house. Three young observed in nest early July. Two juveniles observed flying around nest with adults mid-Aug.

¹ Occupied = a nest used for breeding in the current year by a pair of eagles. Presence of an adult, eggs, or young, freshly molted feathers or plucked down, or current year's mutes (whitewash) suggest site occupancy; Unoccupied = no sign of nesting or territory occupancy in the current nesting season.

Appendix G. Landcover at the Project from field mapping (Appendix G1) and the National Landcover Database (Appendix G2) at the Horse Heaven Wind Project.



Appendix G1. Digitized Landcover at the Horse Heaven Wind Project.



Appendix G2. NLCD Landcover at the Horse Heaven Wind Project.

Appendix H. Oregon and Washington Raptor Use and Fatality Rate Summary Table.

Appendix H. Wind energy facilities in Oregon and Washington with publicly-available and comparable use and fatality data for raptors.

Wind Energy Facility	Raptor Use Estimate^A	Raptor Fatality Estimate^B	No. of Turbines	Total MW
Horse Heaven	0.795	NA	NA	NA
<i>Pacific Northwest</i>				
White Creek, WA (2007-2011)	NA	0.47	89	204.7
Tuolumne (Windy Point I), WA (2009-2010)	0.77	0.29	62	136.6
Vantage, WA (2010-2011)	NA	0.29	60	90
Linden Ranch, WA (2010-2011)	NA	0.27	25	50
Harvest Wind, WA (2010-2012)	NA	0.23	43	98.9
Goodnoe, WA (2009-2010)	NA	0.17	47	94
Leaning Juniper, OR (2006-2008)	0.522	0.16	67	100.5
Klondike III (Phase I), OR (2007-2009)	NA	0.15	125	223.6
Hopkins Ridge, WA (2006)	0.698	0.14	83	150
Biglow Canyon, OR (Phase II; 2009-2010)	0.318	0.14	65	150
Big Horn, WA (2006-2007)	0.511	0.11	133	199.5
Stateline, OR/WA (2006)	0.478	0.11	454	299
Kittitas Valley, WA (2011-2012)	NA	0.09	48	100.8
Wild Horse, WA (2007)	0.291	0.09	127	229
Stateline, OR/WA (2001-2002)	0.478	0.09	454	299
Stateline, OR/WA (2003)	0.478	0.09	454	299
Elkhorn, OR (2010)	1.07	0.08	61	101
Hopkins Ridge, WA (2008)	0.698	0.07	87	156.6
Elkhorn, OR (2008)	1.07	0.06	61	101
Klondike II, OR (2005-2006)	0.504	0.06	50	75
Klondike IIIa (Phase II), OR (2008-2010)	NA	0.06	51	76.5
Combine Hills, OR (2011)	0.746	0.05	104	104
Biglow Canyon, OR (Phase III; 2010-2011)	0.318	0.05	76	174.8
Marengo II, WA (2009-2010)	NA	0.05	39	70.2
Windy Flats, WA (2010-2011)	NA	0.04	114	262.2
Pebble Springs, OR (2009-2010)	NA	0.04	47	98.7
Biglow Canyon, OR (Phase I; 2008)	0.318	0.03	76	125.4
Biglow Canyon, OR (Phase II; 2010-2011)	0.318	0.03	65	150
Nine Canyon, WA (2002-2003)	0.35	0.03	37	48.1
Hay Canyon, OR (2009-2010)	NA	0	48	100.8
Biglow Canyon, OR (Phase I; 2009)	0.318	0	76	125.4
Marengo I, WA (2009-2010)	NA	0	78	140.4
Klondike, OR (2002-2003)	0.504	0	16	24
Vansycle, OR (1999)	0.66	0	38	24.9
Combine Hills, OR (Phase I; 2004-2005)	0.746	0	41	41

A=number of raptors/plot/20min survey

B=number of fatalities/MW/year

Appendix H (continued). Wind energy facilities in Oregon and Washington with fatality data for all bird species. Data from the following sources:

Wind Energy Facility	Estimate Reference
Big Horn, WA (06-07)	Kronner et al. 2008
Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010
Biglow Canyon, OR (Phase II; 09-10)	Enk et al. 2011a
Biglow Canyon, OR (Phase II; 10-11)	Enk et al. 2012b
Biglow Canyon, OR (Phase III; 10-11)	Enk et al. 2012a
Combine Hills, OR (Ph. I; 04-05)	Young et al. 2006
Combine Hills, OR (11)	Enz et al. 2012
Elkhorn, OR (08)	Jeffrey et al. 2009b
Elkhorn, OR (10)	Enk et al. 2011b
Goodnoe, WA (09-10)	URS Corporation 2010a
Harvest Wind, WA (10-12)	Downes and Gritski 2012a
Hay Canyon, OR (09-10)	Gritski and Kronner 2010a
Hopkins Ridge, WA (06)	Young et al. 2007
Hopkins Ridge, WA (08)	Young et al. 2009c
Kittitas Valley, WA (11-12)	Stantec 2012
Klondike, OR (02-03)	Johnson et al. 2003
Klondike II, OR (05-06)	NWC and WEST 2007
Klondike III, OR (Phase I; 07-09)	Gritski et al. 2010
Klondike IIIa, OR (Phase II; 08-10)	Gritski et al. 2011
Leaning Juniper, OR (06-08)	Gritski et al. 2008
Linden Ranch, WA (10-11)	Enz and Bay 2011
Marengo I, WA (09-10)	URS Corporation 2010b
Marengo II, WA (09-10)	URS Corporation 2010c
Nine Canyon, WA (02-03)	Erickson et al. 2003b
Pebble Springs, OR (09-10)	Gritski and Kronner 2010b
Stateline, OR/WA (01-02)	Erickson et al. 2004
Stateline, OR/WA (03)	Erickson et al. 2004
Stateline, OR/WA (06)	Erickson et al. 2007
Tuolumne (Windy Point I), WA (09-10)	Enz and Bay 2010
Vansycle, OR (99)	Erickson et al. 2000b
Vantage, WA (10-11)	Ventus 2012
White Creek, WA (07-11)	Downes and Gritski 2012b
Wild Horse, WA (07)	Erickson et al. 2008
Windy Flats, WA (10-11)	Enz et al. 2011

Appendix I. Estimated Raptor Nest Densities at Other Regional Proposed and Existing Wind Projects Located in Comparable Columbia Plateau Ecoregion Environments.

Appendix I. Estimated raptor nest densities at other regional proposed and existing wind projects located in comparable Columbia Plateau Ecoregion environments. Project data from Table 11 in NWC and ABR 2009.

Project ^a	Raptor Nest Density (#/mi ²), rounded								
	Sum Density	Buteos				Eagle	Falcon	Owl	Accip.
		SWHA ^b	RTHA	FEHA	UNBU	GOEA	PRFA	GHOW	SSHA
Rattlesnake Road, OR	0.45	0.19	0.13	0.05	0.00	0.00	0.08	0.00	0.00
Hopkins Ridge, WA	0.42	0.01	0.27	0.01	0.05	0.00	0.00	0.08	0.00
Leaning Juniper I and II, OR	0.41	0.18	0.16	0.03	0.00	0.00	0.02	0.02	0.00
Goodnoe Hills/Imrie, WA (1 mile radius search area)	0.37	0.05	0.27	0.00	0.00	0.00	0.00	0.05	0.00
Columbia Hills, WA	0.30	0.04	0.18	0.00	0.00	0.02	0.02	0.02	0.02
Horse Heaven, WA 2017 (this study)	0.27	0.01	0.05	0.03	0.13	0.00	0.00	0.03	0.00
Golden Hills, OR	0.25	0.04	0.16	0.00	0.00	0.00	0.00	0.05	0.00
Klondike I and II, OR (5 mile radius search area)	0.23	0.07	0.11	0.00	0.00	0.01	0.00	0.04	0.00
Horse Heaven, WA 2018 (this study)	0.21	0.04	0.05	0.01	0.09	0.00	0.00	0.01	0.00
Juniper Canyon, WA 2007-2008	0.21	0.06	0.05	0.03	0.02	0.03	0.01	0.01	0.00
Stateline OR/WA	0.21	0.03	0.08	0.03	0.00	0.00	0.00	0.07	0.00
Klondike III, OR	0.20	0.04	0.11	0.00	0.01	0.00	0.00	0.03	0.00
Wild Horse, WA	0.16	0.00	0.12	0.00	0.00	0.00	0.02	0.02	0.00
Windy Flats, WA	0.15	0.00	0.13	0.00	0.00	0.00	0.00	0.02	0.00
Big Horn, WA	0.11	0.00	0.06	0.00	0.00	0.00	0.01	0.04	0.00
Zintel Canyon, WA	0.08	0.04	0.02	0.02	0.00	0.00	0.00	0.00	0.00
Nine Canyon, WA	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Density	0.24	0.05	0.12	0.01	0.02	0.00	0.01	0.03	0.00

^a References for projects: Rattlesnake Road (Kronner et al., 2007a); Hopkins Ridge (Young et al., 2003c); Leaning Juniper I and II (Kronner et al., 2005); Goodnoe Hills/Imrie (NWP, 2009); Juniper Canyon (NWC, 2008); Columbia Hills (Erickson et al., 2002b); Golden Hills (Jeffrey et al., 2008a); Stateline (Erickson et al., 2004; NWC and WEST, 2001; Erickson et al., 2002b); Klondike I and II (Johnson et al., 2002a), Klondike III (Mabee et al., 2005), Wild Horse (Erickson et al., 2003b), Windy Flats (ENE, 2007); Big Horn (Johnson and Erickson, 2004); Nine Canyon and Zintel Canyon (WEST and NWC, 2001; WEST and NWC, 2002; Erickson et al., 2002b).

^b SWHA = Swainson's hawk, RTHA = red-tailed hawk, GHOW = great-horned owl, FEHA = ferruginous hawk, UNBU = unknown species of the genus *Buteo*, GOEA = golden eagle, PRFA = prairie falcon, GHOW = great-horned owl, SSHA = sharp-shinned hawk

BAT ACOUSTIC SURVEY REPORT

Horse Heaven Wind Project Benton County, WA



Prepared for:

Horse Heaven Wind Farm, LLC

4865 Sterling Drive Suite 200
Boulder, Colorado 80301

Prepared by:

Quentin Hays, Samantha R. Brown, and Erik W. Jansen

Western EcoSystems Technology, Inc.
2725 NW Walnut Boulevard
Corvallis, Oregon 97330

January 2019



EXECUTIVE SUMMARY

In August 2017 Western EcoSystems Technology, Inc. (WEST) initiated a study of bat activity at the proposed Horse Heaven Wind Project (Project), located in Benton County, Washington. The study was designed to 1) evaluate seasonal levels of bat activity at the Project, including periods of expected peak activity, 2) identify species occurring at the Project during the study period, and 3) provide context of bat activity at the Project relative to other publicly available data.

WEST conducted acoustic surveys at the Project during two periods: from August 19, 2017 through October 30, 2017, and again from May 14, 2018 through October 29, 2018. During the 2017 study period, one Anabat SD2 Active Bat Detector was placed near the ground at 1.5 meters (5.0 feet) at the base of a meteorological (met) tower. During the 2018 study period, the same ground-based detector location was used and data collection was supplemented with an additional Anabat SD2 detector raised to approximately 45 m on the same met tower. The tower was located in shrub-steppe habitat, which is a sub-dominant land cover type at the Project yet representative of where future turbine placement may occur.

During the 72 detector-nights surveyed in 2017, the average bat activity rate (\pm standard error) was 0.33 ± 0.08 bat passes per detector-night. Approximately 91.6% of bat passes were produced by low-frequency, tree-roosting bats (e.g., silver-haired bat, hoary bat); automated identification of bat calls using Kaleidoscope Pro 4.2.0 determined that silver-haired bats were the most frequently detected species, occurring on 14% of detector-nights. During the 303 detector-nights surveyed in 2018 the average bat activity rate was 0.27 ± 0.05 bat passes per detector-night, and similar to 2017, low-frequency bats were detected most frequently, accounting for 98.7% of all bat passes and comprising primarily silver-haired bats. One high-frequency bat species (canyon bat) was detected during both study periods. Neither Townsend's big-eared bat nor pallid bat, both of which are Washington State Candidate Species and could potentially occur at the Project, were detected during the study, and no federal or state-listed bat species were detected.

Overall, bat activity at the Project documented during the bat activity study in 2017 and 2018 at (0.33 bat passes per detector-night) was well below the Rocky Mountains regional average of 4.02 bat passes per detector-night, which is the closest region with publicly available activity data (no activity data from the Pacific Northwest is available for comparison). The average fatality rate of 1.19 bats per megawatt per year in the Pacific Northwest is low compared to the Rocky Mountain regional average of 4.90 bats per megawatt per year (bats/MW/year). Bat fatalities from the operational Nine Canyon Wind Facility, located adjacent to the Project was 2.47 bats/MW/year and consisted of silver-haired bats and hoary bats. If risk patterns at the Project are similar to patterns at Nine Canyon and elsewhere in the Pacific Northwest and Rocky Mountains, it is likely that species composition and fatality rates at the Project would be similar.

STUDY PARTICIPANTS

Western EcoSystems Technology, Inc.

Erik Jansen	Project Manager
Samantha Brown	Report Compiler
Quentin Hays	Report Reviewer
Donald Solick	Bat Biologist
Mandy Kauffman	Statistician
Kori Hutchison	Field Coordinator
Joshua Parrott	Field Technician

REPORT REFERENCE

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INTRODUCTION

During 2017 and 2018, Western EcoSystems Technology, Inc. (WEST) completed a study of bat activity at the proposed Horse Heaven Wind Project (Project) in accordance with recommendations in the US Fish and Wildlife Service (USFWS) *Land-Based Wind Energy Guidelines* (USFWS 2012) and the Washington Department of Fish and Wildlife (WDFW) *Wind Power Guidelines* (WDFW 2009). Although it remains unclear whether bat activity patterns in baseline acoustic data predict post-construction fatality risk (Hein et al. 2013a), ultrasonic detectors collect information on spatial distribution, timing, and species composition that can provide insight into the potential impacts of wind development on bats in a particular area (Kunz et al. 2007a, Britzke et al. 2013) and inform potential collision minimization strategies (Weller and Baldwin 2012). WEST conducted a bat activity study at the Project with the primary objectives to: 1) evaluate seasonal levels of bat activity at the Project, including periods of expected peak activity; and, 2) identify species occurring at the Project during the study period, 3) provide context of bat activity at the Project relative to other publicly-available data. The following report describes the results of acoustic surveys conducted at the Project from August 19, 2017 – October 30, 2017 and May 14, 2018 – October 29, 2018.

STUDY AREA

The 51,263 acre (80.1 mi²) Project area is located in Benton County, Washington, within the Horse Heaven Hills, an anticline ridge of the Yakima Folds within the larger Columbia Plateau Ecoregion (Clarke and Bryce 1997). Topography within the Project consists primarily of rolling hills and incised drainages, with a broad northeast-facing rampart along the northern Project boundary (Figure 1). The highly-eroded drainages along the rampart create numerous canyons that bisect the Project (Badger Canyon, Coyote Canyon, Taylor Canyon) and expose basalt cliffs and ledges. On the southern side of the rampart, the landscape transitions to rolling topography with shallow, meandering canyons that drain south into the Columbia River.

Land cover within the Project is a mosaic of seed crops associated with dryland and irrigated agriculture, shrub-steppe grasslands, and rural/urban development (Figure 2). Agricultural crop cover dominates the Project and surrounding area. Shrub-steppe grasslands are found in topographically steep areas. The entire Project is privately owned of which much is actively managed for dryland agriculture and livestock grazing. The 63-turbine Nine Canyon Wind Project is located approximately 4.5 miles east of the Project.

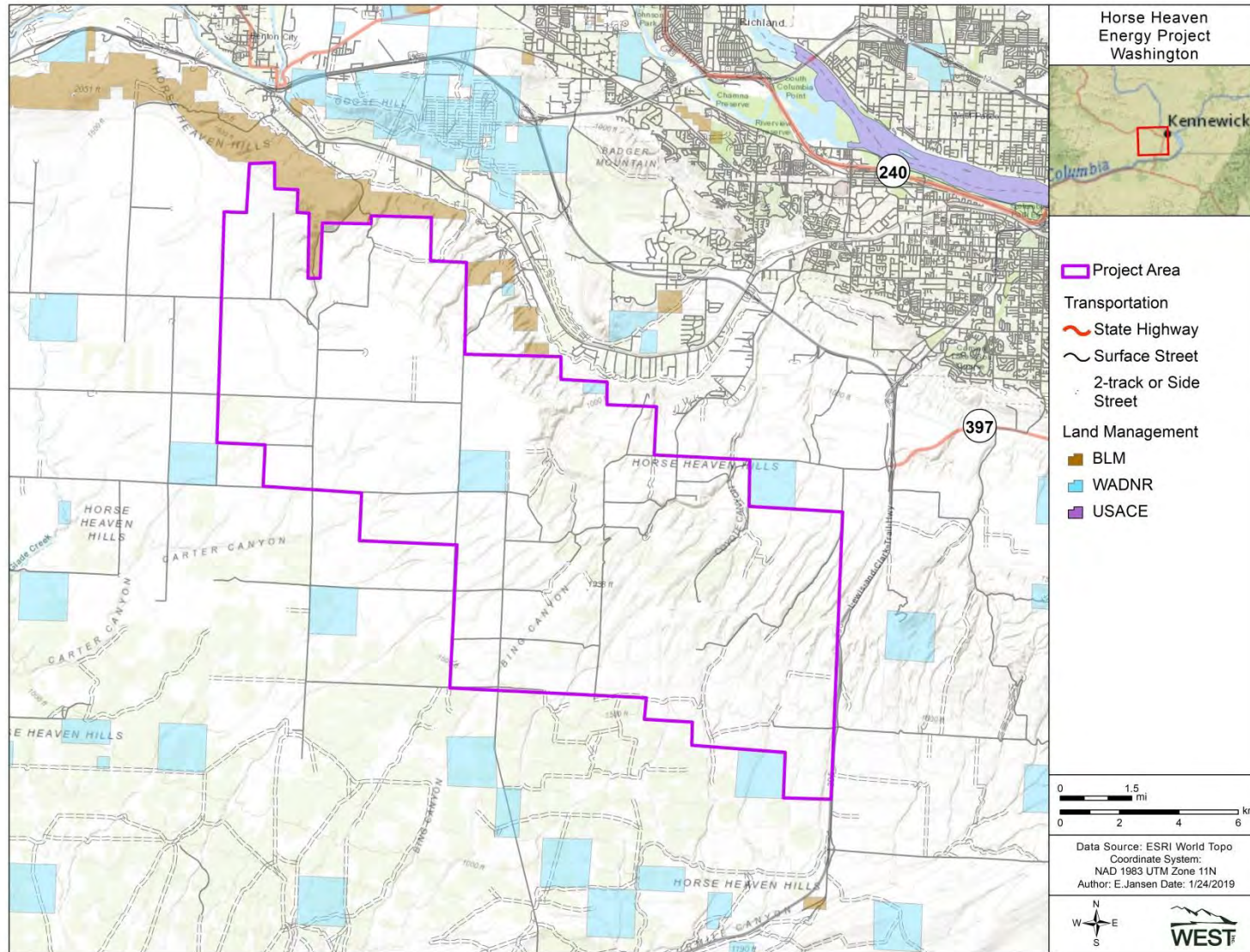


Figure 1. Location of the proposed Horse Heaven Wind Project, Benton County, Washington.

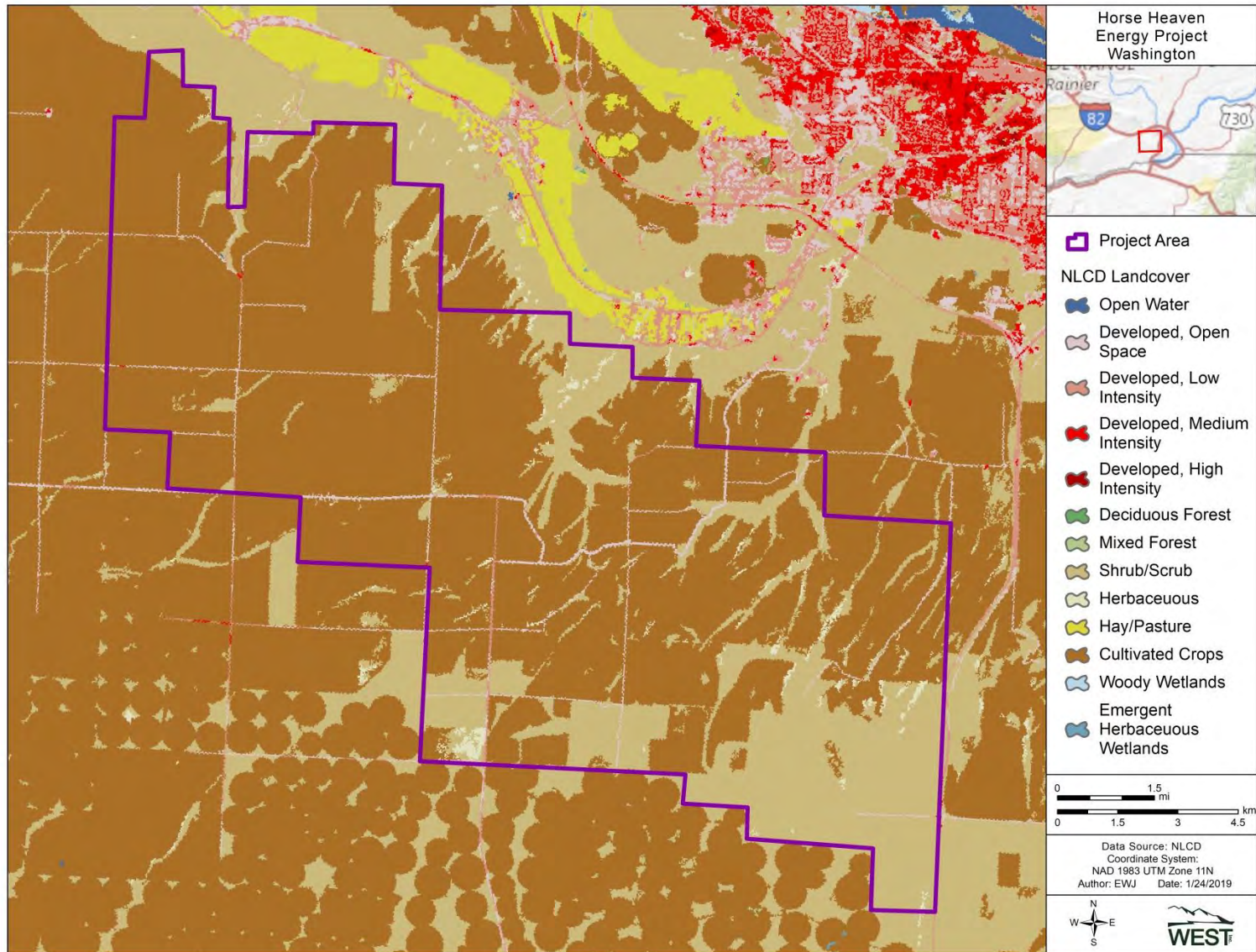


Figure 2. Land cover types within the proposed Horse Heaven Wind Project, Benton County, Washington.

Overview of Bat Diversity

Twelve species of bats potentially occur at the Project (Hayes and Wiles 2013, International Union for the Conservation of Nature [IUCN] 2017; Table 1). None of these species are federally listed under the Endangered Species Act of 1973 and none are listed as threatened, endangered, or sensitive by the state of Washington (Washington Department of Fish and Wildlife [WDFW] 2016). However, the Townsend's big-eared bat (*Corynorhinus townsendii*) and pallid bat (*Antrozous pallidus*) are state candidate species (WDFW 2016).

Table 1. Bat species with potential to occur in the Horse Heaven Wind Project categorized by echolocation call frequency.

Common Name	Scientific Name
High-Frequency (> 30 kilohertz [kHz])	
California bat	<i>Myotis californicus</i>
canyon bat ¹	<i>Parastrellus hesperus</i>
little brown bat ¹	<i>Myotis lucifugus</i>
long-legged bat ¹	<i>Myotis volans</i>
western long-eared bat ¹	<i>Myotis evotis</i>
western small-footed bat ⁴	<i>Myotis ciliolabrum</i>
Yuma bat	<i>Myotis yumanensis</i>
Low-Frequency (15 – 30 kHz)	
big brown bat ¹	<i>Eptesicus fuscus</i>
hoary bat ^{1,2}	<i>Lasiurus cinereus</i>
pallid bat ³	<i>Antrozous pallidus</i>
silver-haired bat ^{1,2}	<i>Lasionycteris noctivagans</i>
Townsend's big-eared bat ³	<i>Corynorhinus townsendii</i>

Source: Hayes and Wiles (2013), IUCN 2017

¹species known to have been killed at wind energy facilities (species reported by: Anderson et al. 2004, Kunz et al. 2007b, Baerwald 2008, Miller 2008)

²Long-distance migrant

³Washington state candidate species (WDFW 2016)

METHODS

Bat Acoustic Surveys

Sampling Stations

Bat activity levels and composition can vary with height above ground level (AGL; Baerwald and Barclay 2009, Collins and Jones 2009, Müller et al. 2013), and high-flying bat species are at greater risk of collision with turbines (Roemer et al. 2017). Therefore, it is useful to monitor activity at different heights (Kunz et al. 2007b). Because most North American bat species spend at least some time flying at relatively low heights, acoustic detectors deployed near the ground may detect a more complete sample of the bat species present within a given area; however, elevated acoustic detectors may provide a more accurate assessment of bat species flying at rotor-swept heights (Kunz et al. 2007b, Müller et al. 2013; but see Amorim et al. 2012).

WEST conducted acoustic surveys to estimate levels of bat activity at the Project during fall (2017) and summer and fall (2018), which includes the expected period of peak activity for migratory bats in eastern Washington (i.e., late summer through fall). Sampling occurred at a meteorological (met) tower in the southeastern corner of the Project. During 2017, only the ground detector (HHg1) was deployed due to the timing of meteorological (met) tower construction; during 2018, both a ground detector (HH1g) and a raised detector (HH1r) were deployed. Anabat SD2 ultrasonic bat detectors (Titley™ Scientific, Columbia, Missouri) were placed at a met tower in the southeastern corner of the Project. Microphones for each detector were deployed at different heights: a ground detector with a microphone elevated slightly (i.e., approximately 1.5 m [5.0 ft]; ground unit) to improve the quality of sound recordings (e.g., to reduce recordings of insect calls), and a raised detector with a microphone raised approximately 45 m (148 ft; raised unit) on the met tower. Detectors were checked every two weeks to swap compact flash cards, batteries, and to ensure units were properly functioning. At the end of each sample period, detectors were decommissioned and brought back from the field for maintenance and calibration.

Large weatherproof boxes housed the detectors and external deep-cycle batteries for protection from weather and wildlife. Microphones were protected by PVC elbows with drain holes that extended outside the container and helped minimize the potential for water damage due to rain. The raised Anabat microphone was elevated on the met tower using a pre-installed pulley system. Microphones were encased in a Bat-Hat weatherproof housing (EME Systems, Berkeley, California), and attached to a coaxial cable that transmitted ultrasonic sound data to an Anabat detector at the base of the tower. The Bat-Hat weatherproof housing was modified by replacing the Plexiglas reflector plate with a 45-degree angle PVC elbow, for better comparability with data collected by detectors on the ground (Britzke et al. 2010).

Survey Schedule

Acoustic monitoring surveys were conducted at the Project during two study periods: from August 19, 2017 through October 30, 2017, and again from May 14, 2018 through October 29, 2018. A second monitoring year was conducted to sample the full length of summer and fall seasons when resident and migratory bats could be present. Detectors were programmed to turn on approximately 30 minutes (min) before sunset and turn off approximately 30 minutes after sunrise each day. To elucidate seasonal activity patterns, the second year was divided into two seasons: summer (May 14 – August 18) and fall (August 19 – October 29). A broader fall migratory period was considered July 30 – October 14 (McGuire and Boyle 2013).

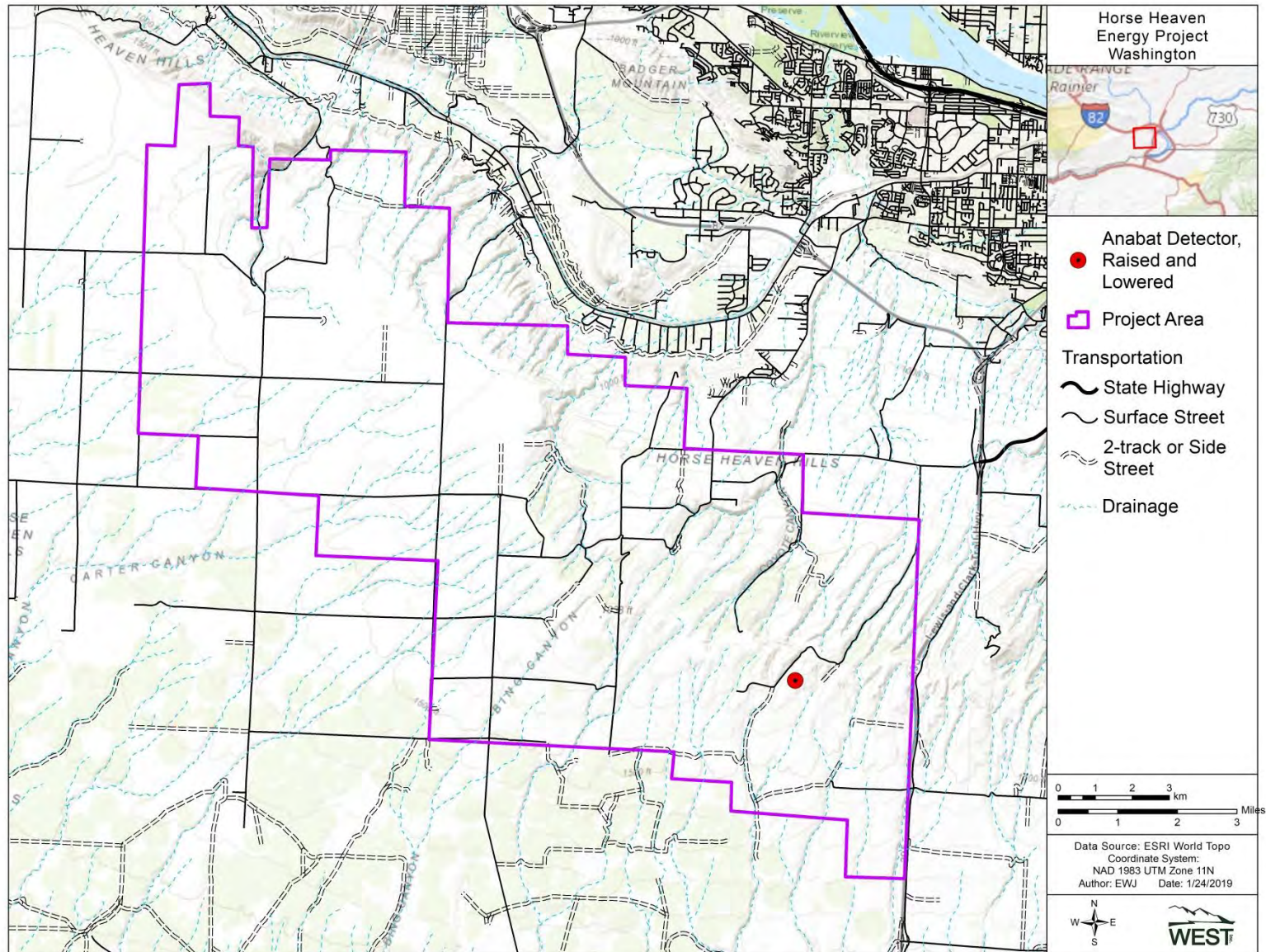


Figure 3. Location of sampling station used during the bat acoustic surveys at the proposed Horse Heaven Wind Project.

Data Collection and Call Analysis

Anabat detectors use a broadband high-frequency microphone to detect the echolocation calls of bats. Incoming echolocation calls are digitally processed and stored on a high-capacity compact flash card. The resulting files can be viewed in appropriate software (e.g., Analook®) as digital sonograms that show changes in echolocation call frequency over time. Frequency versus time displays were used to separate bat calls from other types of ultrasonic noise (e.g., wind, insects), and to determine the call frequency category and, when possible, the species of bat that generated the calls.

To standardize acoustic sampling effort at the Project, Anabat detectors were calibrated and sensitivity levels were set to six (Larson and Hayes 2000), a level that balanced the goal of recording bat calls against the need to reduce interference from other sources of ultrasonic noise (Brooks and Ford 2005).

For ground (HH1g) and raised (HH1r) detectors, bat passes were sorted into two groups based on their minimum frequency. High-frequency (HF) bats such as little brown bat (*Myotis lucifugus*), and canyon bats (*Parastrellus hesperus*), have minimum frequencies greater than 30 kilohertz (kHz). Low-frequency (LF) bats such as big brown bats (*Eptesicus fuscus*), silver-haired bats (*Lasionycteris noctivagans*), and hoary bats (*Lasiurus cinereus*) typically emit echolocation calls with minimum frequencies between 15 and 30 kHz.

Species-level identification of bat calls was completed with the automated identification feature in Kaleidoscope 4.2.0 (Wildlife Acoustics, Concord, Massachusetts) using the Bats of North America classifier 4.2.0 at the most sensitive setting. Kaleidoscope is currently the only program available for automated classification of zero crossing (e.g., Anabat) files for bat species in the US and was used to select for the 12 bat species that potentially occur at the Project (Table 1).

Statistical Analysis

The standard metric for measuring bat activity, the number of bat passes per detector-night, was used as an index of bat activity at the Project. A bat pass was defined as a sequence of at least two echolocation calls (pulses) produced by an individual bat with no pause between calls of more than one second (Fenton 1980, White and Gehrt 2001, Gannon et al. 2003). A detector-night was defined as one detector operating for one entire night. The terms bat pass and bat call are used interchangeably. Bat passes per detector-night was calculated for all bats, for HF bats, and for LF bats. Bat pass rates represent indices of bat activity and do not represent numbers of individuals. The number of bat passes was determined by an experienced bat biologist using Analook®.

Mean bat activity was calculated by detector station and overall. The period of peak sustained bat activity was defined as the seven-day period with the highest average bat activity. This and all multi-detector averages were calculated as unweighted averages of total activity at each detector.

Risk Assessment

Collision with wind turbine blades is thought to be the primary risk to bats at operating wind energy facilities (Arnett et al. 2008), though direct mortality through barotrauma (Baerwald et al. 2008) and other indirect effects such as displacement (Katzner et al. 2016) may occur. The intent of the risk assessment is to use pre-construction bat activity data and mortality information from operating wind facilities to assess the potential level of bat fatalities at the Project. The intent of the risk assessment is not to predict the number of fatalities, but rather to provide context for data collected at the Project; the risk assessment is therefore qualitative, rather than quantitative. In order to assess potential bat fatality rates at the Project, bat activity data collected in 2018 at the Project were compared to activity data from other wind energy facilities in the Rocky Mountains region, which is the closest region with publicly available activity data; no publicly available bat activity data exists from the Pacific Northwest. The nearest operating wind energy facility to the Project is the Nine Canyon Wind Facility (Nine Canyon), located approximately five miles east. Although pre-construction activity was not collected for Nine Canyon, fatality estimates from standardized carcass searches conducted during 2002–2003 (Erickson et al. 2003) and bat fatalities found incidentally by operations staff over 14 years of project operation (2005–2018) are reported for comparison.

Among currently available studies that measured both preconstruction bat activity and subsequent operational fatality rates, most data were collected during known periods of peak activity (i.e., fall) using Anabat (i.e., non-full spectrum) detectors placed near the ground. To facilitate comparisons to these studies, this report uses only the mean activity rate from the HH1g during 2018, as this detector was placed near the ground and sampled the full period of peak bat activity (i.e., late summer through fall).

RESULTS

2017 Bat Acoustic Surveys

Bat Activity

Bat activity was documented at one detector station in the Project for a total of 72 detector-nights between August 19 and October 30, 2017 (Figure 4). The detector station operated for 99% of the study period and documented an overall mean of 0.33 ± 0.08 bat passes per detector-night (Table 2; Figure 4). The period of peak bat activity occurred from September 3 through September 9, 2017 (Figure 5).

Table 2. Bats detected and total bat passes per station from August 19 through October 30, 2018 at the ground detector (HH1g) at Horse Heaven Wind Project in Benton County, Washington.

Station	HF Bats	LF Bats	All Bats	Detector Nights	Bat Passes
HH1g	2	22	24	72	0.33 ± 0.08

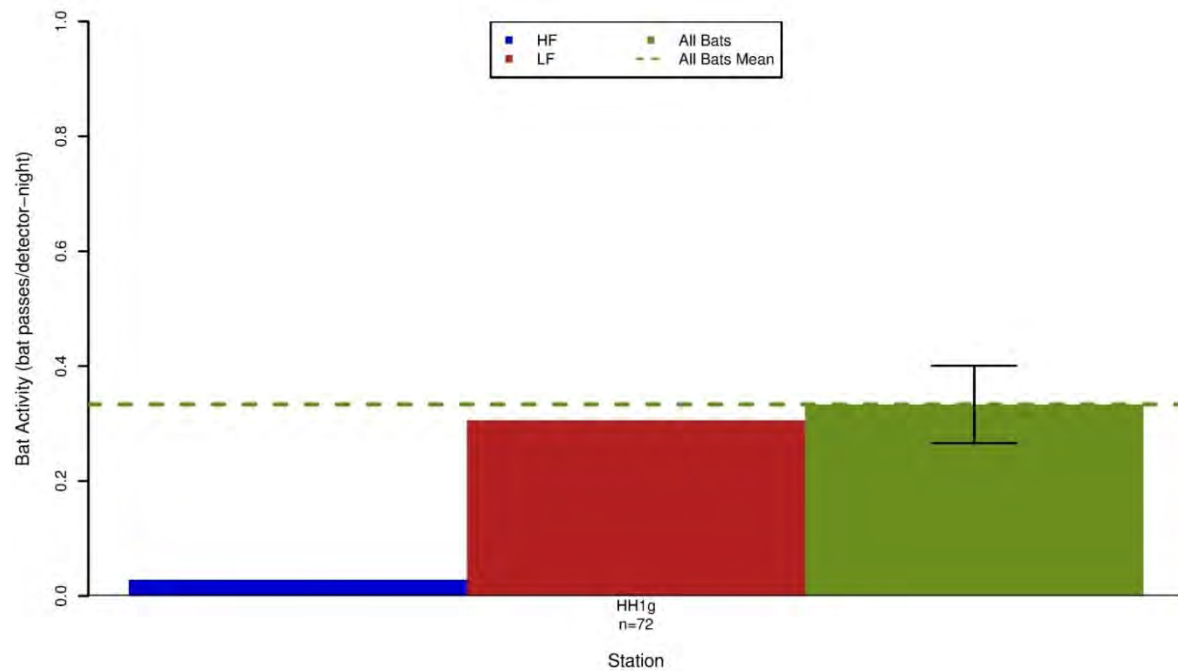


Figure 4. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded during August 19 – October 30, 2017 at the Horse Heaven Wind Project, Benton County, Washington.

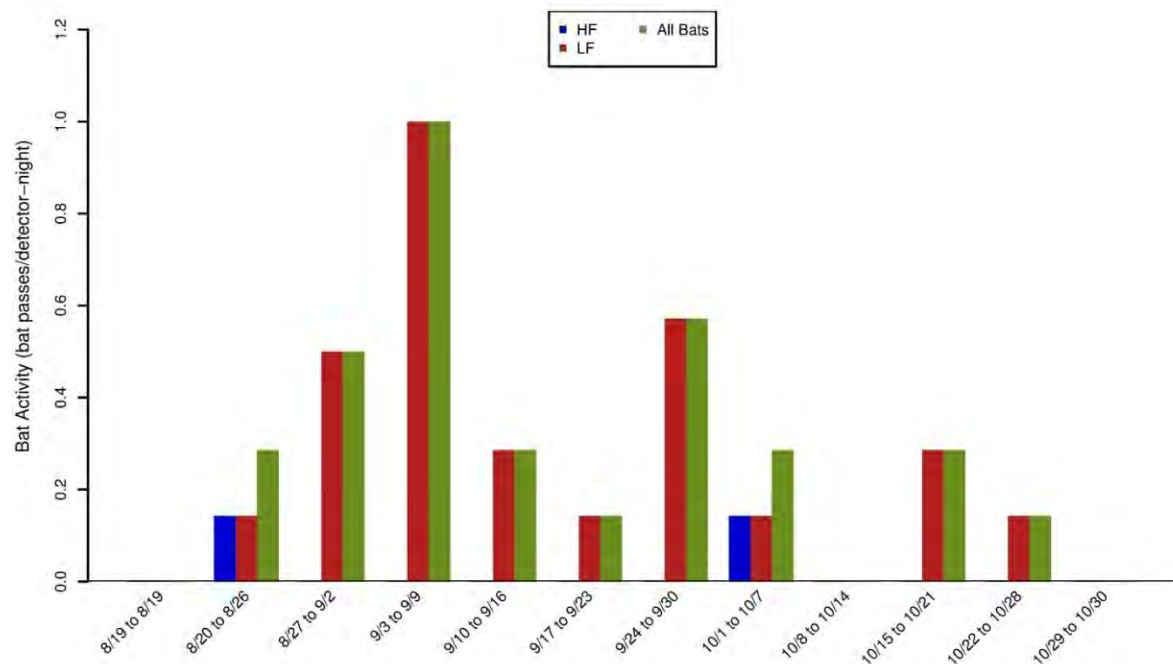


Figure 5. Weekly bat activity during August 19 – October 30 at the Horse Heaven Wind Project in Benton County, Washington.

Species Composition

During the survey season, 91.6% of bat passes were classified as LF (silver-haired bat, hoary bat, big brown bat), and 8.3% of bat passes were classified as HF (canyon bat; Figure 4). Kaleidoscope Pro identified bat calls for four of the 12 species identified as having potential to occur at the Project (Table 2; Table 3). Townsend's big-eared bat and pallid bat calls were not identified during the study. Silver-haired bat was the primary species documented during the study period, detected on 14% of detector-nights (Table 3). Hoary bat was the next most commonly detected species, occurring on approximately 6% of detector-nights (Table 3). Big brown bat and canyon bat were both detected on less than 1% of detector-nights (Table 3). No federally or state-listed bat species were detected.

Table 3. The number (percent composition) of detector-nights a bat species was recorded at the ground detector (HH1g) at Horse Heaven Wind Project, August 19, 2017 – October 30, 2017.

Common Name	Bat Call Frequency	Total ¹
High-Frequency (> 30 kHz)		
canyon bat	1 (1)	1 (1)
Low-Frequency (< 30 kHz)		
big brown bat	1 (1)	1 (1)
hoary bat	4 (6)	4 (6)
silver-haired bat	10 (14)	10 (14)

¹ 72 detector nights total

2018 Bat Acoustic Surveys

Bat Activity

Bat activity was documented at two detector stations in the Project for a total of 303 detector-nights between May 14 and October 29, 2018. The ground detector station had a total of 163 detector nights while the raised station had a total of 140 detector nights (Table 4). The detector stations operated for 90% of the study period and bat activity at both detector stations was a mean of 0.27 ± 0.05 bat passes per detector-night (Table 4). The period of overall peak bat activity occurred from September 13 through September 19, 2018 (Figure 6).

Table 4. Bats detected and total bat passes per station from May 14 through October 29, 2018 at the Horse Heaven Wind Project in Benton County, Washington.

Station	HF Bats	LF Bats	All Bats	Detector Nights	Bat Passes
HH1g	1	53	54	163	0.33±0.08
HH1r	0	28	28	140	0.20±0.05
Total	1	81	82	303	0.27±0.05

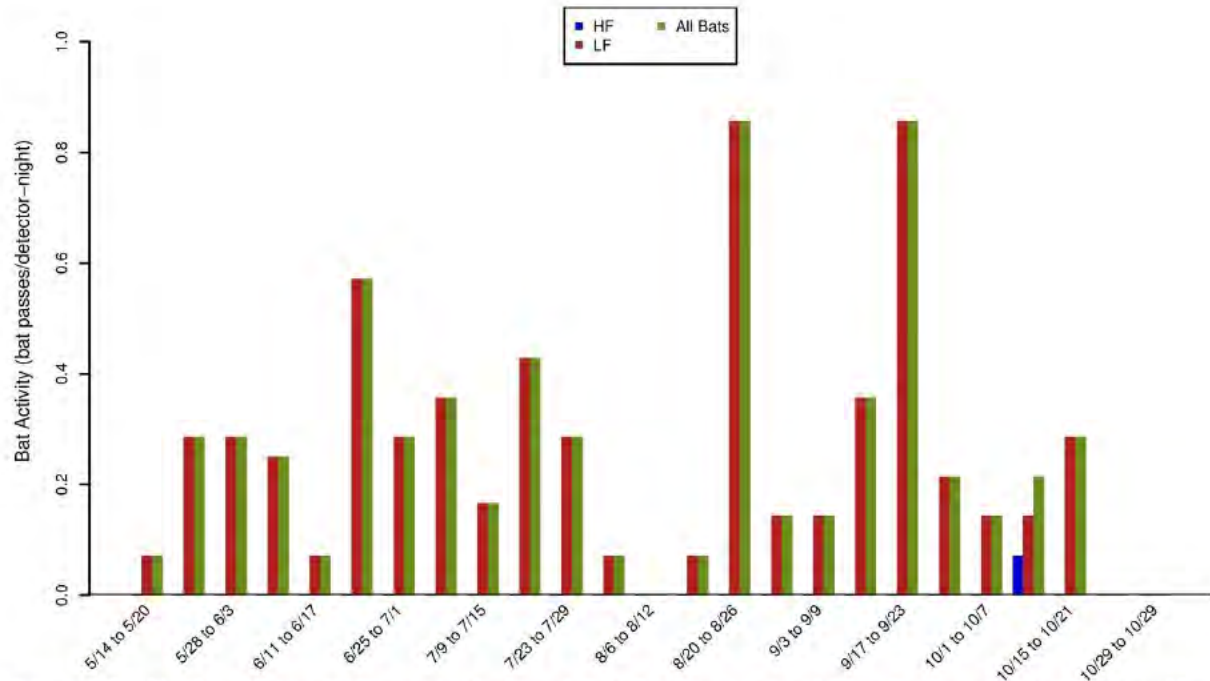


Figure 6. Weekly bat activity recorded as high frequency and low frequency bats from May 14 through October 29, 2018 at the Horse Heaven Wind Project in Benton County, Washington.

Species Composition

During the 2018 survey period, 98.7% of bat passes were classified as LF (silver-haired bat, hoary bat, big brown bat), and 1.2% of bat passes were classified as HF (canyon bat; Table 5). Kaleidoscope Pro identified bat calls for four of the 12 species identified as having potential to occur at the Project (Table 1; Table 5). Similar to 2017, silver-haired bat was the primary species recorded during 2018, recorded on 15% of detector-nights (Table 5). Hoary bat and big brown bat were the next most commonly recorded species, occurring on approximately 3% and 2% of detector-nights, respectively (Table 5). Canyon bat was recorded on the ground-based detector only, for less than 1% of detector-nights (Table 5). No federal or state-listed bat species were recorded.

Table 5. The number (percent composition) of detector-nights a bat species was recorded at the ground detector (HH1g) and raised detector (HH1r) at the Horse Heaven Wind Project, May 14, 2018 – October 29, 2018.

Common Name	HH1g	HH1r	Total ¹
High-Frequency (> 30 kHz)			
canyon bat	2 (1)	0 (0)	2 (1)
Low-Frequency (< 30 kHz)			
big brown bat	7 (4)	0 (0)	7 (2)
hoary bat	3 (2)	6 (4)	9 (3)
silver-haired bat	30 (18)	15 (11)	45 (15)

¹ 303 detector nights total

Temporal Variation

Overall activity of all bats (LF and HF species) in 2018 was lowest in summer (0.22 ± 0.05 bat passes per detector-night), and highest in fall (0.32 ± 0.09), which was consistent with the pattern observed for the LF and HF species group (Table 6; Figure 6). Overall, HF bats comprised a small proportion of bat activity during all seasons compared to LF bats and were only recorded during mid-October (Table 6, Figure 6).

Bat activity at the ground detector station was higher than at the raised detector station throughout the study period, except during the summer months (May 14 – August 18, 2018), when activity at the raised detector station exceeded activity rates at the ground station (Figure 7). Activity by LF species was documented in the summer and fall, and only one HF bat (canyon bat) was recorded in the fall at the ground detector station (Table 6).

Table 6. Mean seasonal bat passes per detector-night by detector station and call frequency during the 2018 survey period within the Horse Heaven Wind Project in Benton County, Washington.

Station	Call Frequency ¹	Summer	Fall	Fall Migration Period
		May 14 – August 18	August 19 – October 29	July 30 – October 14
HH1g	LF	0.20 ± 0.05	0.49 ± 0.16	0.43 ± 0.15
	HF	0.00 ± 0.00	0.01 ± 0.01	0.01 ± 0.01
	AB	0.20 ± 0.05	0.50 ± 0.16	0.44 ± 0.15
HH1r	LF	0.25 ± 0.07	0.14 ± 0.05	0.12 ± 0.04
	HF	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
	AB	0.25 ± 0.07	0.14 ± 0.05	0.12 ± 0.04
Overall	LF	0.22 ± 0.05	0.31 ± 0.09	0.27 ± 0.08
	HF	0.00 ± 0.00	0.01 ± 0.01	0.01 ± 0.01
	AB	0.22 ± 0.05	0.32 ± 0.09	0.28 ± 0.08

¹ Call frequency: high-frequency (HF), low-frequency (LF), and all bats (AB).

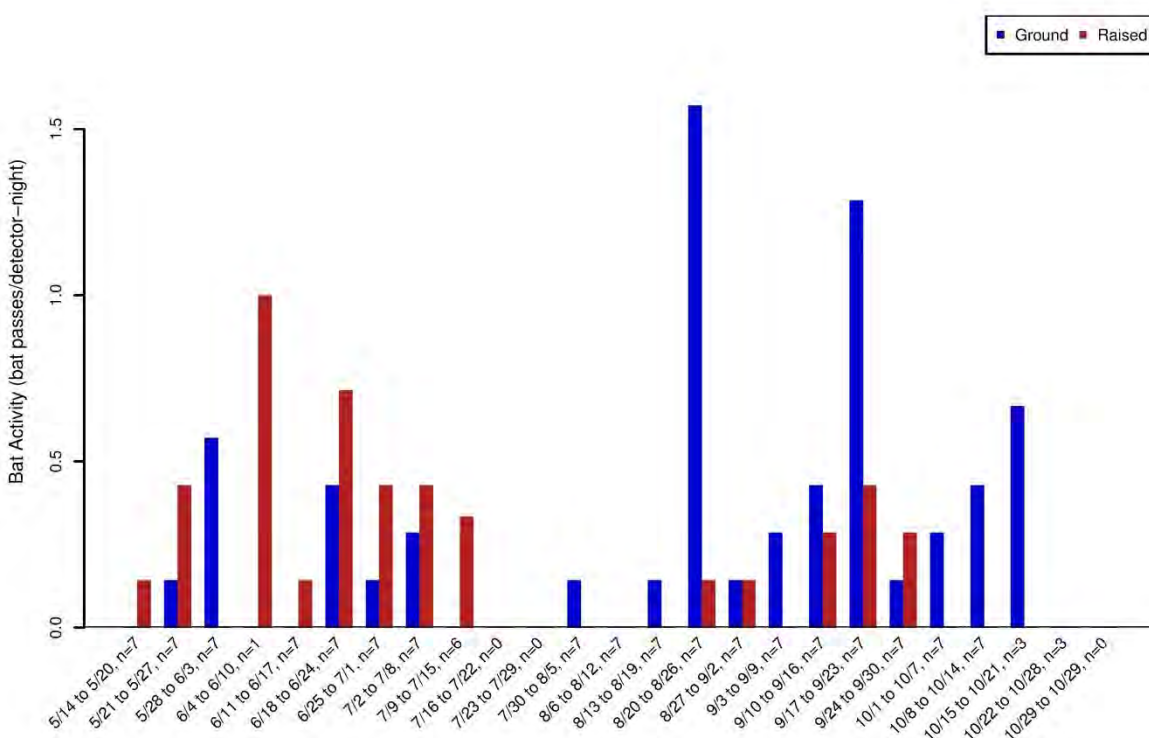


Figure 7. Number of bat passes per detector-night recorded at raised and ground level stations considered representative of future turbine locations in the Horse Heaven Wind Project area from May 14 – October 29, 2018.

RISK ASSESSMENT AND CONCLUSION

Consistent with the US Fish and Wildlife Service (USFWS) *Land-Based Wind Energy Guidelines* (USFWS 2012) and the Washington Department of Fish and Wildlife (WDFW) *Wind Power Guidelines* (WDFW 2009), WEST conducted a bat activity study at the Project with the primary objectives to: 1) evaluate seasonal levels of bat activity at the Project, including periods of expected peak activity, 2) identify species occurring at the Project during the study period, and 3) provide context of bat activity at the Project relative to other publicly available data. Results from the bat activity study include several important findings that are consistent with known patterns from other studies in the region. First, the species documented at the Project are commonly detected species which included silver-haired and hoary bats, both migratory tree-roosting bats. Second, the period of peak activity at the Project occurred during September 2017 and 2018, consistent with known migratory patterns. Third, bat activity rates documented at the Project were consistent with publicly available activity rates from the closest region (i.e., Rocky Mountains).

It is generally thought that pre-construction bat activity rates may be positively related to post-construction bat fatalities (Kunz et al. 2007b). However, to date, few studies of wind energy facilities that have recorded both bat passes per detector night and bat fatality rates, are publicly available (Appendix A). Given the limited availability of pre- and post-construction data sets,

differences in protocols among studies (Ellison 2012), and significant ecological differences among geographically diverse facilities, the relationship between pre-construction activity and measured post-construction fatality rates has not been definitively established. In Canada, Baerwald and Barclay (2009) found a significant positive association between passage rates measured at 30 m (98 ft) above ground level and fatality rates for hoary and silver-haired bats across five sites in southern Alberta. However, a similar relationship has proven difficult to establish on a larger scale. The relatively few studies that have estimated both pre-construction activity and post-construction fatalities show results that trend toward a positive association between these rates, but lack statistically significant correlations. Hein et al. (2013a) compiled study results that included both pre- and post-construction data from the same projects, as well as pre- and post-construction data from facilities within the same regions to assess if pre-construction acoustic activity predicted post-construction fatality rates. Based on data from 12 sites, Hein et al. (2013a) did not find a statistically significant relationship ($p = 0.07$), although the trend was in the expected direction (i.e., higher activity was generally associated with higher fatalities and vice-versa). For these reasons, the current approach to assessing risk to bats using pre-construction acoustic data requires a qualitative analysis of activity levels, spatial and temporal relationships, species composition, and comparison to known regional activity and/or fatality patterns.

During the 2017 study period, 24 bat passes were recorded at the Project; 82 bat passes were recorded in 2018. The period of peak bat activity documented at the Project in 2017 was September 3 – September 9. The period of peak bat activity documented at the Project in 2018 was September 13 – September 19. The overall average bat activity rate at the Project recorded at HH1g in 2017 and 2018 was 0.33 bat passes per detector-night. These findings are in line with known regional patterns of increased bat activity during the fall. During this time, migratory bats (e.g., silver-haired bat, hoary bat) may begin moving toward wintering areas, and many species initiate reproductive behaviors (Cryan 2008). This period of increased landscape-scale movement and reproductive behavior is often associated with increased levels of bat fatalities at operational wind energy facilities (Arnett et al. 2008; Arnett and Baerwald 2013, Thompson et al. 2017). If risk patterns at the Project are consistent with known trends from the region and across the West, it is likely that most fatalities would occur during the fall.

Four species of bat were documented at the Project during the two-year bat activity study, including silver-haired bat, hoary bat, big brown bat, and canyon bat. The most frequently detected species during the 2017 and 2018 study periods was silver-haired bat, occurring on 14% and 15% of detector-nights, respectively. The next most frequently detected species was hoary bat, documented on 6% of detector-nights in 2017 and 3% of detector-nights in 2018. Big brown bat was detected on 1% of detector-nights in 2017, and 2% of detector-nights in 2018; canyon bat was detected on approximately 1% of detector nights in 2017 and less than 1% of detector-nights in 2018. Silver-haired bat and hoary bat are among the most commonly documented bat fatalities at wind energy facilities where these species occur (Cryan and Barclay 2009, Arnett and Baerwald 2013, Tetra Tech 2014, Thompson et al. 2017, AWWI 2018). Given these results and known patterns in bat fatalities at operational wind facilities, if

risk trends are similar to elsewhere in the US, it is likely that silver-haired bat and hoary bat will have the highest risk of collision at the Project.

Overall, bat activity at the Project documented during the bat activity study in 2017 and 2018 at (0.33 bat passes per detector-night) was well below the Rocky Mountains regional average of 4.02 bat passes per detector-night (Appendix A), which is the closest region with publicly available activity data (no activity data from the Pacific Northwest is available for comparison). The average fatality rate of 1.19 bats per megawatt per year in the Pacific Northwest is low compared to the Rocky Mountain regional average of 4.90 bats per megawatt per year (bats/MW/year; Appendix A). The closest operational wind facility with publicly-available fatality data is the Nine Canyon Wind Facility (Nine Canyon), located approximately 5 mi east of the Project. During a year-long post-construction fatality study at Nine Canyon conducted 2002–2003, 27 bat fatalities were recorded and the fatality rate was estimated to be 2.47 bats/MW/year (Erickson et al. 2003). Of the 27 bat fatalities, 20 were found during August 5 through October 24 which coincides with fall migration. All fatalities consisted of silver-haired bats (15) or hoary bats (12; Erickson et al. 2003). During 14 years of operational monitoring at Nine Canyon (2005–2018), two bat fatalities were reported in 2007 and consisted of one hoary bat and one silver haired bat. Bat species composition was consistent with species expected although likely under represents the number of actual bat fatalities because systematic surveys that accounted for scavenging rates or searcher efficiency were not conducted during operational monitoring. If risk patterns at the Project are similar to patterns at Nine Canyon and elsewhere in the Pacific Northwest and Rocky Mountains, it is likely that species composition and fatality rates at the Project would be similar.

Bat fatalities have been discovered at most monitored wind energy facilities in North America and globally (Arnett et al. 2016), ranging from zero (Chatfield and Bay 2014) to 40.2 bats/megawatt/year (Hein et al. 2013b; Appendix A) in the US. In 2012, an estimated 600,000 bats died as a result of interactions with wind turbines in the US (Hayes 2013), and hoary bat population viability may be threatened by fatalities caused by wind turbines (Frick et al. 2017). To date, post-construction monitoring studies of wind energy facilities in North America show that: a) collision mortality is greatest for migratory tree-roosting species (e.g., hoary bat and silver-haired bat; Thompson et al. 2017), which make up approximately 78% of reported bat fatalities; b) the majority of fatalities occur during the fall migration season (Thompson et al. 2017); and c) most fatalities occur on nights with relatively low wind speeds (e.g., less than 6.0 m per second [19.7 ft per second]; Arnett et al. 2008, 2013; Arnett and Baerwald 2013). Finally, a recent meta-analysis suggests that bat mortality rates at wind facilities increase as relative grassland cover (or open cover) decreases (Thompson et al. 2017), suggesting that facilities or turbines in forested areas have higher fatality rates than facilities or turbines that lack surrounding tree cover. Given these trends and the results from the bat activity study at the Project in 2017 and 2018, it is likely that bat mortality at the Project, once operational, would: a) be low, similar to other Pacific Northwest facilities including nearby Nine Canyon; b) consist primarily of migratory, tree-roosting species (i.e., silver-haired bat, hoary bat); and c) occur mainly in the fall.

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Appendix A. North American Fatality Summary Tables

Appendix A. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Activity estimate given as bat passes per detector-night. Fatality estimate given as the number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Horse Heaven (2017–2018)	0.33	8/19/17 – 10/31/17 5/14/18 – 10/29/18			
Pacific Northwest					
Mean	--		1.19	99	134.1
Palouse Wind, WA (2012-2013)			4.23	58	104.4
Biglow Canyon, OR (Phase II; 2009-2010)			2.71	65	150
Nine Canyon, WA (2002-2003)			2.47	37	48.1
Stateline, OR/WA (2003)			2.29	454	299
Elkhorn, OR (2010)			2.14	61	101
White Creek, WA (2007-2011)			2.04	89	204.7
Biglow Canyon, OR (Phase I; 2008)			1.99	76	125.4
Leaning Juniper, OR (2006-2008)			1.98	67	100.5
Big Horn, WA (2006-2007)			1.9	133	199.5
Combine Hills, OR (Phase I; 2004-2005)			1.88	41	41
Linden Ranch, WA (2010-2011)			1.68	25	50
Pebble Springs, OR (2009-2010)			1.55	47	98.7
Hopkins Ridge, WA (2008)			1.39	87	156.6
Harvest Wind, WA (2010-2012)			1.27	43	98.9
Elkhorn, OR (2008)			1.26	61	101
Vansycle, OR (1999)			1.12	38	24.9
Klondike III (Phase I), OR (2007-2009)			1.11	125	223.6
Stateline, OR/WA (2001-2002)			1.09	454	299
Stateline, OR/WA (2006)			0.95	454	299
Tuolumne (Windy Point I), WA (2009-2010)			0.94	62	136.6
Klondike, OR (2002-2003)			0.77	16	24
Combine Hills, OR (2011)			0.73	104	104
Hopkins Ridge, WA (2006)			0.63	83	150
Biglow Canyon, OR (Phase I; 2009)			0.58	76	125.4
Biglow Canyon, OR (Phase II; 2010-2011)			0.57	65	150
Hay Canyon, OR (2009-2010)			0.53	48	100.8
Windy Flats, WA (2010-2011)			0.41	114	262.2
Klondike II, OR (2005-2006)			0.41	50	75
Vantage, WA (2010-2011)			0.4	60	90
Wild Horse, WA (2007)			0.39	127	229
Goodnoe, WA (2009-2010)			0.34	47	94
Marengo II, WA (2009-2010)			0.27	39	70.2
Biglow Canyon, OR (Phase III; 2010-2011)			0.22	76	174.8
Marengo I, WA (2009-2010)			0.17	78	140.4
Klondike IIIa (Phase II), OR (2008-2010)			0.14	51	76.5
Kittitas Valley, WA (2011-2012)			0.12	48	100.8
Rocky Mountains					
Mean	4.02		4.90	70	85.0
Summerview, Alb (2006; 2007)	7.65 ^A	07/15/06-07- 09/30/06-07	11.42	39	70.2
Summerview, Alb (2005-2006)			10.27	39	70.2
Judith Gap, MT (2006-2007)			8.93	90	135

Appendix A. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region. Activity estimate given as bat passes per detector-night. Fatality estimate given as the number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Foot Creek Rim, WY (Phase I; 1999)			3.97	69	41.4
Judith Gap, MT (2009)			3.2	90	135
Milford I, UT (2010-2011)			2.05	58	145
					160.5 (58.5
Milford I & II, UT (2011-2012)			1.67	107	Phase I, 102 Phase II)
Foot Creek Rim, WY (Phase I; 2001-2002)	2.2 ^{A,B}	6/15/01-9/1/01	1.57	69	41.4
Foot Creek Rim, WY (Phase I; 2000)	2.2 ^{A,B}	6/15/00-9/1/00	1.05	69	41.4

A = Activity rate was averaged across phases and/or years

B = Activity rate calculated by WEST from data presented in referenced report

Appendix A (continued). Wind energy facilities in North America with comparable activity and fatality data for bats. Data from the following sources:

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
Big Horn, WA (06-07)		Kronner et al. 2008	Klondike III (Phase I), OR (07-09)		Gritski et al. 2010
Biglow Canyon, OR (Phase I; 08)		Jeffrey et al. 2009b	Klondike IIIa (Phase II), OR (08-10)		Gritski et al. 2011
Biglow Canyon, OR (Phase I; 09)		Enk et al. 2010	Leaning Juniper, OR (06-08)		Gritski et al. 2008
Biglow Canyon, OR (Phase II; 09-10)		Enk et al. 2011b	Linden Ranch, WA (2010-2011)		Enz and Bay 2011
Biglow Canyon, OR (Phase II; 10-11)		Enk et al. 2012b	Marengo I, WA (2009-2010)		URS Corporation 2010b
Biglow Canyon, OR (Phase III; 10-11)		Enk et al. 2012a	Marengo II, WA (2009-2010)		URS Corporation 2010c
Combine Hills, OR (Phase I; 04-05)		Young et al. 2006	Milford I & II, UT (2011-2012)		Stantec 2011b
Combine Hills, OR (11)		Enz et al. 2012	Milford I, UT (2010-2011)		Stantec 2012b
Elkhorn, OR (08)		Jeffrey et al. 2009a	Nine Canyon, WA (2002-2003)		Erickson et al. 2003
Elkhorn, OR (10)		Enk et al. 2011a	Palouse Wind, WA (12-13)		Stantec 2013a
Foot Creek Rim, WY (Phase I; 99)		Young et al. 2003a	Pebble Springs, OR (09-10)		Gritski and Kronner 2010b
Foot Creek Rim, WY (Phase I; 00)	Gruver 2002	Young et al. 2003a, 2003b	Stateline, OR/WA (01-02)		Erickson et al. 2004
Foot Creek Rim, WY (Phase I; 01-02)		Young et al. 2003a, 2003b	Stateline, OR/WA (03)		Erickson et al. 2004
Goodnoe, WA (09-10)		URS Corporation 2010a	Stateline, OR/WA (06)		Erickson et al. 2007
Harvest Wind, WA (10-12)		Downes and Gritski 2012a	Summerview, Alb (05-06)		Brown and Hamilton 2006
Hay Canyon, OR (09-10)		Gritski and Kronner 2010a	Summerview, Alb (06; 07)	Baerwald 2008	Baerwald 2008
Hopkins Ridge, WA (06)		Young et al. 2007	Tuolumne (Windy Point I), WA (09-10)		Enz and Bay 2010
Hopkins Ridge, WA (08)		Young et al. 2009	Vansycle, OR (99)		Erickson et al. 2000
Judith Gap, MT (06-07)		TRC 2008	Vantage, WA (10-11)		Ventus 2012
Judith Gap, MT (09)		Poulton and Erickson 2010	White Creek, WA (07-11)		Downes and Gritski 2012b
Kittitas Valley, WA (11-12)		Stantec Consulting Services 2012	Wild Horse, WA (07)		Erickson et al. 2008
Klondike, OR (02-03)		Johnson et al. 2003	Windy Flats, WA (10-11)		Enz et al. 2011
Klondike II, OR (05-06)		NWC and WEST 2007			

SITE CHARACTERIZATION STUDY REPORT

Badger Canyon Wind Project Benton County, Washington



Prepared for:
Badger Canyon MW LLC

Prepared by:
Andrea Chatfield and Joel Thompson
Western Ecosystems Technology, Inc.
2725 Northwest Walnut Boulevard
Corvallis, Oregon 97330

March 2018



EXECUTIVE SUMMARY

The proposed Badger Canyon Wind Project (Project) includes an area of approximately 41,289 acres (64.51 square miles) of primarily private land in Benton County, Washington. Wpd Wind Projects, Inc. is proposing to develop this area under the auspices of a wholly-owned subsidiary, Badger Canyon MW, LLC. This Site Characterization Study (SCS) is intended to fulfill the tasks described in the US Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (WEG) for Tier 2 site characterization and the USFWS Eagle Conservation Plan Guidance (ECPG) for Stage 1 site assessment, and to help guide formulation of specific detailed surveys for the Project. Specifically, the information contained herein reflects a desktop analysis of publicly available information that pertains to plants, animals, and habitat features that may be important considerations during Project planning and development. Environmental resources within the Project boundary (Project area) were examined through a search of existing data. In addition, an initial reconnaissance-level site visit was conducted in December 2017, to provide additional cursory, baseline information on landscape and habitat features potentially important during Project development.

The dominant land cover type at the Project is cultivated dry land wheat farming, comprising over 92% of the Project area. Much smaller patches of shrub/scrub and grassland habitat, as well as developed areas (farmsteads) are present throughout the Project. One special status plant species, the state threatened woven-spore lichen, is known to occur within five miles of the Project but is not likely to occur within the Project boundary. Additionally, four rare and/or high quality plant communities have been documented in the region, all along the northern boundary of the Project. Two Washington Department of Fish and Wildlife (WDFW) Priority Habitats (freshwater wetland and shrub-steppe) have also been identified in the area, primarily to the north of the Project.

There are 15 diurnal raptor species and seven owl species that may occur in or near the Project area at some point during the year. Of the raptor species with potential to occur within the Project area, one species is state threatened (ferruginous hawk), two species are state candidates for listing (golden eagle and burrowing owl), and two species are state Priority Species (bald eagle and prairie falcon). Nesting habitat for tree-nesting raptor species (e.g., Swainson's hawk, red-tailed hawk) is present in scattered, isolated trees within the Project area and surrounding region, while ground-nesting species (e.g., burrowing owl, northern harrier) have the potential to nest throughout the Project, and cliffs to the north of the Project provide nesting substrate for species such as ferruginous hawk and barn owl.

Sixteen bat species have the potential to occur in and around the Project, with eight species having an approximate range and habitat requirements that overlap the Project area. The only listed or candidate bat species in Washington are Townsend's big-eared bat and Keen's myotis, both of which are State candidates for listing; however, Keen's myotis occupy only the extreme northwestern corner of the state and Townsend's big-eared bats are unlikely to occur within the Project due to a general lack of roosting and hibernating sites.

Three wildlife species listed as state threatened or endangered by the WDFW have at least some potential to occur within the Project: American white pelican, ferruginous hawk, and sandhill crane. An additional 12 species (six birds, four mammals, and two reptiles) are considered State candidates for listing. No species currently listed, or candidates for listing, under the USFWS Endangered Species Act have the potential to occur within the Project.

Based on this SCS, significant adverse impacts to special status species are not anticipated; however, due to the potential for occurrence of some sensitive plant and wildlife species within the Project area, it is recommended that Tier 3 site-specific studies be conducted to further refine risk assessments for these species. The following Tier 3 studies are recommended prior to construction in order to more clearly assess the potential risk to sensitive plants and wildlife: vegetation/land cover mapping, year-round large bird/eagle use surveys, small bird use surveys, raptor nest surveys with particular emphasis on bald and golden eagles, bat acoustic surveys, rare plant surveys, and a wetlands and waters of the US survey.

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INTRODUCTION

Many wind energy developers now choose to utilize the US Fish and Wildlife Service (USFWS) voluntary wind project development guidelines, which provide a template for a tiered planning process when exploring a potential wind energy project. The Land-based Wind Energy Guidelines (WEG; USFWS 2012) are intended to function in concert with the USFWS Eagle Conservation Plan Guidance (ECPG; USFWS 2013), and promote intentional tiered project development which strategically assesses and minimizes impacts to wildlife. This tiered approach includes: Tier 1 - Preliminary Site Evaluation; Tier 2 - Site Characterization; Tier 3 - Field Studies to Document Site Wildlife and Habitat and Predict Project Impacts; Tier 4 - Post-construction Studies to Document Impacts; Tier 5 - Other Post-construction Studies. This document addresses Tier 2 Site Characterization recommendations for the proposed Badger Canyon Wind Project and serves to identify potential biotic and abiotic resource issues at the Project. Identification of resource issues early in the planning process allows developers of wind energy facilities to identify, avoid, and minimize future problems which may occur. This document will be used to guide the Tier 3 field studies necessary to evaluate identified resources of concern within the proposed Badger Canyon Wind Project (Project).

STUDY AREA

Regional Setting

The Project lies within the semi-arid Columbia Plateau Ecological region, which encompasses a large portion of south central Washington (Washington Biodiversity Council 2008). The Columbia Plateau tilts upward and southward into the Great Basin of eastern Oregon, western Idaho, and northern Nevada, and is bordered by the Cascades to the west, the Okanogan Highlands to the north, the Rockies to the east, and the Blue Mountains to the southeast. The Columbia and Snake rivers are the dominant topographic features of the Columbia Plateau; in Washington, the plateau is bisected by the Columbia River. Today, the areas with suitable soil are used for agriculture; crops include wheat (*Triticum* spp.), alfalfa (*Medicago sativa*), potatoes (*Solanum tuberosum*), grass hay, and vineyards. Other areas within the region are used for cattle grazing. In the Yakima Valley to the north and the Columbia Basin to the south, irrigated agriculture is prevalent and includes pastures, orchards, and vineyards. Hops (*Humulus lupulus*) and field crops are also commonly grown. In un-cultivated areas, this ecoregion is characterized by arid sagebrush- (*Artemisia* spp.) steppe and grassland. The regional climate can be typified as arid to semiarid with low precipitation, warm to hot dry summer, and relatively cold winters (Franklin 1973). Mean annual temperature in the region is 59° Fahrenheit (15° Celsius), with mean annual precipitation of 10 inches (25 centimeters; Franklin 1973, Daly 2000).

Over the last two decades, the Columbia Plateau Ecoregion of eastern Washington and Oregon has experienced extensive wind energy developed. In Washington alone, there are currently 20 operating wind energy facilities with a total installed capacity of 3,075 megawatts (MW), the majority of which are located in the Columbia Plateau (American Wind Energy Association

(AWEA) 2017). In Benton County, where the proposed Project is located, there is currently only one operating facility, the Nine Canyon wind energy facility, located approximately 10 miles (mi; 16.1 kilometers [km]) to the east-southeast of the Project.

Project Area

The proposed Project area encompasses approximately 41,288.94 acres (ac; 64.51 square miles [mi²]; Project area) within Benton County in southeastern Washington, approximately two mi (3.2 km) south of Benton City and 10 mi west of the city of Kennewick (Figure 1). The roughly east-west Chandler Butte ridgeline rests between Benton City and the Project area. Topography within the Project area is gently sloping, with elevations ranging from 371 meters (m; 1,217 feet [ft]) in the southwest corner of the Project to 573 m (1,880 ft) along the eastern edge of the Project (Figure 2). The Horse Heaven Hills, an anticline ridge of the Yakima Folds, lies along the northeastern border of the Project. On the southern side of the ridge, the landscape transitions to relatively rolling topography with shallow, meandering canyons that drain southwest into the Columbia River. At its closest point, the Columbia River runs approximately eight mi (12.9 km) to the northeast of the Project and wraps around the Project to the east and south (Figure 1). The Yakima River flows eastward into the Columbia approximately two mi to the north of the Project (Figure 1).

Modern land use within the Project area is almost entirely tilled dry-land agriculture (wheat) with remnants of native shrub-steppe habitat still present along the northern boundary of the Project area (Figures 3 and 4). A network of county and a few private roads traverse the Project area. Representative photos of the land cover types and landscape features within the Project area are included in Appendix A.

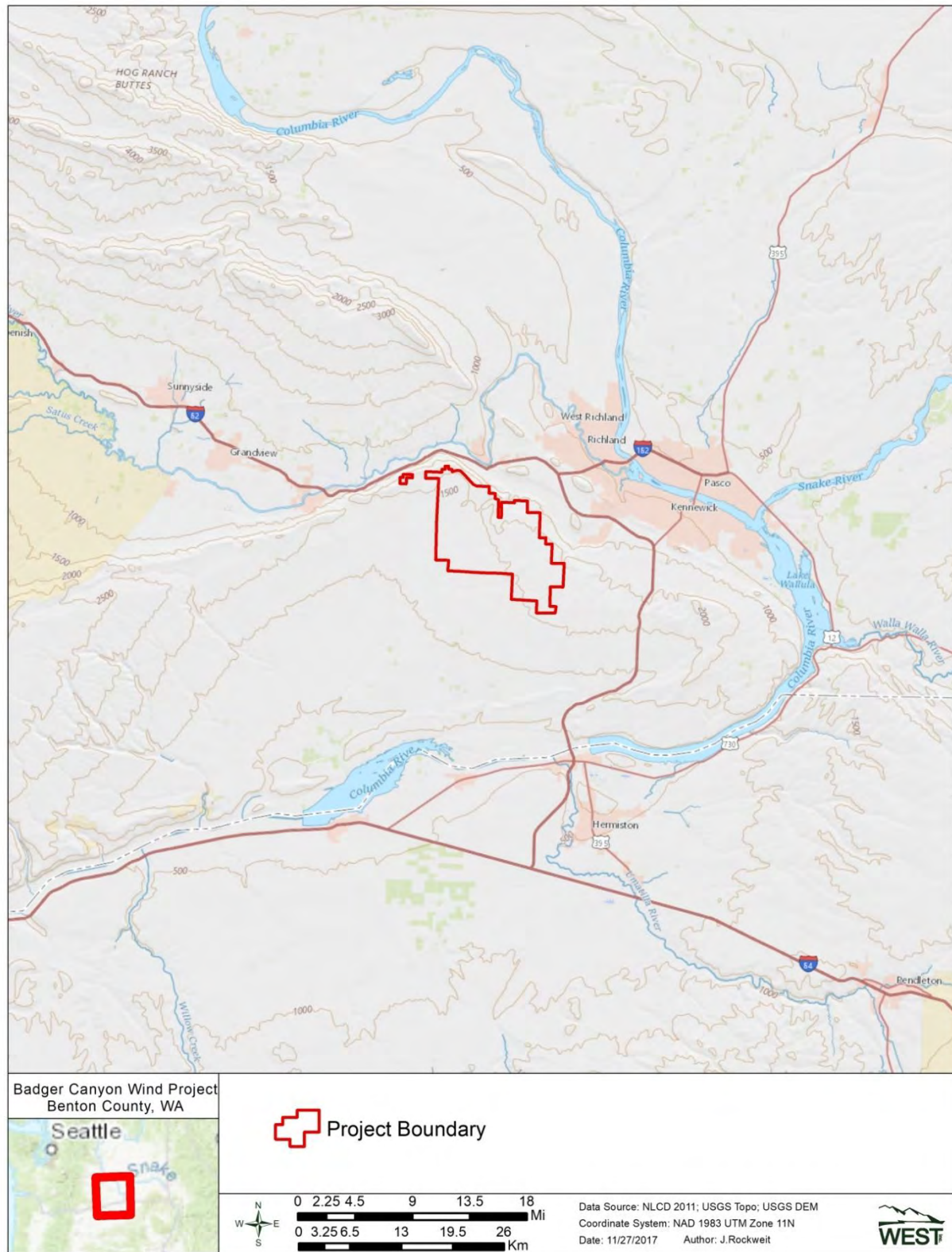


Figure 1. Location of the Badger Canyon Wind Project, Benton County, Washington.

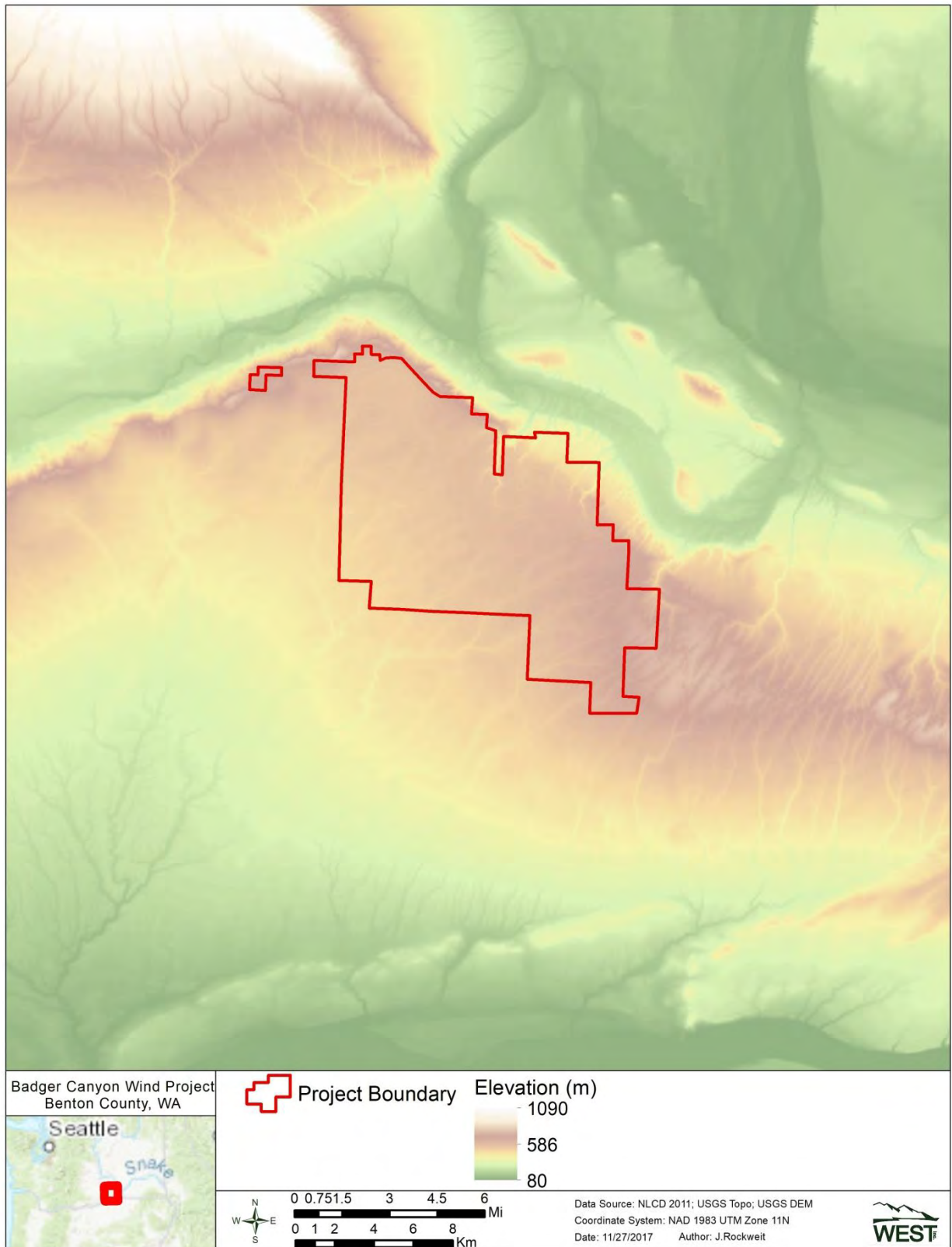


Figure 2. Digital elevation model of the Badger Canyon Wind Project area.

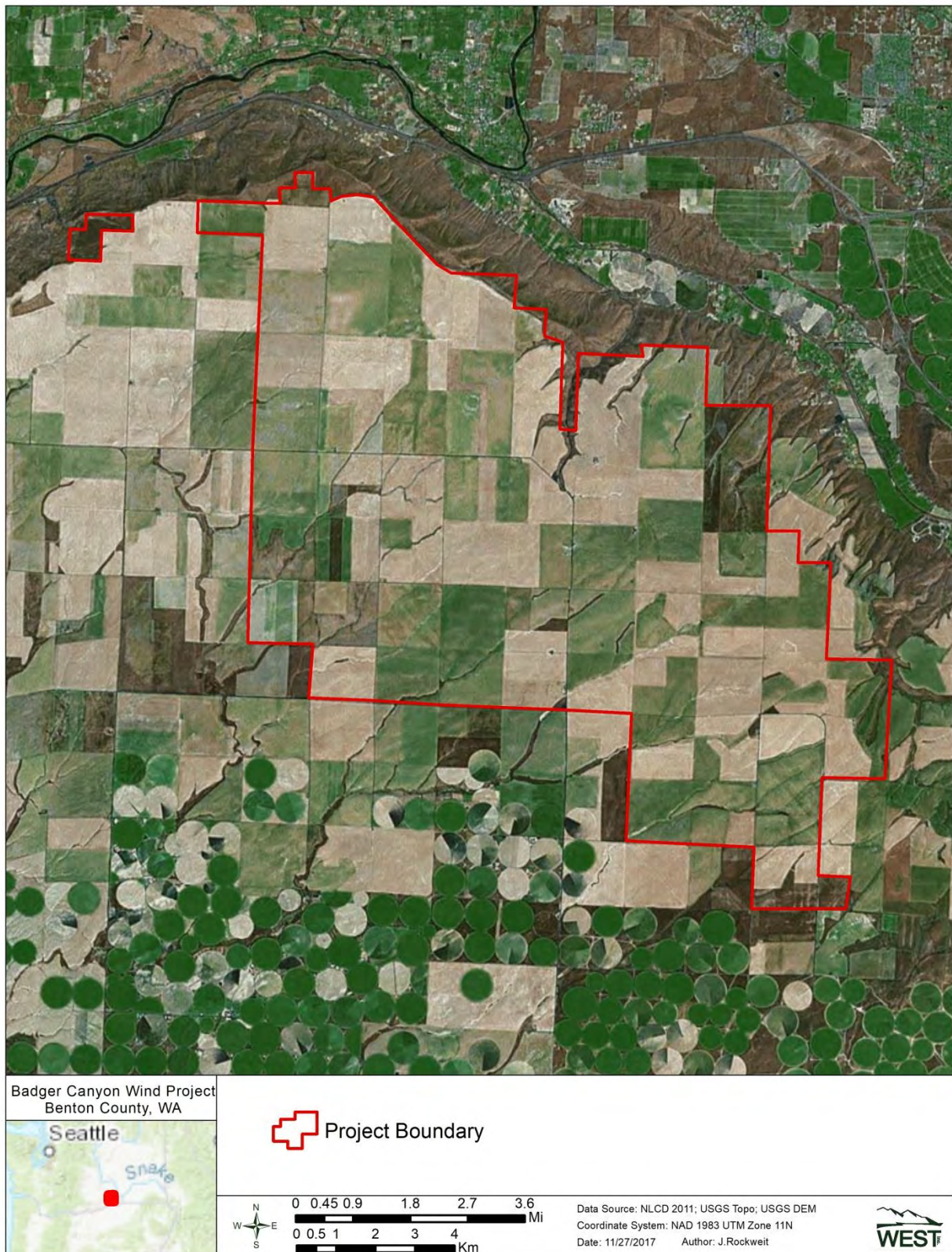


Figure 3. Aerial photograph of the Badger Canyon Wind Project area.

METHODS

Environmental resources within the Project and surrounding area were examined through a search of existing publicly available data and an initial reconnaissance-level site visit. The initial site visit occurred on December 11, 2017 and entailed a preliminary examination of the area from accessible public and private roads. Biological features and potential wildlife habitat assessed during the site visit included plant communities and wetlands, topographic and geological features, potential raptor nesting habitat, habitat for prey populations, and potential bat roosting and foraging habitat. Photographs of the Project area are presented in Appendix A.

Published literature, field guides, and public data sets were among the resources reviewed to identify known environmental resources within the Project area and surrounding region. The information presented in this analysis was obtained from the following sources:

- Bat Conservation International (BCI) species accounts and range maps (BCI 2017);
- List of Important Bird Areas (IBAs) by the National Audubon Society (Audubon 2017 2017);
- Priority Habitats and Species (PHS) database, maintained by the Washington Department of Fish and Wildlife (WDFW; 2017a);
- Published or available literature regarding wind-energy impacts to wildlife, with an emphasis on projects in the Columbia Plateau Ecoregion;
- Published literature, WDFW species status reports, and other publically-available information on the life history and range for special status species;
- State or federally protected nature preserves and lands protected by The Nature Conservancy (US Geological Survey [USGS] 2017a; The Nature Conservancy 2017);
- TNC and American Wind Wildlife Institute's (AWWI) Wind and Wildlife Landscape Assessment Tool (AWWI 2017);
- US Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) data (USDA Natural Resource Conservation Service [NRCS] 2017);
- USFWS Critical Habitat designations (USFWS 2016);
- USFWS National Wetland Inventory (NWI) data (USFWS NWI 2016);
- USFWS county-level species occurrence information (USFWS 2017);
- USGS National Land Cover Dataset (NLCD; USGS NLCD 2011);
- USGS topographic maps and digital elevation data (USGS 2017, USGS DEM 2016);
- Washington Natural Heritage Program (WNHP) spatial dataset of rare or at-risk plants and plant communities (WNHP 2017b);
- Washington State Species of Concern Lists, maintained by the WDFW (2017b); and

- WNHP online *Field Guide to the Rare Plants of Washington* (WNHP 2017a).

WEST determined the likelihood a sensitive animal or plant species may occur within the Project by considering the species' range, habitat suitability within the Project, species' mobility, population size, and records of occurrence within or adjacent to the Project. A similar assessment was made for sensitive plant communities and habitats. Based on these factors, the likelihood of occurrence was defined for each sensitive species/community using the following categories:

- None – Project outside the species known range, no suitable habitat within the Project, restricted mobility and small population size.
- Unlikely – Project outside the species known range and suitable habitat appears absent within the Project; however, due to the species mobility and population size, species may occur within the Project during migration or other times of the year.
- Possible – Project is located within the range of the species but contains marginal suitable habitat; species highly mobile and may occur year-round.
- Likely – Project is located within the range of the species and contains suitable habitat; records of species occurrence in the surrounding area but absent from the Project.
- Occurs – Records of species occurrence within the Project based on PHS and/or WNHP data or other survey data.

LAND COVER AND HABITATS

Land Use/Land Cover

The proposed Project area encompasses 41,288.94 ac (64.51 mi²). According to the USGS NLCD (2011; Homer et al. 2015), the dominant cover type within the Project area is cultivated cropland, covering 38,028.09 ac (59.42 mi²), or 92.1% of the Project (Table 1; Figure 4). Much smaller patches of shrub/scrub cover types are present throughout the Project, comprising an additional 6.1% of the Project area (2,520.30 ac [3.94 mi²]; Table 1; Figure 4). The remaining 1.8% is covered by small amounts of developed areas (primarily roads; 671.98 ac [1.05 mi²]), grassland/herbaceous cover types (67.60 acres [0.11 mi²]), and open water (0.98 acres [< 0.01 mi²]; Table 1; Figure 4).

Table 1. Land use and habitat types present within the Badger Canyon Wind Project.

Cover Type	Acres	Percent Composition (%)
Cultivated Crops	38,028.09	92.1
Shrub/scrub	2,520.30	6.1
Developed, Open Space	564.06	1.4
Developed, Low Intensity	100.13	0.2
Grassland/Herbaceous	67.60	0.2
Developed, Medium Intensity	7.79	< 0.1
Open Water	0.98	< 0.1
Total	41,288.94	100

Data obtained from USGS NLCD, compiled from satellite imagery (USGS NLCD 2011; Homer et al. 2015).

Wetlands and Riparian Areas

Digital NWI data (USFWS NWI 2016) are available for the Project area; however, formal wetland delineations have not been completed. According to the NWI, less than 0.1% of the Project area is composed of wetland habitat. The majority of this wetland habitat (7.59 ac; 93.9%) is riverine which is contained within a network of unnamed intermittent drainages located throughout the Project (Figure 5). The remaining 0.49 ac of wetland habitat is present within a single emergent wetland in the southeastern portion of the Project (Figure 5). At its closest point, the Yakima River runs approximately 2-3 mi (3.2-4.8 km) from the northwest corner of the Project. The majority of the Project area drains to the southwest into the Columbia River, with a much smaller portion of the Project along the northeastern boundary ultimately draining northeast into the Columbia and northwest into the Yakima River (Figures 3 and 5).

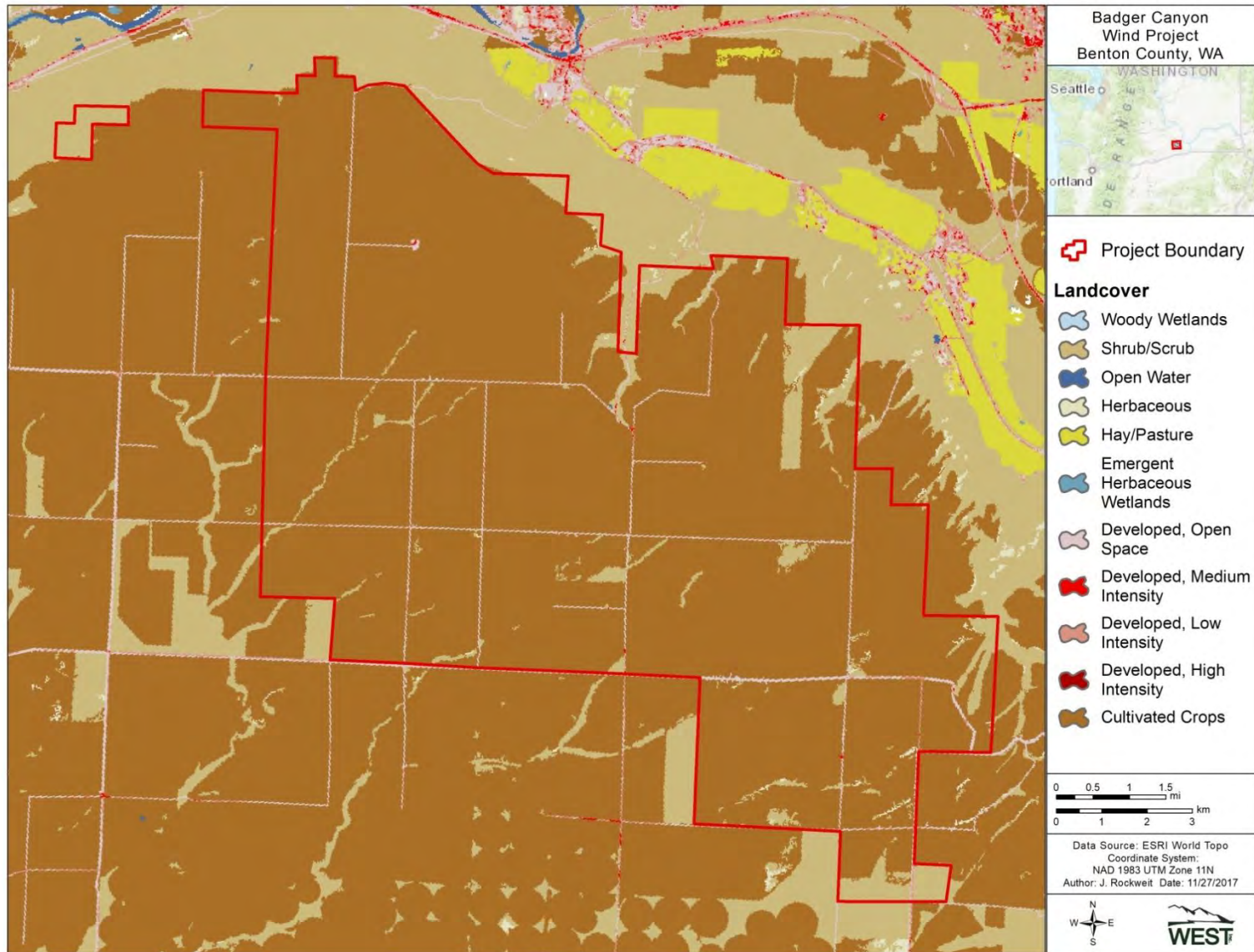


Figure 4. Land cover within the Badger Canyon Wind Project (USGS NLCD 2011).

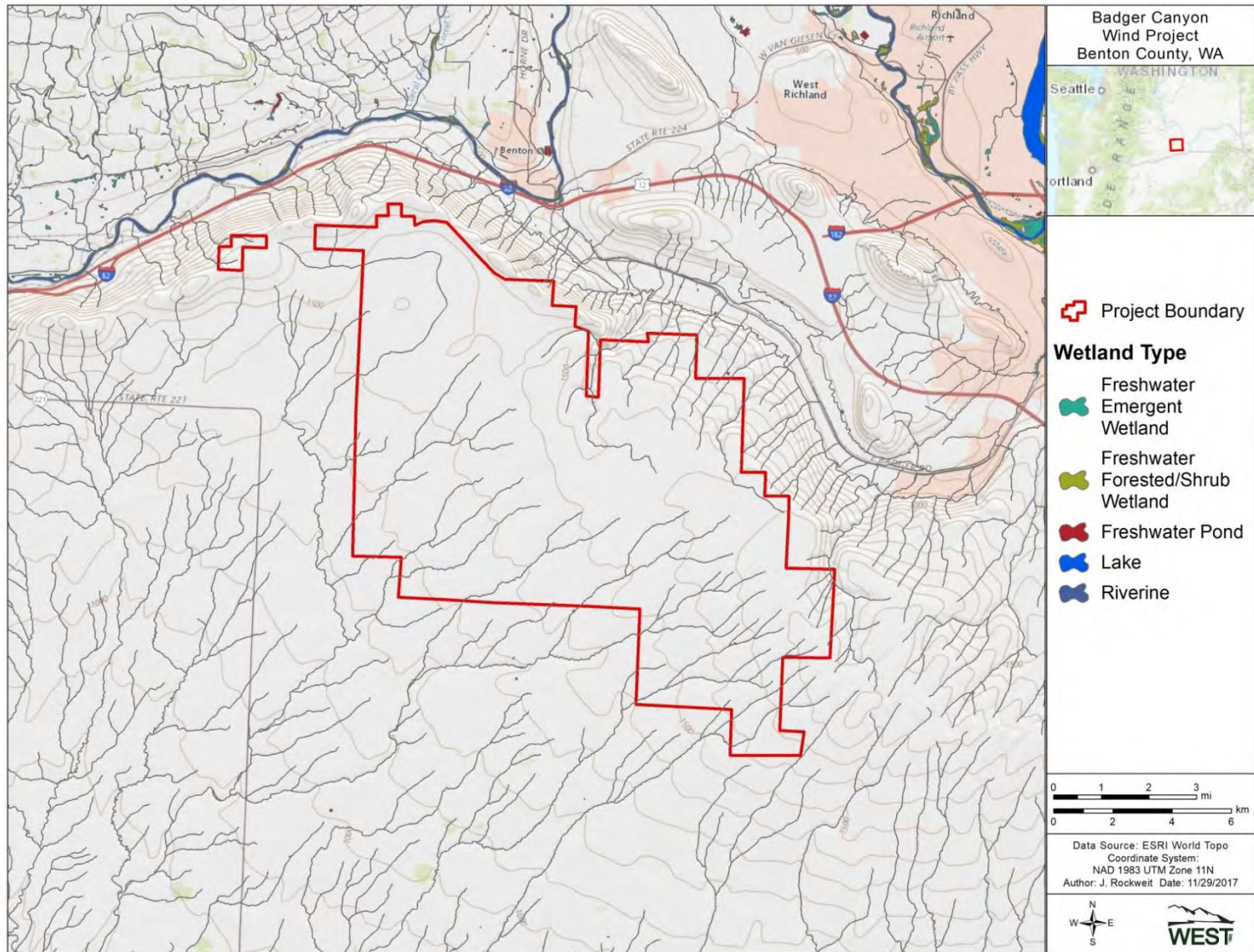


Figure 5. National Wetland Inventory map of the Badger Canyon Wind Project (USFWS NWI 2016).

Priority Habitats

The PHS List, maintained by the WDFW, is a catalog of habitats and species considered to be priorities for conservation and management. Priority habitats are habitat types or elements with unique or significant value to a diverse assemblage of species. The PHS online database identified two Priority Habitats occurring within three mi (4.8 km) of the Project: freshwater emergent wetland and shrub-steppe (Table 2; WDFW 2017a).

Table 2. Priority Habitats occurring in the vicinity of the Badger Canyon Wind Project.

Habitat	Description	Potential for Occurrence in the Project area
Freshwater emergent wetland	Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water (WDFW 2008).	Present. Small emergent wetland documented within southeastern portion of Project (WDFW 2017a), but some potential for other small wetlands throughout the Project.
Shrub-steppe	Non-forested vegetation type consisting of one or more layers of perennial bunchgrasses and a conspicuous but discontinuous layer of shrub (WDFW 2008).	Possible. Vast majority of Project is cultivated cropland; however, small patches of remnant scrub-steppe may be present. Documented shrub-steppe habitat occurs along the northern boundary of the Project (WDFW 2017a; WNHP 2017b).

Occurrence data obtained from WDFW 2017a

Rare Plants and Plant Communities

The WNHP maintains a database containing information on the location of federal and/or state listed and rare plants and rare and/or high quality plant communities across the state (WNHP 2017b). According to a search of the online database only a single special-status plant species is known to occur within five miles of the Project. The woven-spore lichen (*Texosporium sancti-jacobi*), a state threatened species and federal species of concern, has been documented at four separate locations in shrub-steppe habitat within approximately one mi (1.6 km) of the Project. The woven-spore lichen inhabits arid to semi-arid native shrub-steppe, grassland, biscuit scabland, or savannah communities, on flat to gentle north-facing slopes (WNHP 2017a). Given the preponderance of cultivated cropland throughout the Project area and lack of native vegetation and north-facing slopes, this species is unlikely to occur within the Project.

In addition to the woven-spore lichen, the WNHP lists four rare and/or high quality plant communities that have been identified within five mi of the Project. These include: rock buckwheat (*Erigonum sphaerocephalus*)/Sandburg bluegrass (*Poa secunda*), Douglas buckwheat (*E. douglasii*)/Sandburg bluegrass, big sagebrush (*Artemisia tridentata*)/Idaho fescue (*Festuca idahoensis*), and Wyoming big sagebrush (*A. t. wyomingensis*)/bluebunch wheatgrass (*Pseudoregneria spicata*; Figure 6). Each of these plant communities has been documented in native shrub-steppe ecosystems occurring along the northern boundary of the Project (Figure 6). Again, due to the current agricultural land uses within the Project, native shrub-steppe habitat with the potential to support these rare/high quality plant communities is unlikely to occur

within the Project. It should be noted, however, that the WNHP dataset represents an ongoing and incomplete inventory of Washington's rare plants and ecosystems and does not preclude the need for field surveys.

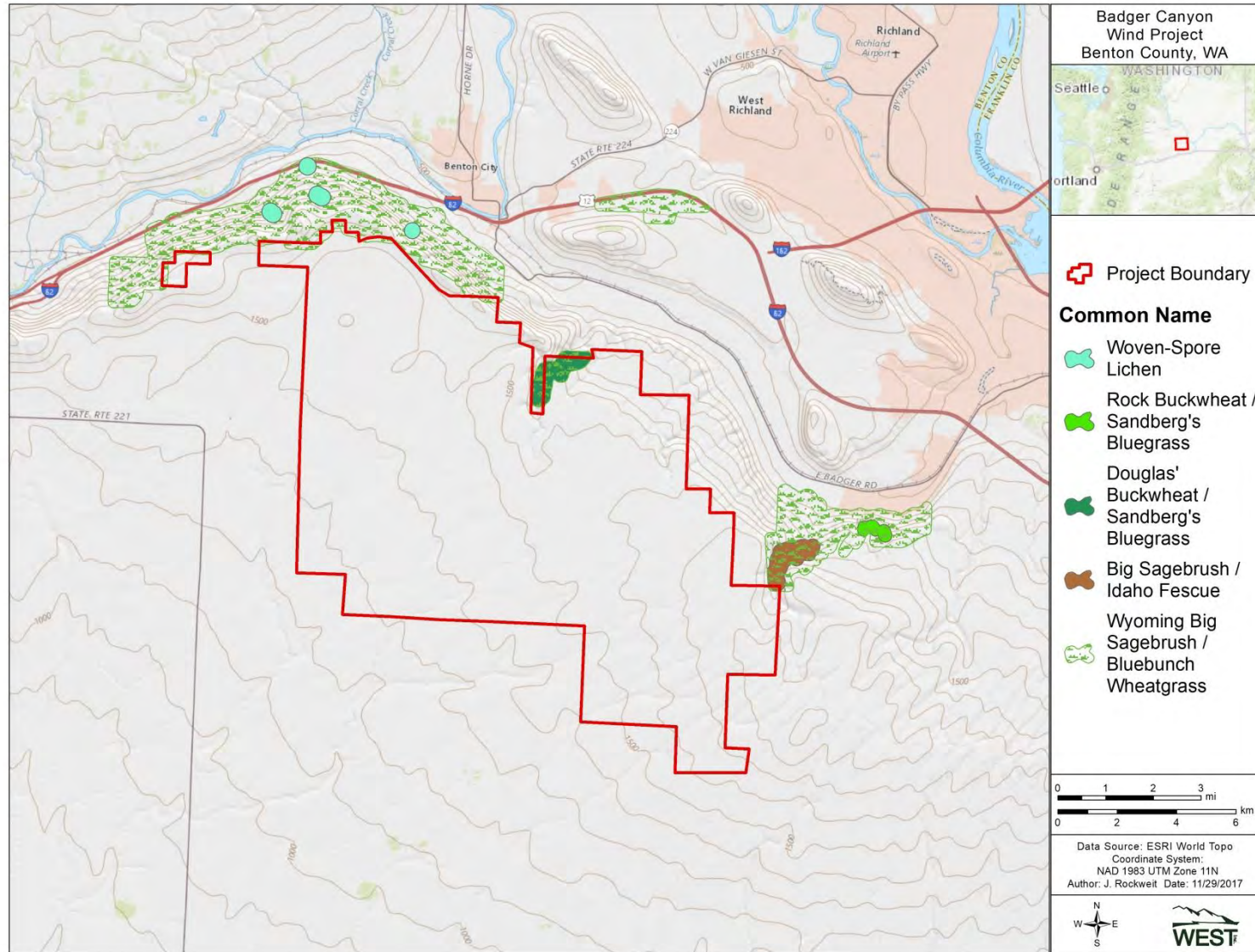


Figure 6. Known locations of rare plants and plant communities in the vicinity of the Badger Canyon Wind Project. Data from the Washington Natural Heritage Program (WNHP; 2017b).

WILDLIFE RESOURCES

Federal and State Listed Species

Based on review of State and federal special-status species lists and occurrence information (USFWS 2017, WDFW 2017a, WDFW 2017b), no wildlife species currently listed, or candidates for listing, under the federal Endangered Species Act (ESA) have the potential to occur within the Project. However, 16 State-listed or candidate wildlife species have at least some potential to occur in the Project, including ten bird species, four mammal species, and two reptile species (Table 3). Also included in the list are WDFW Priority Species (five birds and two mammals) which have been identified as priorities for conservation and management and are known to occur in the region (WDFW 2017a; Table 3). Additionally, while the bald eagle (*Haliaeetus leucocephalus*) is no longer a federal or State threatened species, it is included in the list as it is protected, along with the golden eagle, under the federal Bald and Golden Eagle Protection Act (BGEPA 1940). Impacts to eagles are of particular concern at wind energy facilities nation-wide and are discussed in greater detail in the sections below.

Of the 18 special-status species with potential to occur in the Project, six species (burrowing owl [*Athene cunicularia*], ferruginous hawk [*Buteo regalis*], loggerhead shrike [*Lanius ludovicianus*], prairie falcon [*Falco mexicanus*], black-tailed jackrabbit [*Lepus californicus*], and Townsend's ground squirrel [*Urocitellus townsendii townsendii*]) have been documented as occurring within two miles of the Project (WDFW 2017a). An additional eight species are likely or have potential to occur in the Project: American white pelican (*Pelecanus erythrorhynchos*), bald eagle, golden eagle (*Aquila chrysaetos*), sandhill crane (*Grus canadensis*), Vaux swift (*Chaetura vauxi*), white-tailed jackrabbit (*Lepus townsendii*), sagebrush lizard (*Sceloporus graciosus*), and striped whipsnake (*Masticophis taeniatus*). The remaining four species are unlikely to occur: sagebrush sparrow (*Artemisiospiza nevadensis*), greater sage grouse (*Centrocercus urophasianus*), sage thrasher (*Oreoscoptes montanus*), and Townsend's big-eared bat (*Corynorhinus townsendii*). General habitat requirements and the potential for occurrence for each of these species is presented below in Table 3.

Table 3. State and/or federal listed or candidate wildlife species, or state Priority Species, with potential to occur within the Badger Canyon Wind Project.

Species	Status	Habitat	Potential for Occurrence in the Project area
Birds			
American white pelican <i>Pelecanus erythrorhynchos</i>	ST	Breeds primarily on isolated islands in freshwater lakes and forages in shallow areas (Stinson 2016). Nests on Columbia River dredge islands near the Tri-Cities (Stinson 2016).	Possible. Suitable habitat not present within Project but may fly over area between foraging areas; known to nest on Badger Island approximately 20 miles east of the Project (Stinson 2016).
Bald eagle <i>Haliaeetus leucocephalus</i>	BGEPA, PS	Nests in trees or cliffs near water, typically along shorelines, lakes, reservoirs, and rivers; feeds on fish and carrion.	Likely. Uncommon year-round visitor to area; known to nest along Columbia River to the east and north of Project.
Burrowing owl <i>Athene cunicularia</i>	SC, PS	Occurs in open areas; nests in burrows dug by badgers or other mammals; feeds on insects, small rodents, lizards, frogs, and small birds.	Possible. Common resident of Tri-Cities area from mid-April to early September (Ennor 1991); numerous documented breeding locations within several miles of the Project (WDFW 2017a); foraging and nesting habitat present throughout Project area.
Ferruginous hawk <i>Buteo regalis</i>	ST, PS	Occurs in open prairie habitat and commonly feeds on ground squirrels, rabbits, and hares; nests in trees, cut banks, cliffs, and rocky pinnacles (Ennor 1991)	Likely. Common in Tri-Cities area during breeding season; numerous nest sites documented within several miles of the Project, particularly along escarpment to the north (WDFW 2017a).
Golden eagle <i>Aquila chrysaetos</i>	SC, BGEPA	Breeds in hilly or mountainous areas, nests on rocky cliffs or isolated large trees. Common prey species include ground squirrels, marmots, rabbits, and hares.	Likely. While not known to nest in Benton County, may occur as uncommon visitor to area, particularly during spring and fall migration (Hayes 2013).
Loggerhead shrike <i>Lanius ludovicianus</i>	SC	Uses open habitats with scattered shrubs; typically nests in mature sagebrush habitat; feeds on insects, small mammals, birds, reptiles, and amphibians.	Likely. Documented at several locations to the north of the Project (WDFW 2017a); nesting and foraging habitat present, particularly in shrub-steppe habitat to north of Project, but also in agricultural areas within site.
Prairie falcon <i>Falco mexicanus</i>	PS	Inhabits arid environments of eastern Washington and nests on cliffs usually associated with native steppe and shrub-steppe habitats. Known to breed in most counties in central and eastern Washington; largest wintering populations in Washington are in central Columbia Basin including Benton County (Hays and Dobler 2004).	Likely. Documented in numerous locations within several miles of Project area (WDFW 2017a). Potential to nest in cliffs along Columbia River and occur year round in the Project.

Table 3. State and/or federal listed or candidate wildlife species, or state Priority Species, with potential to occur within the Badger Canyon Wind Project.

Species	Status	Habitat	Potential for Occurrence in the Project area
Sagebrush sparrow <i>Artemisiospiza nevadensis</i>	SC, PS	Restricted to open shrub lands and grasslands with mature big sagebrush stands; nests on the ground or in sagebrush; feeds on insects.	Unlikely. Suitable mature sagebrush habitat appears to be absent from Project; species more likely to occur in shrub-steppe habitat to north of Project.
Greater sage grouse <i>Centrocercus urophasianus</i>	ST	Inhabits shrub-steppe where it is closely associated with sagebrush; majority of diet comprised of sagebrush, grasses, forbs, and insects; historically occurred throughout eastern Washington (WDFW 2012a).	Unlikely. Project falls outside of species' current range (WDFW 2012a); suitable shrub-steppe habitat appears very limited in Project area.
Sage thrasher <i>Oreoscoptes montanus</i>	SC	Inhabits open, shrub-steppe habitats, preferring areas dominated by sagebrush or bitterbrush with native grasses intermixed. Post-breeding, often moves into thickets such as along creek drainages.	Unlikely. Preferred habitat appears to be absent from Project; more likely in shrub-steppe habitats to north of Project.
Sandhill crane <i>Grus canadensis</i>	SE	Nesting habitat ranges from open meadows to deep bogs and marshes; migration stopover and staging areas occur primarily near croplands where waste grains are available near wetlands.	Possible. Breeding in Washington occurs only in western Yakima and Klickitat counties (Stinson 2017); possible to occur during migration or as transients during post-breeding; cropland within Project may provide stopover habitat.
Vaux swift <i>Chaetura vauxi</i>	SC	Inhabits riparian thickets, woodlands, orchards, rocky cliffs, talus slopes, and rimrock areas (Ennor 1991)	Possible. Nesting and roosting habitat not present within Project area; may occur during migration.
Mammals			
Black-tailed jackrabbit <i>Lepus californicus</i>	SC, PS	Occurs in sagebrush and rabbitbrush dominated habitats as well as areas of mixed grassland and shrub (WDFW 2012d);	Possible. Suitable habitat appears to be present; however, known to be rare within Project area (WDFW pers. comm.). Documented occurrence within several miles to the north of the Project (WDFW 2017a).
Townsend's big eared bat <i>Corynorhinus townsendii</i>	SC	In Washington, occurs in a variety of arid and moist lowland habitats including shrub-steppe (WDFW 2012c); roosts in caves, lava tubes, mines, old buildings, and bridges.	Unlikely. Suitable roosting habitat appears to be absent from Project area; some potential to occur as a rare visitor; has not been documented as occurring in the southern Columbia Basin (WDFW 2012c).

Table 3. State and/or federal listed or candidate wildlife species, or state Priority Species, with potential to occur within the Badger Canyon Wind Project.

Species	Status	Habitat	Potential for Occurrence in the Project area
Townsend's ground squirrel <i>Urocitellus townsendii townsendii</i>	SC, PS	Inhabits shrub-steppe, native grasslands, pastures, orchards, vineyards, highway margins, vacant lots, and the banks of canals; occurs only in Washington in the Columbia Basin west of the Columbia River, including throughout Benton County.	Likely. Known to occur at a number of locations to north of Project area (WDFW 2017a); suitable habitat appears to be present.
White-tailed jackrabbit <i>Lepus townsendii</i>	SC	Occurs in open, grassy, or sagebrush plains; where the range of the two jackrabbits species overlaps, white-tailed jackrabbits tends to be more common in bunchgrass habitats with less shrub cover (WDFW 2012d).	Possible. Suitable habitat appears to be present; however, known to be rare within Project area (WDFW pers. comm.)
Reptiles			
Sagebrush lizard <i>Sceloporus graciosus</i>	SC	Associated with vegetated sand dunes and sandy habitats that support shrubs and have large areas of bare ground.	Possible. Project falls within species' range and suitable sandy habitat may be present within Project area.
Striped whipsnake <i>Masticophis taeniatus</i>	SC	Inhabits shrub-steppe habitats within the driest portions of the central Columbia Basin (WDFW 2012b).	Possible. Historical records for the species in Benton County (WDFW 2012b); suitable habitat may be present within the Project.

SE: state-listed endangered species; ST: state-listed threatened species; SC: state candidate species for listing; PS: state priority species; BGEPA: species protected under the Bald and Golden Eagle Protection Act (BGEPA 1940)

Species status from WDFW (2017b)

Birds

Bird Migration

The Project is located within the Pacific Flyway and numerous birds likely migrate through landscape. The Project contains stopover habitat (i.e., habitat where migratory species may stop to rest, drink, and refuel) for raptors, songbirds, waterfowl, and shorebirds in the form of cropland and pastures with much smaller areas of disturbed shrub, grassland, and wetland habitat. In general, high-quality stopover habitat such as riparian/wetland habitat, forest, and shrubland is absent from Project area. Based on USFWS NWI data there are less than eight ac of wetland habitat in the Project area, the majority of which is present within unnamed ephemeral drainages throughout the Project's croplands. There is some potential for migrating waterfowl, shorebirds, and waterbirds to use these areas seasonally, as well as flooded agricultural fields, as stopover habitats; however, given the limited amount of such habitat, use is not expected to be substantial.

Several factors influence the migratory paths of raptors; one of the most significant influences is geography. Ridgelines and the shorelines of large bodies of water are used by migrating raptors because they provide conditions necessary for energy-efficient travel over long distances (Liguori 2005) and serve as navigational aids. For these reasons, raptors tend to follow corridors or pathways along prominent ridges with defined edges or along shorelines during migration. While higher, north-south trending ridgelines are generally west of the Project area, there is some potential for escarpments along the river corridors in the region, particularly the ridge along the northern boundary of the Project and south of the Yakima River, to be used by both resident and migrating raptors. At their closest points, the Yakima River runs approximately two mile to the north of the Project and the Columbia River runs approximately eight miles to the northeast of the Project (Figure 1). Trees and associated habitats along the rivers likely provide perch sites and foraging areas for raptors and other species during migration.

Passerines are by far the most abundant bird group in most terrestrial ecosystems and are the most commonly reported fatalities at wind energy facilities (NRC 2007). In inland areas, it is generally assumed that nocturnal migrating passerines move in broad fronts rather than along specific topographical features (Gauthreaux et al. 2003, NRC 2007). Many species of songbirds migrate at night and may collide with tall man-made structures, though no large mortality events on the scale of those observed at communication towers (National Wind Coordinating Committee [NWCC] 2004) have been documented at wind energy facilities in North America. Large numbers of passerines have collided with lighted communication towers and buildings when foggy conditions and spring or fall migration coincide. Birds appear to become confused by structural lighting during foggy or low-ceiling conditions and fly in circles around lighted structures until they become exhausted or collide with the structure (Erickson et al. 2001a). Most collisions at communication towers are attributed to the guy wires on these structures. At the nearby Nine Canyon wind energy facility, a nocturnal migration radar study was conducted in fall 2000 and spring 2001 (Mabee and Cooper 2000, Erickson et al. 2001b). Results of the study indicated that approximately 86% of birds flew at altitudes above the maximum proposed

turbine height of 80 m (262 ft). Nocturnal migration studies at the Stateline and Vansycle wind energy facilities, approximately 24 mi (38.6 km) to the southeast of the Project, revealed similar mean flight altitudes despite having greater topographic relief within their immediate areas than the Nine Canyon facility (Mabee and Cooper 2004).

Avian collision fatality data from studies conducted at 30 wind energy facilities across North America were examined to estimate how many night migrants collide with turbines and towers and how aviation obstruction lighting relates to collision fatalities (Kerlinger et al. 2010). Fatality rates, adjusted for scavenging and searcher efficiency, of nighttime migrants at turbines 54 to 125 m (117 to 410 ft) in height ranged from less than one bird/turbine/year to approximately seven birds/turbine/year, with generally higher rates recorded in eastern North America and lower rates in the West. Multi-bird fatality events (defined as more than three birds killed in one night at a single turbine) were extremely rare and were not related to turbine lighting. The largest mortality events attributed to turbines at US wind energy facilities to date include 14 migrant songbirds found at two turbines during spring migration at Buffalo Ridge, Minnesota (Johnson et al. 2002), and 27 migrants at the Mountaineer facility in West Virginia (Kerns and Kerlinger 2004). The West Virginia mortalities apparently occurred during inclement weather and the fatalities occurred at a turbine near a heavily lit substation. Most migrant songbird casualties recorded during systematic carcass searches at turbines have been a single fatality found during a single search (Erickson et al. 2001a). Furthermore, no significant differences were detected when comparing songbird mortality at lit and unlit turbines. From this research, red flashing Federal Aviation Administration (FAA) lighting on turbines does not appear to be an attractant to nocturnal migrants and turbines appear to be at heights below typical migration flight elevations.

In the Pacific Northwest region of the US (i.e., Oregon and Washington), overall bird fatality rates at wind energy facilities have ranged from 0.16 birds/MW/year at the Marengo II facility in Columbia County, Washington to 8.45 birds/MW/year at the Windy Flats facility in Klickitat County, Washington (URS Corporation 2010b, Enz et al. 2011). During a one-year fatality monitoring study at the nearby Nine Canyon facility, the overall bird fatality rate was estimated to be 3.59 bird fatalities/turbine/year or 2.76 birds/MW/year (Erickson et al. 2003). During the study, 36 bird fatalities (28 small birds and eight large birds) representing 13 species were found at turbine search plots during the study. The species most commonly found as fatalities were horned lark (*Eremophila alpestris*; 36 fatalities) and ring-necked pheasant (*Phasianus colchius*; five fatalities). Of the 36 bird fatalities reported during the study, 28 were passerine species but only six were classified as nocturnal migrants (Erickson et al. 2003).

Important Bird Areas

The Audubon Society has identified Important Bird Areas (IBAs) throughout the Western Hemisphere that provide essential habitat for birds (Audubon 2017). These IBAs include sites for breeding, wintering, and migrating birds and can range from only a few acres to thousands of acres in size. There are three recognized IBAs within 20 miles (32.2 km) of the Project: the Yakima River Delta and the Hanford Reach, located to the north of the Project, and the Umatilla, located south of the Project (Figure 7). While the IBAs are all more than five mi from the Project,

given the location of the IBA, birds moving between these areas have the potential to pass through or near the Project.

The Yakima River Delta IBA, located approximately seven mi (11.3 km) to the northeast of the Project (Figure 7), is centered on the confluence of the Yakima and Columbia Rivers. The IBA includes open freshwater, marsh, mudflat, and sand and gravel shore, supporting five species of state or federal listed or candidate species, up to 12 species of raptors, as well as many species of waterfowl, shorebirds and other water-dependent species. The site is also important for its riparian forests lining the river which provide perches for eagles, cormorants, herons, and kingfishers.

The Hanford Reach IBA comprises a 56-km stretch of the Columbia River and its near-shore environment. This IBA, which is designated as the Hanford Reach National Monument, is the last free-flowing section of one of the largest rivers in the US. The southern extent of the IBA lies approximately eight mi (12.9 km) to the north of the Project (Figure 7). The area supports a high concentration of wintering bald eagles and waterfowl, cliffs providing nesting habitat for swallows, owls, hawks, and falcons, and the river provides fish for American white pelicans, gulls, and cormorants.

The Umatilla IBA, located about 12 miles (19.3 km) to the south of the Project (Figure 7), is comprised of the Umatilla National Wildlife Refuge. This IBA includes a varied mix of habitat including open water, sloughs, shallow marsh, seasonal wetlands, cropland, islands, and shrub-steppe. The IBA is vital to migrating waterfowl, bald eagles, colonial nesting birds and other migratory and resident wildlife in an area where wetlands and other natural habitats are otherwise scarce.

US Fish and Wildlife Service Birds of Conservation Concern

The USFWS lists 28 species as birds of conservation concern (BCC) within the Great Basin Bird Conservation Region (BCR), within which the Project is located (USFWS 2008). These species have been identified as vulnerable to population declines in the area by the USFWS (2008). Several species are also State and/or federal listed or candidate species (e.g., ferruginous hawk, golden eagle, loggerhead shrike, sage thrasher, sagebrush sparrow) and are discussed in greater detail in the listed species section above. Although some of these BCC species may use habitats in the Project vicinity during migration or nesting (e.g., wetlands, shrub-steppe habitat), the majority of the Project area is comprised of agricultural lands with limited ecological value to most BCCs in the region.

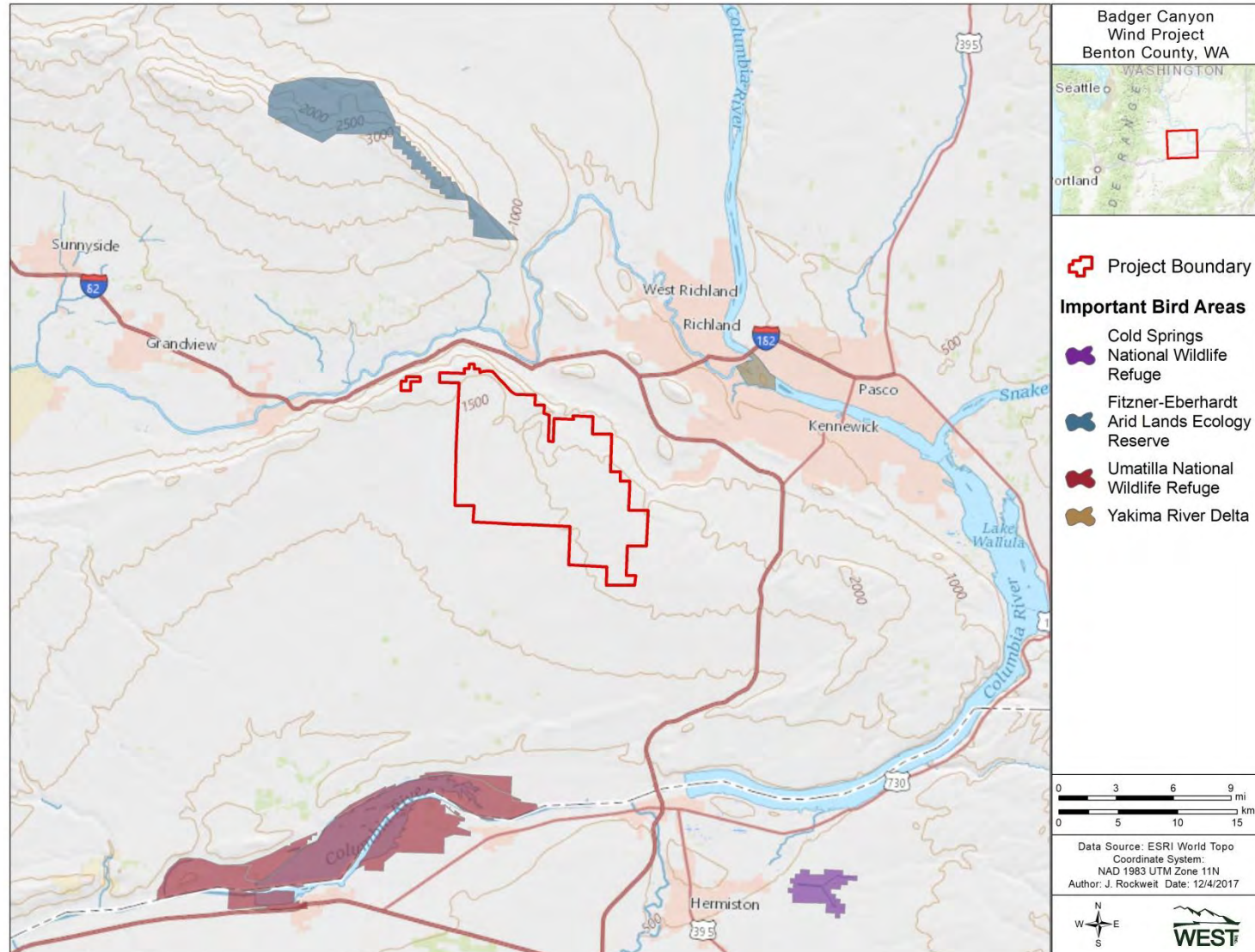


Figure 7. Location of Important Bird Areas occurring in the vicinity of the Badger Canyon Wind Project, Benton County, Washington.

Raptors

Diurnal raptors occur in most areas with the potential for wind energy development and have shown susceptibility to the potentially adverse impact of wind energy development (NRC 2007). Fifteen diurnal raptor species and seven owl species have at least some potential to occur within the Project area for at least part of the year. Of these, eight species are likely to breed within the Project or surrounding area and likely occur regularly within the Project: northern harrier (*Circus cyaneus*), Swainson's hawk (*Buteo swainsoni*), red-tailed hawk (*B. jamaicensis*), ferruginous hawk, American kestrel (*Falco sparverius*), barn owl (*Tyto alba*), great-horned owl (*Bubo virginianus*), and burrowing owl. One additional species, rough-legged hawk (*B. lagopus*) is a common winter resident of the area. Eight species are considered uncommon permanent residents and/or breeders in the region; however, suitable nesting and foraging habitat is generally absent from the Project area and these species are likely to occur only as uncommon to rare visitors to the Project: osprey (*Pandion haliaetus*), golden eagle, bald eagle, peregrine falcon (*F. peregrinus*), prairie falcon, long-eared owl (*Asio otus*), short-eared owl (*A. flammeus*), and western screech owl (*Megascops kennicottii*). Five additional species may occur during migration or as uncommon winter residents in the region: sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*A. cooperii*), northern goshawk (*A. gentilis*), merlin (*F. columbarius*), and snowy owl (*B. scandiacus*). Of the raptor species potentially occurring within the Project, one is State threatened (ferruginous hawk), two are State candidates for listing (golden eagle and burrowing owl), and four are considered WDFW Priority Species (bald eagle, burrowing owl, ferruginous hawk, and prairie falcon; WDFW 2017b).

Based on fatality monitoring studies conducted at 29 operating wind energy facilities in the Pacific Northwest with publically available data, diurnal raptor fatality rates have ranged from zero to 0.47 raptors/MW/year (Young et al. 2006, Erickson et al. 2000, Johnson et al. 2003, URS Corporation 2010a, Enk et al. 2010, Gritski and Kronner 2010, Downes and Gritski 2012). During a one-year fatality monitoring study at the nearby Nine Canyon facility in 2002-2003, only two raptors (one American kestrel and one short-eared owl) were found within search plots resulting in an estimated raptor fatality rate of 0.05 raptors/MW/year (Erickson et al. 2003). To date, the most common raptor species documented during fatality searches conducted at wind energy facilities in the Pacific Northwest have been American kestrels and red-tailed hawks (WEST, unpublished database). Based on publically available reports compiled by WEST (WEST, unpublished database), only five ferruginous hawk fatalities and one burrowing owl fatality have been reported in Washington and Oregon

Eagles

Both bald and golden eagles are protected under the federal Bald and Golden Eagle Protection Act (BGEPA; 1940), and in Washington, the golden eagle is a State candidate for listing (WDFW 2017b). Currently, the relative level of eagle use of the Project area is unknown, though both bald and golden eagles are known to occur in the region. While nesting habitat for both species is absent from the Project area, both species may forage throughout the site, particularly during winter or migration seasons. The golden eagle is considered an uncommon year-round resident of the Columbia Plateau (Seattle Audubon Society [SAS] 2017). Based on

statewide golden eagle nest surveys conducted in 2013, 158 breeding pairs of golden eagles are estimated in the state (Hayes 2013). The majority of nesting territories in the state occurred in Okanogan County and the Columbia Plateau ecoregion; however, WDFW reported no known nest sites in Benton County (Hayes 2013).

Alternatively, the bald eagle is considered a fairly common resident of the Columbia Plateau in winter, but only occurs rarely in summer (SAS 2017). As of 2015, the total number of known bald eagle territories in the state was 1,334, with the number of nests increasing annually each year since 2005 (Kalasz and Buchanan 2016). Bald eagles typically nest near large bodies of water, such as lakes or larger rivers; however, they also require trees that are sufficiently large and have the branch structure necessary to support an eagle nest. Based on data from the Washington Survey Data Management database, historical bald eagle nesting territories are located along the Columbia River, approximately eight and 21 miles (12.9 and 33.8 km) to the northeast and east of the Project, respectively (Kalasz and Buchanan 2016). Nest sites and breeding season foraging habitat for bald eagles are absent from the Project, therefore, the species is unlikely to occur during the breeding season. Bald eagles are more likely to occur in the winter, potentially foraging on carrion once their primary prey (fish) becomes more scarce (Kalasz and Buchanan 2016).

For reasons not well-understood, golden eagles are known to have a higher susceptibility to collisions with wind turbine rotors than are bald eagles (Allison 2012). A small number of wind projects in five western states all located within high-quality golden eagle breeding habitat, have produced substantially larger numbers of golden eagle fatalities, with fatality rate estimates as high as 15-70 golden eagles per year (Allison 2012). Nonetheless, most wind energy facilities that have been constructed within the golden eagle's geographic range, including all wind energy projects that have been constructed outside of golden eagle breeding habitat, have resulted in very small numbers of recorded fatalities (zero to three per project; Allison 2012). Within the Pacific Northwest region of the US (i.e., Washington and Oregon), six golden eagle fatalities have been reported in publicly available reports from four different wind energy facilities (URS Corporation 2010a, Enk et al. 2011, Enz and Bay 2012, Enz et al. 2012). To date, no bald eagle fatalities have been reported in publicly available reports at facilities in the Pacific Northwest (WEST, unpublished database). Over the course of one year of pre-construction avian use surveys conducted at the nearby Nine Canyon wind energy facility in Benton County, only one golden eagle and one unidentified eagle were recorded during the study (Erickson et al. 2001b). No eagle fatalities were documented during a one-year post-construction fatality monitoring study at the Nine Canyon facility (Erickson et al. 2003). While the publicly available data suggests eagle mortality at wind energy facilities in the Pacific Northwest may be relatively low, publicly available data is limited to relatively short fatality monitoring studies (1-2 years typically) at facilities that have, in many cases, been operational for less than 10 years.

Year round eagle/large bird use surveys, consistent with the USFWS ECPG (USFWS 2013) and WEG (USFWS 2012), will help estimate use of the Project area by eagles and other raptor species.

Potential Raptor Nesting Habitat

Limited nesting habitat is available for raptors within the Project area. Scattered isolated trees are present throughout the Project at current or abandoned farmsteads that may provide nest sites for red-tailed hawks, Swainson's hawks, and great-horned owls. Grasslands, pasture and cropland may provide habitat for ground-nesting species, such as burrowing owls, northern harriers, and short-eared owls. Just north of the Project boundary, within the canyons of the Horse Heaven Hills, cliffs and cut banks may provide nest sites for ferruginous hawks and barn owls. Riparian forest habitat along the Yakima River likely supports the highest density of nesting raptors within several miles of the Project. Nesting habitat for bald and golden eagles is absent from the Project area.

A raptor nest survey, including surveys for bald and golden eagle nests within a 10-mile radius of the Project area, and surveys for all raptor nests within two miles of the Project area, would help evaluate potential impacts to nesting raptors from the construction and operation of the Project.

Areas of Potentially High Prey Density

Small- and medium-sized mammals comprise the primary prey base for many raptor species, although birds and insects may also contribute to the diet of many raptor species. Large aggregations of prey species (e.g., prairie dog colonies) are not present in the Project area; however, there are a number of other rodent (e.g., ground squirrels and chipmunks), lagomorphs (e.g., black-tailed jackrabbit), and passerines (i.e., songbirds), particularly those associated with agricultural lands, that are likely to occur throughout the Project. Rodents may be most concentrated along field edges and roads (Preston 1990, Rosenzweit 1989). Waterfowl and waterbirds are also potential prey for eagles and other large raptors; however, perennial and ephemeral water sources in and near the Project area are limited. Flooded agricultural fields may provide foraging opportunities for large raptors during wet periods, and grain fields may attract small mammals which in turn may attract foraging raptors. Larger streams and rivers and lakes which provide fish for raptors such as bald eagles and osprey are absent from the Project. Overall, given the habitat types available within the Project area (i.e., >90% tilled agriculture) there is limited potential for concentrated prey sources to occur.

Bats

Due to the lack of full understanding of bat populations in North America, species and relative abundance of bats occurring within the Project area are difficult to determine. Based on range maps and species accounts from BCI (2017), 16 species of bat are known to occur in Washington, with eight species having an approximate range and habitat requirements that include the Project area: pallid bat (*Antrozous pallidus*), big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), California bat (*Myotis californicus*), little brown bat (*M. lucifugus*), dark-nosed small-footed myotis (*M. melanorhinus*), and canyon bat (*Parastrellus hesperus*). While roosting habitat for the majority of bat species is generally absent from the Project area, each of the species listed above have the potential to forage within, or migrate through, the Project area. The only listed or candidate bat species in

Washington are Townsend's big-eared bat and Keen's myotis (*M. keenii*), both of which are state candidates for listing (WDFW 2017b); however, Keen's myotis occupy only the extreme northwestern corner of the state and Townsend's big-eared bats are unlikely to occur within the Project due to a general lack of roosting and hibernating sites.

Studies conducted at wind energy facilities have documented use of areas within and around these facilities by resident or breeding bats during the summer reproductive period; however, these species are rarely found as casualties at turbines (Johnson 2005). To date, most bat casualties at wind energy facilities in the Columbia Plateau have been migratory species (e.g., hoary and silver-haired bats (Johnson and Erickson 2011), which conduct relatively long fall migrations between summer roosts and wintering areas. For unknown reasons, bat mortality rates are disproportionately high during the fall. However, it may be that tree-roosting bats fly at lower altitudes above ground level (AGL) during spring migration than during fall migration. For example, hoary bats fly one to five m (three to 16 ft) above the ground while migrating through New Mexico in the spring, but apparently not in the fall (Cryan and Veilleux 2007). Similarly, a hoary bat collided with an aircraft above Oklahoma at an altitude of 8,000 ft (2,438 m) in October of 2001 (Peurach 2003), which may support the theory that bats generally fly at higher altitudes in the fall.

In the Pacific Northwest, bat fatality rates at wind energy facilities have varied widely, ranging from 0.12 bats/MW/year at the Kittitas Valley facility in Kittitas County, Washington (Stantec 2012) to 4.23 bats/MW/year at the Palouse facility in Whitman County, Washington (Stantec 2013). During the one-year post-construction fatality monitoring study at the nearby Nine Canyon facility, the bat fatality rate was estimated at 2.47 bats/MW/year (Erickson et al. 2003), which falls near the middle of the range of fatality rates for the Pacific Northwest. Consistent with the results from other studies in the Pacific Northwest and across the county, 20 of the 27 total bat fatalities (74%) documented at Nine Canyon, were found during the late summer/early fall period and all 27 fatalities comprised just two species: silver-haired bat and hoary bat (Erickson et al. 2003).

SUMMARY

Table 4 summarizes key wildlife considerations for the Project. Of the wildlife species protected by or under review through the federal ESA, none have the potential to occur within the Project area. Three species with state threatened or endangered status have at least some potential to occur in the Project area including: American white pelican, ferruginous hawk, and sandhill crane. An additional 12 species designated as state candidates for listing also have potential to occur within the Project including six birds, four mammals, and two reptiles. Both the golden and bald eagle, provided additional protection through the federal BGEPA, have the potential to occur within the area. One state-listed plant species (woven-spore lichen) and four rare and/or high quality plant communities are known to occur within five miles of the Project area; however, the likelihood of these species/communities occurring in the Project is very low due to the current predominate land use.

Fifteen diurnal raptor species and seven owl species have the potential to occur as residents and/or migrants in the Project area at some point during the year. Nesting habitat within the Project is limited to scattered, isolated trees and pasture/cropland (for ground-nesting raptors), but is more abundant in the surrounding landscape in trees, cliffs, and cut banks.

The Project area is located within the Pacific Flyway and numerous birds likely migrate through the region. The Project area is characterized by flat to gently sloping terrain that generally would not be expected to concentrate or funnel raptors during migration; however, the escarpment just north of the Project boundary, above the Yakima River, may be used by both resident and migrating raptors. Stopover habitat for songbirds, waterfowl, and shorebirds in the form of cropland/pasture and smaller amounts of shrubland is present with the Project area; however, these areas are generally not considered high-quality stopover habitat and are abundant across the landscape.

Relatively high bat mortality at other wind energy facilities in North America is a concern, and some species that appear to be at greatest risk, such as hoary and silver-haired bats, are likely to occur in the Project area, particularly during fall migration. At least eight bat species have the potential to occur within the Project area at some time during the year. While roosting habitat is generally lacking within the Project area for most of these species, the Project's pastures, croplands and limited riparian/wetland habitat may provide foraging and drinking habitat for some resident bat species.

Table 4. Summary of the potential for wildlife and plant conflicts in the proposed Badger Canyon Wind Project¹; VH = Very High, H = High, M = Moderate, and L = Low

Issue	VH	H	M	L	Notes
Raptor nest sites			✓		Limited habitat for nesting raptors in Project area; higher potential for nesting in canyons and riparian areas to north of Project; potential for ferruginous hawk and burrowing owl nests (state listed/candidate species).
Concentrated raptor flight areas				✓	A number of raptors are likely to use the Project area but site characteristics not expected to concentrate raptor flight activity or migratory activity in any particular area. Escarpment above the Yakima River, just north of the Project area may see higher raptor use during migration and/or winter.
Avian migratory pathways				✓	Project area located along the Pacific Flyway, but limited high quality stopover habitat present; extensive riparian/wetland habitat absent. Potential use by migrating passerines, but not likely used as concentrated migration pathway or stopover area.
Raptor prey species			✓		Potential for rodents, lagomorphs, and prey bird species to occur within Project area, but not likely in high concentrations.
Federal protected wildlife species				✓	No federal listed, candidate, or under review species currently have the potential to occur within the Project; both bald and golden eagles, protected under the federal BGEPA have the potential to occur.

Table 4. Summary of the potential for wildlife and plant conflicts in the proposed Badger Canyon Wind Project¹; VH = Very High, H = High, M = Moderate, and L = Low

Issue	VH	H	M	L	Notes
State protected wildlife species		✓			Sixteen state-listed or candidate species have at least some potential to occur.
Uniqueness of habitat				✓	Habitat and land use within the Project area is predominately agricultural. Two WDFW Priority Habitats and four WNHP rare/high quality plant communities are found in Project vicinity. Three IBAs are within 20 miles of Project.
Rare plants/ecosystems				✓	One federal and/or state listed plant known to occur within 5 miles of the Project area and four rare/high quality plant communities known to occur in region; all are unlikely to occur in Project.
Bats			✓		At least eight bat species have at least some potential to occur within the Project area, one of which is a state candidate for listing. Bat species that have shown relatively high levels of fatalities at wind energy facilities are likely to be present.

¹Summarized for the Badger Canyon Wind Project as a whole but the habitat of the Project area varies in its ability to support species of concern.

USFWS Land-Based Wind Energy Guidelines Tier 2 Questions

Chapter 3 of the USFWS WEG (2012) includes seven Tier 2 questions which should be addressed during site characterization efforts. A contextual review of these questions after synthesis of a SCS report may help identify areas where existing data do not sufficiently address potential impacts to biological resources which may occur through development of a wind energy facility, and should serve to guide formulation of project-specific Tier 3 study plans intended to fill data gaps. This Badger Canyon SCS attempts to answer the Tier 2 questions through a desktop review of publicly available information. However, some data gaps remain; recommended field studies intended to fill data gaps are included in the following section (Conclusion and Next Steps). It is also useful to consider the seven Tier 2 questions individually in the context of this SCS; although the previous Summary section includes much pertinent information, it does not specifically relate SCS report findings to Tier 2 questions. The following list describes how this report has addressed specific Tier 2 questions, where information related to these questions can be found in this report, and what if any data gaps remain:

1. Are known species of concern present on the proposed site, or is habitat (including designated critical habitat) present for these species?

No federal listed wildlife species have the potential to occur within the Project and no designated critical habitat is present within the Project or surrounding area. Sixteen State-listed or candidate species (10 birds, four mammals, and two reptiles) have at least some potential for occurrence (see Listed Species section). There is one federal or State-listed plant species known to occur within five mi of the Project, as well as four rare/high quality plant communities. Tier 3 field studies will help confirm presence or absence of many of these species (see Conclusion and Next Steps section).

2. Does the landscape contain areas where development is precluded by law or designated as sensitive according to scientifically credible information?

A desktop review of publicly available information did not reveal any areas on the landscape where development is precluded by law. Two WDFW Priority Habitats are known to occur within 2 miles of the Project: freshwater wetland and scrub-steppe. Tier 3 field studies will help determine the presence or absence of any sensitive areas in the Project (see Conclusion and Next Steps section).

3. Are there plant communities of concern present or likely to be present at the site?

There is one federal- and/or State-listed plant species (woven-spore lichen), as well as four rare and/or high quality plant communities known to occur in the Project vicinity. All are unlikely to occur in the Project (see Rare Plants and Ecosystems section). Tier 3 field studies will help determine the occurrence of plant communities of concern at the Project (see Conclusion and Next Steps section).

4. Are there known critical areas of congregation of species of concern, including, but not limited to: maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopover or corridors, leks, or other areas of seasonal importance?

There are no known critical areas of congregation of species of concern within the Project area and desktop analyses do not suggest any are likely to occur. Tier 3 field studies will help determine the presence or absence of critical congregation areas in (see Conclusion and Next Steps section).

5. Using best available scientific information has the developer or relevant federal, State, tribal, and/or local agency identified the potential presence of a population of a species of habitat fragmentation concern?

The Project area consists exclusively of private lands managed for crop production and livestock grazing. As such, modern land use of the Project has already led to a fragmented landscape (see Table 1; Figures 3 and 4), and it is unlikely that populations of species with high fragmentation concern are present.

6. Which species of birds and bats, especially those known to be at risk by wind energy facilities, are likely to use the proposed site based on an assessment of site attributes?

Many species of birds and bats are likely to use the Project area at some point during the year (see Raptors, Bird Migration, and Bats sections). There are 15 diurnal raptor species and seven owls which have the potential to occur within the Project. Of these, eight species may breed within the Project or Project vicinity, including the ferruginous hawk (state threatened) and burrowing owl (state candidate), as well as several other

sensitive bird species. Diurnal raptors and some owls are known to be at risk by wind energy facilities. There are at least eight species of bats with the potential to occur in the Project (see Bats section) including both hoary and silver-haired bats, which are known to be at risk by wind energy facilities. Tier 3 field studies will help refine the species present which are known to be at risk from wind energy facilities.

7. Is there a potential for significant adverse impacts to species of concern based on the answers to the questions above, and considering the design of the proposed project?

While the Project design has not yet been determined, based on the general location of the proposed Project and following a desktop review of publicly available information pertaining to the Project area, the potential for significant adverse impacts to species of concern due to development of the Project appears to be low. However, a number of pre-construction baseline biological studies are recommended in order to properly characterize site-specific wildlife use and evaluate the biotic resources in the Project area (see Conclusion and Next Steps section).

CONCLUSION AND NEXT STEPS

Based on this SCS, the Project does not appear to have a high potential for conflict with the majority of wildlife and plant issues listed in Table 12. Regardless, a number of pre-construction baseline wildlife and botanical studies are recommended for the Project with the purpose of characterizing wildlife use (particularly avian and bat use) within the Project area, estimating impacts of the proposed facility on sensitive wildlife and botanical resources, and to assist with siting turbines to minimize impacts to the extent practicable. Baseline studies recommended at this time are presented in Table 5 and include the following:

- Vegetation and land cover mapping following WDFW habitat classification standards and consistent with the Washington Wind Power Guidelines (WDFW 2009).
- Year round large bird/eagle use surveys consistent with recommendations presented in the USFWS ECPG (USFWS 2013), designed to characterize use of the Project area by large birds, with added emphasis on bald and golden eagle use of the Project area.
- Small bird use surveys, consistent with recommendations presented in the WEG (USFWS 2012) and the Washington Wind Power Guidelines (WDFW 2009), designed to evaluate small bird use of the Project area.
- Nesting raptor surveys with an emphasis on bald and golden eagles and other sensitive raptor species as recommended in the WEG (USFWS 2012), ECPG (USFWS 2013), and Washington Wind Power Guidelines (WDFW 2009).
- Bat acoustic monitoring at one meteorological tower location during the spring, summer, and fall using methods recommended in the WEG (USFWS 2012) and the Washington Wind Power Guidelines (WDFW 2009).

- Threatened, endangered, and sensitive species (TESS) surveys, inclusive of rare plants, following methods consistent with the Washington Wind Power Guidelines for surveying and evaluating impacts to special status TESS, plants and natural communities (WDFW 2009).

The large bird/eagle and small bird use surveys listed above should be sufficient to provide a baseline risk assessment for bird species possibly occurring within the Project area and the need for additional studies or more detailed spatial distribution mapping. Early and regular consultation with the USFWS and WDFW is recommended, as it is possible that additional species-specific surveys for sensitive bird, mammal, reptile, and plant species may be encouraged by these agencies. The following Table (Table 5) includes a column for Tier 2 questions. This is intended to highlight how recommended Tier 3 field studies will address information gaps identified during Tier 2 site characterization, and ties directly to information presented in the preceding USFWS Land-Based Wind Energy Guidelines Tier 2 section.

Table 5. Recommended Pre-construction Wildlife and Botanical Studies for the Badger Canyon Wind Energy Project.

Study	Purpose	Information Gaps Addressed from USFWS Tier 2 Question(s)	Timing
Vegetation/land cover mapping	To identify potentially suitable habitat for state or federal sensitive species and to calculate habitat mitigation ratios resulting from potential habitat disturbance.	Questions 1-3	Spring or summer
Large bird / Eagle use surveys	To assess spatial and temporal use of the Project area by bald and golden eagles and other raptor species	Question 1, Question 4, Question 6, Question 7	Year-round
Small bird use surveys	To assess spatial and temporal avian use of the Project area, with a focus of small bird use	Question 1, Question 4, Question 5, Question 6	Spring and fall migration periods
Nesting raptor surveys	To locate nests that may be subject to disturbance and/or displacement effects from Project construction and/or operation, particularly nests of bald or golden eagles or other sensitive raptor species	Question 1, Question 4, Question 5, Question 6, Question 7	Twice during late winter through early summer breeding season
Bat acoustic surveys	To estimate the level of, and seasonal and spatial patterns of, bat activity within the Project area	Question 1, Question 5, Question 6, Question 7	A continuous spring, summer, and fall survey period
TESS survey	To determine the presence, as well as the spatial distribution, of any state and federal threatened, endangered, or sensitive wildlife or rare plant species.	Question 1, Question 2, Question 3, Question 5, Question 7	Spring and early summer when target species are most readily identified (e.g., nesting or flowering)

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**Appendix A. Photographs Taken During Tier 2 Site Visit to the Badger Canyon
Wind Project on December 11-12, 2017**



Photo 1. Taken from near northwest corner of Project area, looking to the west.



Photo 2. Taken from near northwest corner of Project area, looking to the south.



Photo 3. Taken near northwest corner of the Project, looking to southeast.



ENVIRONMENTAL & STATISTICAL CONSULTANTS

2725 NW Walnut Boulevard Corvallis, OR 97330
Phone: 307-634-1756 ♦ www.west-inc.com ♦ Fax: 307-637-6981

DATE: October 30, 2018 *Public Draft - For Distribution*

TO: Joseph Wood and Jeffrey Wagner, wpd Wind Projects Inc.

FROM: Andrea Chatfield and Samantha Brown, WEST, Inc.

RE: Results of the 2018 vegetation and land cover mapping for the Badger Canyon Wind Project Study Area, Benton County, Washington.

INTRODUCTION

Badger Canyon MW LLC (Badger Canyon) is proposing to develop the Badger Canyon Wind Project (Project) in Benton County, Washington. Badger Canyon contracted Western EcoSystems Technology, Inc. (WEST) to conduct a vegetation and land cover assessment in the area where the Project is proposed (Study Area). This assessment was performed as recommended in the Washington Department of Fish and Wildlife (WDFW) Wind Power Guidelines (WDFW 2009). The resulting information can be used to identify potentially suitable habitat for sensitive plant and wildlife species, to help guide surveys for sensitive species within development corridors, and for informing mitigation requirements for temporary and permanent impacts to habitat resulting from Project development. This memorandum summarizes the methodology and results of the 2018 vegetation and land cover assessment within the Study Area.

SITE DESCRIPTION

Regional Setting

The Study Area lies within the semi-arid Columbia Plateau Ecological region, which encompasses a large portion of south central Washington (Washington Biodiversity Council 2008). The Columbia Plateau tilts upward and southward into the Great Basin of eastern Oregon, western Idaho, and northern Nevada, and is bordered by the Cascade Mountains to the west, the Okanogan Highlands to the north, the Palouse Hills to the east, and the Blue Mountains to the southeast. The Columbia and Snake rivers are the dominant topographic features of the Columbia Plateau; in Washington, the Plateau is bisected by the Columbia River. Today, the areas with suitable soil are used for agriculture; crops include wheat (*Triticum* spp.), alfalfa (*Medicago sativa*), potatoes (*Solanum tuberosum*), grass hay, and vineyards. Other areas within the region are used for livestock grazing. In the Yakima Valley to the north and the Columbia Basin to the south, irrigated agriculture is prevalent and includes pastures, orchards, and vineyards. Hops (*Humulus lupulus*) and field crops are also commonly grown. In uncultivated areas, this ecoregion is characterized by arid sagebrush- (*Artemisia* spp.) steppe and

grassland. The regional climate can be typified as arid to semiarid with low precipitation, warm to hot dry summer, and relatively cold winters (Franklin and Dryness 1973). Mean annual temperature in the region is 59° Fahrenheit (15° Celsius), with mean annual precipitation of 10 inches (25 centimeters; Franklin and Dryness 1973, Daly 2000).

Study Area

The Study Area encompasses 36,550 acres (14,791 hectares) of private and state-owned land within Benton County in southeastern Washington, approximately 2.4 miles (mi; 3.9 kilometers [km]) south of Benton City and 12.0 mi (19.2 km) west of the city of Kennewick (Figure 1). Topography within the Study Area is gently sloping, with elevations ranging from 1,193 feet (364 meters [m]) in the southwest corner of the Study Area to 1,860 feet (567 m) along the eastern edge of the Study Area. The Horse Heaven Hills, an anticline ridge of the Yakima Folds, lies along the northeastern border of the Study Area. On the southern side of the ridge, the landscape transitions to relatively rolling topography with shallow, meandering canyons that drain southwest into the Columbia River. At its closest point, the Columbia River runs approximately eight mi (12.9 km) to the northeast of the Study Area and wraps around the Study Area to the east and south (Figure 1). The Yakima River flows eastward into the Columbia approximately two mi (3.2 km) to the north of the Study Area (Figure 1).

The native vegetation of the Study Area consisted of a bluebunch wheatgrass (*Pseudoroegneria spicata*)-Idaho fescue (*Festuca idahoensis*) zonal association, which was predominately grassland and shrub-steppe with deciduous riparian forest and scrub along drainages (Franklin and Dryness 1973). Today, native grassland and shrub-steppe habitats have been replaced by tilled dry-land agriculture (primarily wheat) with a smaller amount of uncultivated grassland, the majority of which is managed as part of the US Department of Agriculture Farm Service Agency's Conservation Reserve Program (CRP). Remnants of native shrub-steppe habitat are present within a few drainages, particularly in the southeastern portions of the Study Area. A network of county and a few private roads traverse the Study Area.

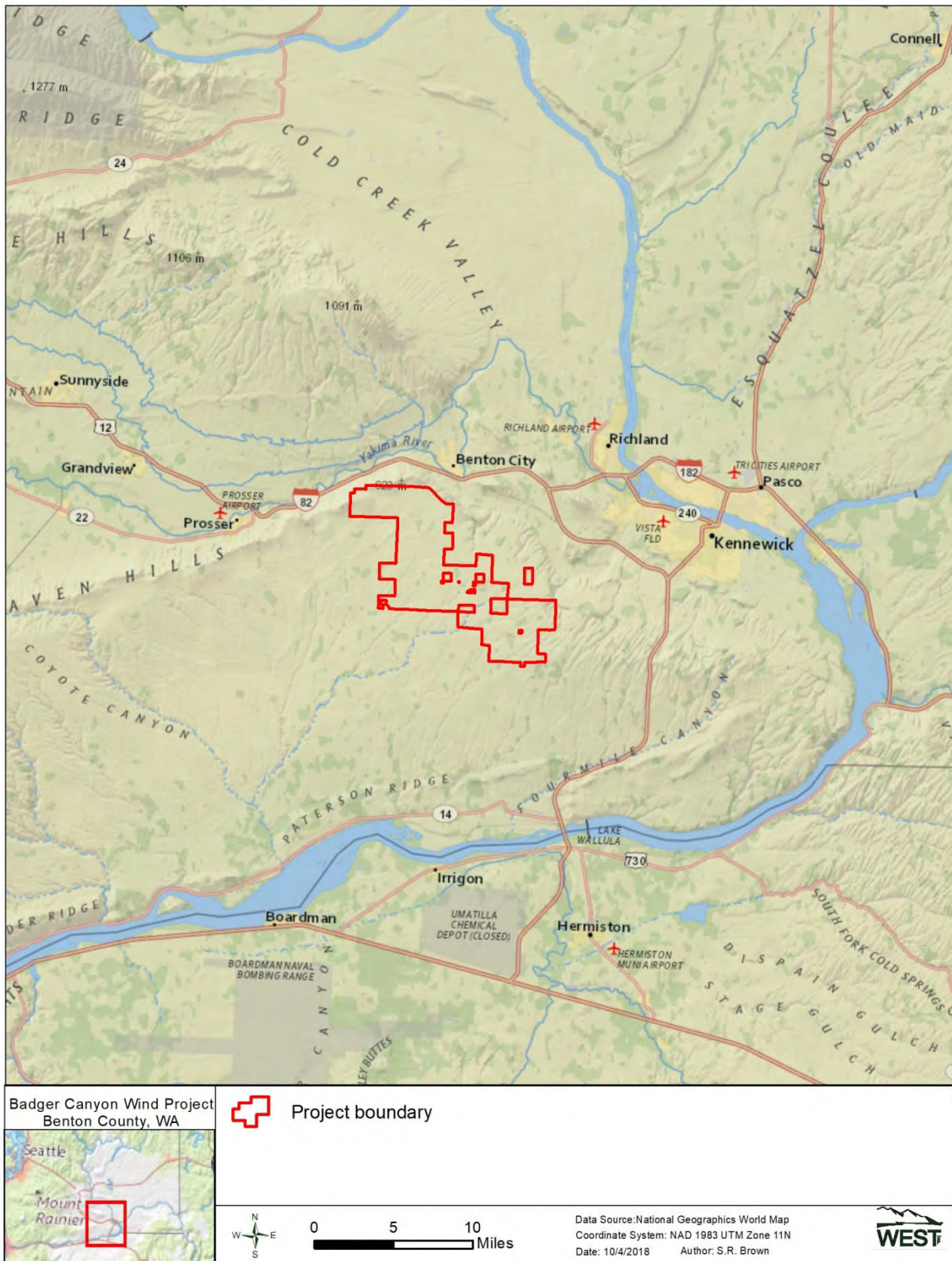


Figure 1. Location of the Badger Canyon Wind Project, Benton County, Washington.

METHODS

The objective of the 2018 vegetation and land cover assessment was to characterize and map the general vegetation and cover types across the Study Area. Land cover types mapped were consistent with those described by the WDFW (2009) and included the following:

- Shrub-steppe – areas dominated by shrubs less than 16.4 feet (5.0 m) tall;
- Grassland – uncultivated areas with herbaceous vegetation including CRP grasslands;
- Agriculture – cultivated cropland and pasture;
- Developed – urban areas, stand-alone structures/residences/farms, highways, and other disturbed areas.

The above land cover types were initially mapped using aerial imagery and remotely sensed data that included the National Landcover Dataset (USGS 2011) and National Wetland Inventory (USFWS 2018) which were then field-verified by a qualified WEST biologist. Following field-verification, a WEST Geographic Information System (GIS) specialist digitized the final habitat designations to create a vegetation/land cover map of the Study Area.

RESULTS

Based on the mapping effort, four vegetation/land cover types were identified within the Study Area. The predominant cover type was agriculture, encompassing 81.8% of the total Study Area (Table 1; Figure 2). Agricultural areas within the Study Area were primarily cultivated cropland consisting of dryland wheat. This was followed by grasslands which encompassed a further 16.5% of the Study Area (Table 1; Figure 2). Smaller areas of remnant shrub-steppe (1.4% of the Study Area; Table 1) were located primarily in the southeastern corner of the Study Area (Figure 2). Very small areas of development (mainly individual structures, residences, or farm buildings) were scattered throughout the Study Area, and composed the remaining 0.2% of the Study Area (Table 1, Figure 2).

Table 1. Vegetation/land cover types, acreages, and percent coverage within the Badger Canyon Wind Project Study Area, Benton County, Washington.

Vegetation/Land Cover Type	Total Acres	Percent Coverage
Agriculture	29,915.10	81.8
Grassland/CRP*	6,025.16	16.5
Shrub-Steppe	524.03	1.4
Developed	85.28	0.2
Total	36,549.57	100

*CRP=Conservation Reserve Program lands

Based on the WDFW Wind Power Guidance, no mitigation is required for impacts (temporary or permanent) to agriculture (cropland or pasture) or developed/disturbed areas which are considered Class IV habitats and have generally low value to wildlife and native plants (WDFW 2009). The remaining two land cover types, shrub-steppe and grassland (including CRP lands),

are considered Class III habitats requiring a 0.1:1 mitigation ratio for temporary impacts (in addition to restoring the temporarily impacted habitat) and a 1:1 ratio for permanent impacts. Shrub-steppe and grassland vegetation communities provide important breeding and foraging habitat for a number of sensitive wildlife species, and shrub-steppe is classified as a priority habitat in Washington (WDFW 2009). Grasslands within the Study Area are likely classified into one of two categories: 1) areas along the margins of tilled agricultural fields or along drainages which are too steep to be cultivated or 2) parcels that are currently enrolled in the CRP. In general, it is unknown which non-cultivated grassland parcels are CRP lands as this information is not publicly available; however, for the purposes of habitat mitigation, CPR lands and grasslands are functionally similar and are both considered Class III habitats (WDFW 2009).

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Figure 2. Land cover types mapped within the Badger Canyon Wind Project Study Area, Benton County, Washington.

Bat Activity Study for the Badger Canyon Wind Project Benton County, Washington

**Final Report
May 11 – October 29, 2018**



Prepared for:

Badger Canyon MW LLC
205 SE Spokane Street, Suite 300
Portland, Oregon 97202

Prepared by:

Quentin Hays, Samantha Brown, and Andrea Chatfield

Western EcoSystems Technology, Inc.
2725 Northwest Walnut Boulevard
Corvallis, Oregon 97330

November 30, 2018



EXECUTIVE SUMMARY

In May 2018 Western EcoSystems Technology, Inc. (WEST) initiated a bat activity study at the proposed Badger Canyon Wind Project (Project) in Benton County, Washington. WEST designed bat acoustic surveys at the Project to evaluate levels of bat activity and species' use of the area during the period of expected peak activity (i.e., late spring through fall).

WEST conducted acoustic surveys in the area where the Project is proposed (Study Area) from 11 May through 29 October 2018. A single Wildlife Acoustics SM3 full-spectrum acoustic detector was outfitted with two microphones and deployed at a Project meteorological (met) tower representative of future turbine locations. One microphone was deployed near the ground, at approximately five feet (ft; 1.5 meters [m]), while the other microphone was raised on the met tower to approximately 148 ft (45 m) above ground level. The ground microphone is considered a ground sampling station, while the raised microphone is considered a raised sampling station. The met tower was located in grassland habitat, which is the dominant land cover type within the Study Area.

During the 172 detector-nights surveyed, the average bat activity rate (\pm standard error) documented at the ground sampling station was 1.27 ± 0.17 bat passes per detector-night, while the raised sampling station recorded an average bat activity rate of 0.96 ± 0.13 bat passes per detector-night. Approximately 94% of bat passes were produced by low-frequency, tree-roosting bats; automated identification of bat calls using Kaleidoscope Pro 4.2.0 determined that silver-haired bats were the most frequently detected species, occurring on approximately 24% of detector-nights. Two high-frequency bat species (canyon bat and little brown bat) were detected during the study period. Neither Townsend's big-eared bat nor pallid bat, both of which are state candidate species, were detected during the study. No federal or state-listed bat species were documented.

The overall bat activity rate at the ground sampling station (BC1g) within the Study Area (1.27 bat passes per detector-night) was below the Rocky Mountains regional average of 4.02 bat passes per detector-night, which is the closest region with publicly available activity data (no activity data from the Pacific Northwest is available for comparison). The average fatality rate for the Rocky Mountains is 4.90 bats/megawatt (MW)/year, significantly higher than the average fatality rate in the Pacific Northwest, which is 1.19 bats/MW/year. If risk patterns at the Project are similar to patterns elsewhere in the Pacific Northwest and Rocky Mountains, it is likely that fatality rates at the Project would be similarly low.

STUDY PARTICIPANTS

Western EcoSystems Technology

Andrea Chatfield	Project Manager
Quentin Hays	Lead Biologist
Samantha Brown	Report Compiler
Donald Solick	Bat Biologist
Larisa Bishop-Boros	Bat Biologist/Data Analyst
Samantha Brown	GIS Technician
Casi Lathan	Project Tracking and Data Manager
David Klein	Technical Editing Manager
Katie Wynne	Technical Editing Coordinator
Carissa Goodman	Technical Editor
Joshua Parrott	Field Technician

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INTRODUCTION

Western EcoSystems Technology, Inc. (WEST) completed a study of bat activity at the proposed Badger Canyon Wind Project (Project) in accordance with recommendations in the US Fish and Wildlife Service (USFWS) *Land-Based Wind Energy Guidelines* (USFWS 2012) and the Washington Department of Fish and Wildlife (WDFW) *Wind Power Guidelines* (WDFW 2009). Although it remains unclear whether bat activity patterns in baseline acoustic data predict post-construction fatality risk (Hein et al. 2013a), ultrasonic detectors do collect information on spatial distribution, timing, and species composition that can provide insight into the possible impacts of wind development on bats in a particular area (Kunz et al. 2007a, Britzke et al. 2013) and inform potential collision minimization strategies for a particular project (Weller and Baldwin 2012). WEST conducted acoustic surveys to estimate levels of bat activity and to determine which bat species occur in the area where the Project is proposed (Study Area). The following report describes the results of acoustic surveys conducted within the Study Area from 11 May through 29 October 2018.

STUDY AREA

The Study Area encompasses approximately 36,550 acres (14,791 hectares) of privately-owned land within Benton County in southeastern Washington, approximately 2.4 miles (mi; 3.9 kilometers [km]) south of Benton City and 12.0 mi (19.2 km) west of Kennewick (Figure 1). Topography within the Study Area is gently sloping, with elevations ranging from 1,150 feet (ft; 351 meters [m]) in the southwest corner to 1,860 ft (567 m) along the eastern edge. The Horse Heaven Hills, an anticline ridge of the Yakima Folds, lies along the northeastern border of the Study Area. South of the Horse Heaven Hills, the landscape transitions to relatively rolling topography with shallow, meandering canyons that drain southwest into the Columbia River. At its closest point, the Columbia River lies approximately eight mi (12.9 km) northeast of the Study Area (Figure 1). The Yakima River flows eastward into the Columbia approximately two mi (3.2 km) to the north of the Study Area (Figure 1).

Land cover within the Study Area primarily consists of wheat associated with dry-land agriculture, with a smaller amount of uncultivated grassland managed as part of the US Department of Agriculture Farm Service Agency's Conservation Reserve Program. A few scattered trees, primarily associated with farms and residences, are distributed throughout the Study Area. These trees, as well as some structures in developed areas, may provide roosting habitat for bats.

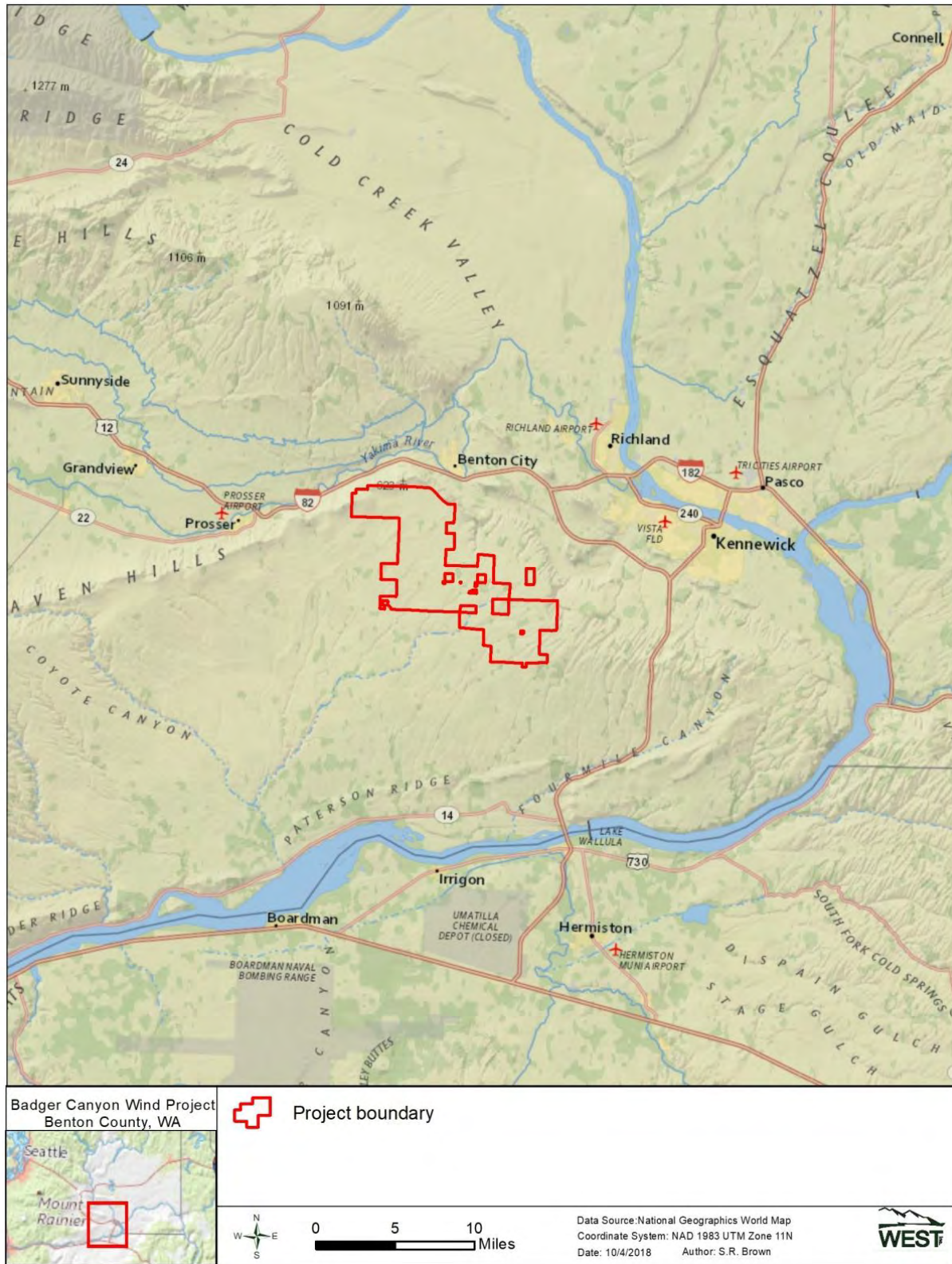


Figure 1. Location of the Badger Canyon Wind Project Study Area, Benton County, Washington.

Overview of Bat Diversity

Thirteen species of bats potentially occur in the Study Area (Hayes and Wiles 2013, International Union for the Conservation of Nature [IUCN] 2017; Table 1). None of these species are federally listed under the Endangered Species Act of 1973 and none are listed as threatened, endangered, or sensitive by the state of Washington (WDFW 2016). However, the Townsend's big-eared bat (*Corynorhinus townsendii*) and pallid bat (*Antrozous pallidus*), both of which have the potential to occur at the Project, are state candidate species (WDFW 2016).

Table 1. Bat species with potential to occur within the Badger Canyon Wind Project Study Area categorized by echolocation call frequency (International Union for Conservation of Nature [IUCN] 2017).

Common Name	Scientific Name
High-Frequency (> 30 kilohertz [kHz])	
California bat	<i>Myotis californicus</i>
canyon bat ¹	<i>Parastrellus hesperus</i>
little brown bat ¹	<i>Myotis lucifugus</i>
long-legged bat ¹	<i>Myotis volans</i>
western long-eared bat ¹	<i>Myotis evotis</i>
western small-footed bat ⁴	<i>Myotis ciliolabrum</i>
Yuma bat	<i>Myotis yumanensis</i>
Low-Frequency (15 – 30 kHz)	
big brown bat ¹	<i>Eptesicus fuscus</i>
hoary bat ^{1,2}	<i>Lasiurus cinereus</i>
pallid bat ³	<i>Antrozous pallidus</i>
silver-haired bat ^{1,2}	<i>Lasionycteris noctivagans</i>
Townsend's big-eared bat ³	<i>Corynorhinus townsendii</i>
Very Low-Frequency (< 15 kHz)	
spotted bat	<i>Euderma maculatum</i>

Source: Hayes and Wiles (2013)

¹species known to have been killed at wind energy facilities (species reported by: Anderson et al. 2004, Kunz et al. 2007b, Baerwald 2008, Miller 2008)

²Long-distance migrant

³Washington state candidate species (Washington Department of Fish and Wildlife [WDFW] 2016)

METHODS

Bat Acoustic Surveys

WEST conducted acoustic surveys to estimate levels of bat activity at the Project during the period of known activity for migratory and resident bats in eastern Washington. A single Wildlife Acoustics Song Meter (SM3) full-spectrum acoustic detector was deployed at a meteorological (met) tower on the Project on 11 May 2018 and documented bat activity through 29 October 2018 (Figure 2). The single detector comprised two sampling stations with separate microphones, one located near the ground at approximately five ft (1.5 m; station BC1g), and one raised on the met tower to approximately 148 ft (45 m; station BC1r). The detector and external deep-cycle battery were housed inside a large weatherproof box for protection from weather and wildlife.

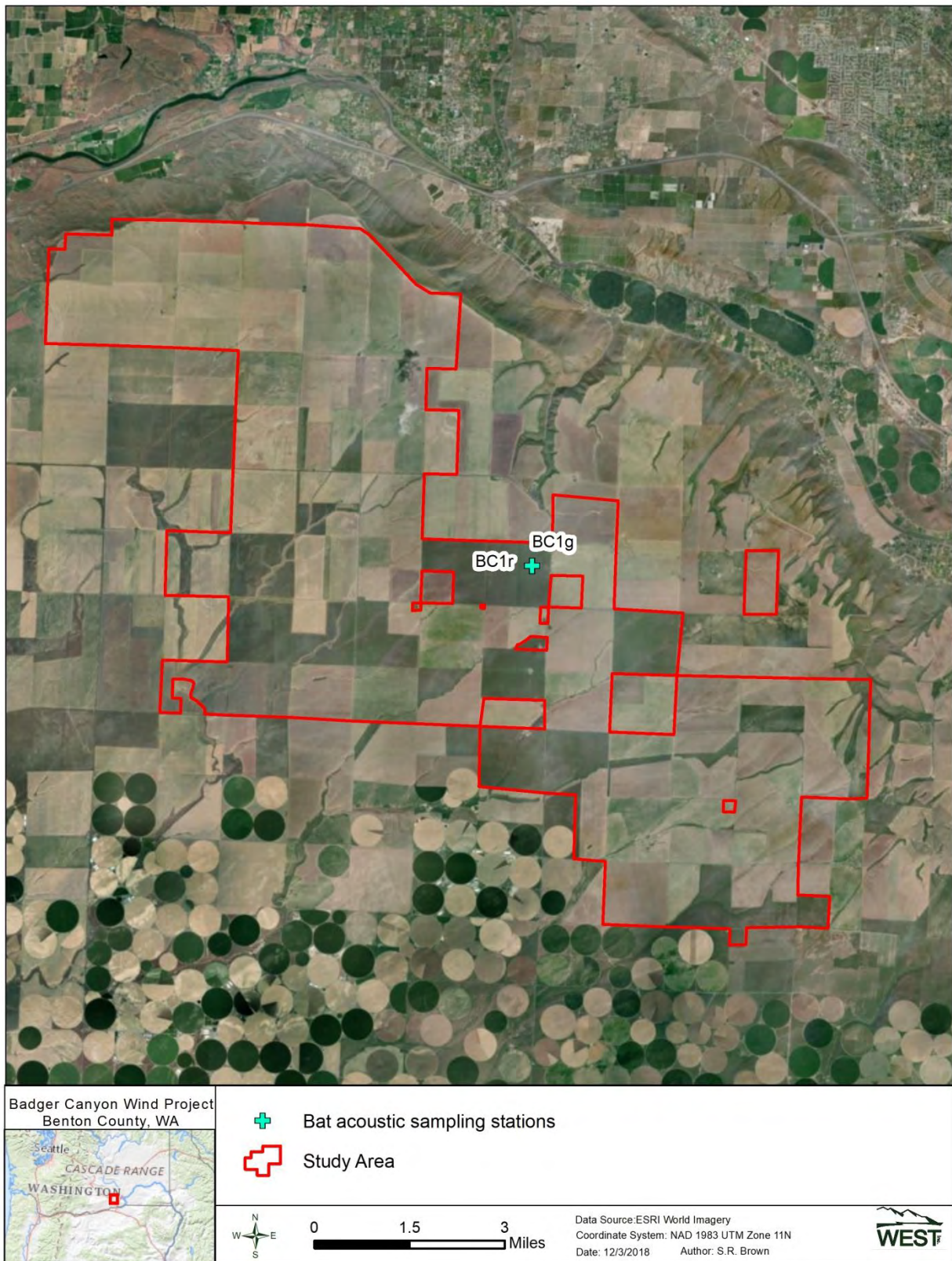


Figure 2. Location of sampling stations used during the bat activity study at the Badger Canyon Wind Project Study Area, Benton County, Washington.

Data Collection and Call Analysis

The Wildlife Acoustics Song Meter SM3 is a full-spectrum bat detector that records complete acoustic waveforms by sampling sound waves at 192 kilohertz (kHz). This high sampling rate enables the detector to make high-resolution recordings of sound amplitude data at all frequencies up to 96 kHz. High-quality recordings produced by the SM3 detector provide more information for making species-level identifications.

SM3 detectors use an omnidirectional microphone to detect and record bat echolocation calls that are then stored as files on one to four Secure Digital cards. During analysis, all recorded files were converted from full spectrum to zero cross (division ratio 8) using software program Kaleidoscope Pro (version 4.2.0; Wildlife Acoustics, Concord, Massachusetts). Noise files (e.g., wind or insect noise) were automatically filtered by Kaleidoscope into a Noise subfolder and not reviewed or included in results. All ultrasonic files were then viewed in Analook® software as digital sonograms that showed changes in echolocation call frequency over time. Frequency versus time displays were used to determine call frequency category and when possible, the species of bat that generated the calls.

For each detector station, bat passes were sorted into two groups based on minimum frequency. High-frequency (HF) bats, such as canyon bat (*Parastrellus hesperus*), have minimum echolocation or social call frequencies greater than 30 kHz. Low-frequency (LF) bats, such as big brown bats (*Eptesicus fuscus*), silver-haired bats (*Lasionycteris noctivagans*), and hoary bats (*Lasiurus cinereus*), typically produce calls with minimum frequencies below 30 kHz.

For species identification purposes, files identified as HF and LF were run through an automated acoustic identification program, Kaleidoscope Pro (version 4.2.0; Wildlife Acoustics, Maynard, Massachusetts). The Bats of North America classifier (version 4.2.0; Wildlife Acoustics) was used at the recommended sensitivity setting of neutral (zero) to select for the 13 bat species that potentially occur within the Study Area (Table 1).

Statistical Analysis

The standard metric for measuring bat activity, the number of bat passes per detector-night, was used as an index of bat activity within the Study Area. A bat pass was defined as a sequence of at least two echolocation calls (pulses) produced by an individual bat with no pause between calls of more than one second (Fenton 1980, White and Gehrt 2001, Gannon et al. 2003). A detector-night was defined as one detector operating for one entire night. The terms bat pass and bat call are used interchangeably in this report. Bat passes per detector-night was calculated for all bats, for HF bats, and for LF bats. Bat pass rates represent indices of bat activity and do not represent numbers of individuals. The number of bat passes was determined by an experienced bat biologist using Analook®.

Mean bat activity was calculated by detector station and overall. The period of peak sustained bat activity was defined as the seven-day period with the highest average bat activity. This and

all multi-detector averages were calculated as unweighted averages of total activity at each detector.

Risk Assessment

Collision with wind turbine blades is the primary risk to bats at operating wind energy facilities (Arnett et al. 2008). The intent of the risk assessment is to use pre-construction bat activity data and other relevant information to describe the potential for bat fatalities at the Project. The intent of the risk assessment is not to predict the number of fatalities, but rather provide context for data collected within the Study Area. To assess the potential risk to bats at the Project, bat activity data collected within the Study Area in 2018 were compared to existing publicly available activity data from other wind energy facilities in the Rocky Mountains region. No publicly available bat activity data exists from the Pacific Northwest; data from the Rocky Mountains represent the closest region available for comparison.

Forecasting collision risk for bats at the Project is challenging for several reasons. First, there are relatively few publicly available studies presenting both pre-construction bat activity and post-construction fatality data, and the ecological differences among geographically dispersed facilities could limit the strength of inference. Further, as explained in detail below, there is no clear correlation between pre-construction bat activity and post-construction fatality data. Second, among studies with both pre-construction bat activity and post-construction fatality data, most pre-construction data were collected during the fall (i.e., the period of greatest risk) using Anabat™ zero-cross detectors (Titely Scientific™, Columbia, Missouri) placed near the ground. In contrast, this study used SM3 full-spectrum detectors near the ground and elevated near the rotor-swept area. Finally, the primary limitation of conducting a qualitative risk assessment for the Project is the difference in data collected by Anabat (used at most other projects) and SM3 detectors (used at the Project). Full-spectrum detectors, such as the SM3 units used at the Project, may record more bat passes per detector-night on average than the Anabat (zero-cross) units used for data collection at the majority of wind farms. Full-spectrum detectors have more sensitive microphones that sample more airspace, as well as different data processing algorithms (Solick et al. 2011, Adams et al. 2012), which may combine to result in higher activity rates than those measured by Anabat detectors. For this reason, activity levels recorded by SM3 detectors are not directly comparable to activity levels recorded by Anabat detectors, though trends in spatial and temporal activity rates collected by Anabat detectors can serve to contextualize trends in data collected using SM3 detectors. Differences in data collection technology (i.e., full-spectrum versus zero-cross detectors), and the resultant possibility that use of SM3 detectors rather than Anabat units at the Project led to increased collection of bat acoustic data should be considered. Inclusion of Anabat data in this report is for general discussion purposes only.

It is generally thought that pre-construction bat activity rates are positively related to post-construction bat fatalities (Kunz et al. 2007b). However, to date, few studies of wind energy facilities that have recorded both bat passes per detector night and bat fatality rates are publicly available (Appendix A). Given the limited availability of pre- and post-construction data sets, differences in protocols among studies (Ellison 2012), and significant ecological differences

among geographically diverse facilities, the relationship between pre-construction activity and measured post-construction fatality rates has not been definitively established. In Canada, Baerwald and Barclay (2009) found a significant positive association between pass rates measured at 30 m (98 ft) above ground level and fatality rates for hoary and silver-haired bats across five sites in southern Alberta. However, on a continental scale, a similar relationship has proven difficult to establish. The relatively few studies that have estimated both pre-construction activity and post-construction fatalities show results that trend toward a positive association between activity and fatality rates, but lack statistically significant correlations. Hein et al. (2013a) compiled study results that included both pre- and post-construction data from the same projects, as well as pre- and post-construction data from facilities within the same regions to assess if pre-construction acoustic activity predicted post-construction fatality rates. Based on data from 12 sites, Hein et al. (2013a) did not find a statistically significant relationship ($p = 0.07$), although the trend was in the expected direction (i.e., higher activity was generally associated with higher fatalities and vice-versa). For these reasons, the current approach to assessing risk to bats using pre-construction acoustic data requires a qualitative analysis of activity levels, spatial and temporal relationships, species composition, and comparison to known regional activity and/or fatality patterns.

RESULTS

Bat Acoustic Surveys

Bat Activity

Bat activity was documented at two sampling stations within the Study Area for a total of 344 detector-nights between 11 May and 29 October 2018 (Table 2). Both sampling stations operated for 100% of the study period. Bat activity was slightly higher at ground sampling station BC1g than raised sampling station BC1r, with an overall average mean of 1.12 bat passes per detector-night for the entire study period (Table 2, Figure 3). The period of peak bat activity at the Project occurred from 5 September through 11 September 2018 (Figure 4).

Table 2. Results of bat acoustic surveys by sampling station conducted at the Badger Canyon Wind Project Study Area from 11 May – 29 October 2018. Passes are separated by call frequency: high frequency (HF) and low frequency (LF).

Detector Station	Type	Habitat	Number of HF Bat Passes	Number of LF Bat Passes	Total Bat Passes	Detector-Nights	Bat Passes/Night [*]
BC1g	ground	grassland	19	200	219	172	1.27 ± 0.16
BC1r	raised	grassland	5	160	165	172	0.96 ± 0.14
Total			24	360	384	344	1.12 ± 0.13

^{*} ± bootstrapped standard error.

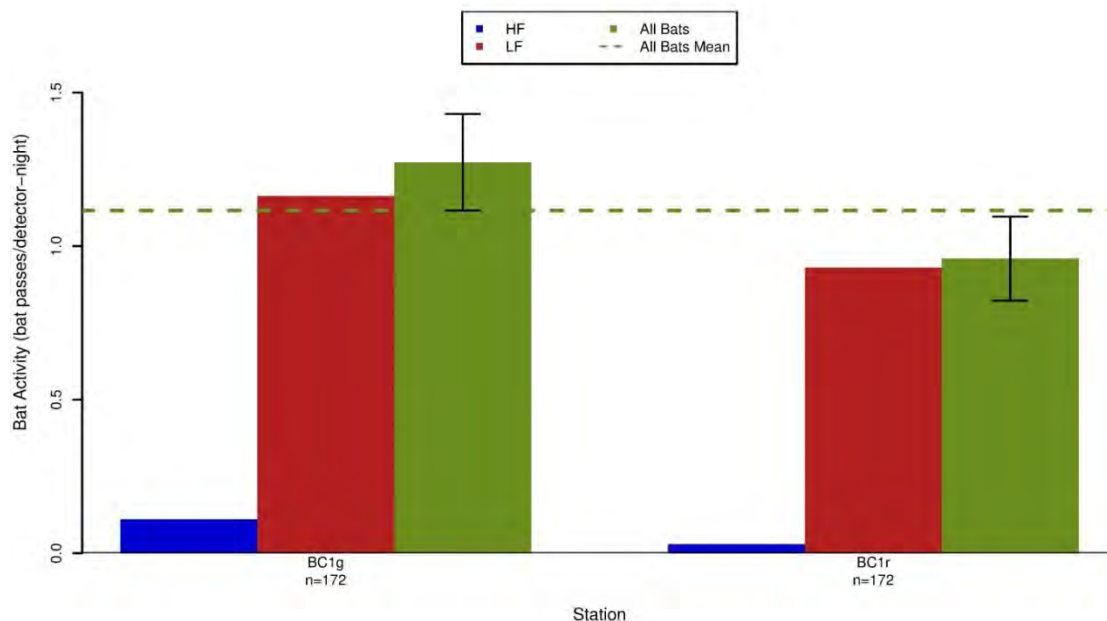


Figure 3. Bat passes per detector-night for high-frequency (HF), low-frequency (LF) and all bats recorded at the Badger Canyon Wind Project Study Area from 11 May – 29 October 2018. Bootstrapped standard errors are represented by black error bars on the ‘All Bats’ columns.

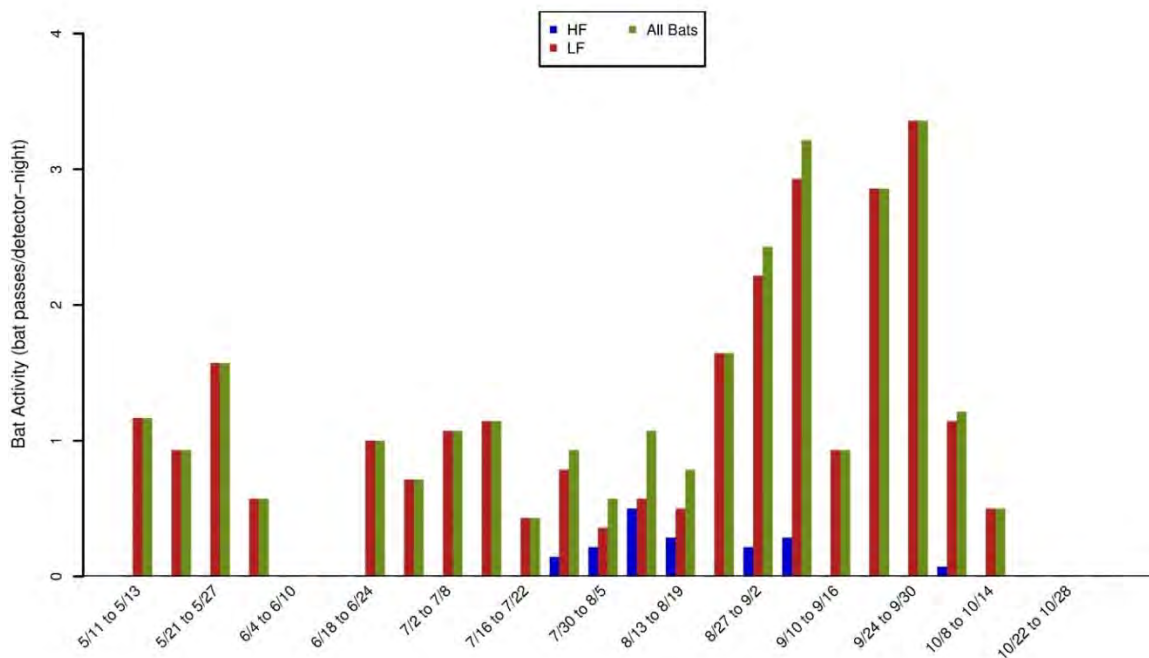


Figure 4. Weekly patterns of bat activity for high-frequency (HF), low-frequency (LF), and all bats at the Badger Canyon Wind Project Study Area from 11 May – 29 October 2018.

Species Composition

At both detector stations, approximately 93.7% of bat passes were classified as LF (e.g., big brown bat, hoary bat, silver-haired bat), and approximately 6.3% of bat passes were classified as HF (i.e., canyon bat, little brown bat; Table 3). Results from Kaleidoscope Pro automated call identification were reviewed by an experienced bat biologist: bat calls for five of the 12 species identified as having potential to occur within the Study Area were confirmed (Table 1; Table 3). Silver-haired bat was the primary species documented during the study period, detected on approximately 24% of detector-nights (Table 3). Hoary bat and big brown bat were the next most commonly detected species, occurring on approximately 14% and 6% of detector-nights, respectively (Table 3). Canyon bat was the most frequently detected HF bat, documented on approximately 3% of detector-nights; only two calls were confirmed from little brown bat during the study period (Table 3). Townsend's big-eared bat and pallid bat calls were not confirmed during the study period; no federal or state-listed bat species were detected.

Table 3. Nights (and percent) species present by sampling station at the Badger Canyon Wind Project Study Area from 11 May – 29 October 2018.

Common Name	BC1g*	BC1r*	Total*
High-Frequency (> 30 kHz)			
canyon bat	9 (5%)	0 (0%)	9 (3%)
little brown bat	2 (1%)	0 (0%)	2 (1%)
Low-Frequency (< 30 kHz)			
big brown bat	10 (6%)	9 (5%)	19 (6%)
hoary bat	23 (13%)	24 (14%)	47 (14%)
silver-haired bat	40 (23%)	41 (24%)	81 (24%)

*Nights species present

kHz = kilohertz

DISCUSSION AND RISK ASSESSMENT

Bat fatalities have been discovered at most monitored wind energy facilities in North America and globally (Arnett et al. 2016), with bat fatality rates in the US ranging from zero (Chatfield and Bay 2014) to 40.2 bats/megawatt (MW)/year (Hein et al. 2013b). In 2012, an estimated 600,000 bats died as a result of interactions with wind turbines in the US (Hayes 2013), and hoary bat population viability may be threatened by fatalities caused by wind turbines (Frick et al. 2017). Proximate causes of bat fatalities are primarily due to collisions with moving turbine blades (Grodsky et al. 2011, Rollins et al. 2012), but to a limited extent may also be caused by barotrauma (Baerwald et al. 2008). The underlying reasons bats approach wind turbines are still largely unknown (Cryan and Barclay 2009, Reimer et al. 2018).

Several key findings from the bat activity study at the Project are consistent with known patterns from other studies in the western US. First, the five bat species confirmed within the Study Area are known from throughout the region and the most commonly detected species (silver-haired and hoary bats) are migratory tree-roosting bats, a pattern consistent with known trends. Second, the period of peak activity during the study period occurred in the fall, consistent with

known patterns from the region and throughout the western US. Third, bat activity rates documented at the Project were relatively consistent with activity rates from the closest region with publicly available data (i.e., Rocky Mountains region).

Approximately 93% of bat passes recorded within the Study Area were produced by three LF bat species, silver-haired bat, hoary bat, and big brown bat, which were documented on 24%, 14% and 6% of detector-nights, respectively. Low-frequency bats, including silver-haired and hoary bats, are the most commonly reported fatalities at many wind energy facilities in the US (Arnett et al. 2008, Arnett and Baerwald 2013, Thompson et al. 2017). Given these results and trends seen elsewhere in the US, LF bats including silver-haired bat and hoary bat would likely have the highest risk of collision at the Project.

Bat activity within the Study Area peaked in early September, which is consistent with known patterns from the region and throughout the western US. During the fall, migratory bats may begin moving toward wintering areas, and many species initiate reproductive behaviors (Cryan 2008). This period of increased landscape-scale movement and reproductive behavior is often associated with increased levels of bat fatalities at operational wind energy facilities (Arnett et al. 2008; Arnett and Baerwald 2013, Thompson et al. 2017). If risk patterns at the Project are consistent with known trends, it is likely that most fatalities would occur during the fall.

Overall, bat activity within the Study Area (1.12 bat passes per detector-night), as well as the average bat activity at the ground sampling station (1.27 bat passes per detector-night), were well below the Rocky Mountains regional average of 4.02 bat passes per detector-night (Appendix A), which is the closest region with publicly available activity data (no activity data from the Pacific Northwest is available for comparison). Corresponding post-construction bat fatality rates for the Rocky Mountains region range from 1.05 to 11.42 bats/MW/year, with an average of 4.02 bats/MW/year (Appendix A). As the relationship between pre-construction activity rates and post-construction fatality rates has not been definitively established (Hein et al. 2013; see Risk Assessment in Methods section p. 6-7), fatality rates documented at other facilities in the Pacific Northwest, where a majority of wind energy facilities are located along the Columbia Plateau, were used to assess potential risk to bats at the Project. At these Pacific Northwest facilities, bat fatality rates have ranged from 0.12 to 4.23 bats/MW/year with an average fatality rate of 1.19 bats/MW/year (Appendix A), which is somewhat lower than that documented in the Rocky Mountains region. If risk patterns at the Project are similar to patterns elsewhere in the Pacific Northwest, it is likely that fatality rates at the Project would be similarly low.

CONCLUSION

To date, post-construction monitoring studies of wind energy facilities in North America show that: a) collision mortality is greatest for migratory tree-roosting species (e.g., hoary bat and silver-haired bat; Thompson et al. 2017), which make up approximately 78% of reported bat fatalities; b) the majority of fatalities occur during the fall migration season (Thompson et al. 2017); and c) most fatalities occur on nights with relatively low wind speeds (e.g., less than 6.0

m per second [19.7 ft per second]; Arnett et al. 2008, 2013; Arnett and Baerwald 2013). Finally, a recent meta-analysis suggests that bat mortality rates at wind facilities increase as relative grassland cover (or open cover) decreases (Thompson et al. 2017), suggesting that facilities or turbines in forested areas have higher fatality rates than facilities or turbines that lack surrounding tree cover. Given these trends and the results from the bat activity study at the Project Study Area in 2018, it is likely that bat mortality at the Project, once operational, would be: a) low, similar to other Pacific Northwest facilities; b) consist primarily of migratory, tree-roosting species (i.e., silver-haired bat, hoary bat); and c) occur mainly in the fall.

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Appendix A. Pacific Northwest and Rocky Mountain Fatality Summary Tables

Appendix A. Wind energy facilities in the Pacific Northwest and Rocky Mountains region of North America with comparable activity and fatality data for bats, separated by geographic region. Activity estimate given as bat passes per detector-night. Fatality estimate given as the number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Badger Canyon (2018)	1.12	5/11/18 – 10/29/18			
<i>Pacific Northwest</i>					
Mean	--		1.19	99	134.1
Palouse Wind, WA (2012-2013)			4.23	58	104.4
Biglow Canyon, OR (Phase II; 2009-2010)			2.71	65	150
Nine Canyon, WA (2002-2003)			2.47	37	48.1
Stateline, OR/WA (2003)			2.29	454	299
Elkhorn, OR (2010)			2.14	61	101
White Creek, WA (2007-2011)			2.04	89	204.7
Biglow Canyon, OR (Phase I; 2008)			1.99	76	125.4
Leaning Juniper, OR (2006-2008)			1.98	67	100.5
Big Horn, WA (2006-2007)			1.9	133	199.5
Combine Hills, OR (Phase I; 2004-2005)			1.88	41	41
Linden Ranch, WA (2010-2011)			1.68	25	50
Pebble Springs, OR (2009-2010)			1.55	47	98.7
Hopkins Ridge, WA (2008)			1.39	87	156.6
Harvest Wind, WA (2010-2012)			1.27	43	98.9
Elkhorn, OR (2008)			1.26	61	101
Vansycle, OR (1999)			1.12	38	24.9
Klondike III (Phase I), OR (2007-2009)			1.11	125	223.6
Stateline, OR/WA (2001-2002)			1.09	454	299
Stateline, OR/WA (2006)			0.95	454	299
Tuolumne (Windy Point I), WA (2009-2010)			0.94	62	136.6
Klondike, OR (2002-2003)			0.77	16	24
Combine Hills, OR (2011)			0.73	104	104
Hopkins Ridge, WA (2006)			0.63	83	150
Biglow Canyon, OR (Phase I; 2009)			0.58	76	125.4
Biglow Canyon, OR (Phase II; 2010-2011)			0.57	65	150
Hay Canyon, OR (2009-2010)			0.53	48	100.8
Windy Flats, WA (2010-2011)			0.41	114	262.2
Klondike II, OR (2005-2006)			0.41	50	75
Vantage, WA (2010-2011)			0.4	60	90
Wild Horse, WA (2007)			0.39	127	229
Goodnoe, WA (2009-2010)			0.34	47	94
Marengo II, WA (2009-2010)			0.27	39	70.2
Biglow Canyon, OR (Phase III; 2010-2011)			0.22	76	174.8
Marengo I, WA (2009-2010)			0.17	78	140.4
Klondike IIIa (Phase II), OR (2008-2010)			0.14	51	76.5
Kittitas Valley, WA (2011-2012)			0.12	48	100.8
<i>Rocky Mountains</i>					
Mean	4.02		4.90	70	85.0
Summerview, Alb (2006; 2007)	7.65 ^A	07/15/06-07-09/30/06-07	11.42	39	70.2
Summerview, Alb (2005-2006)			10.27	39	70.2
Judith Gap, MT (2006-2007)			8.93	90	135

Appendix A. Wind energy facilities in the Pacific Northwest and Rocky Mountains region of North America with comparable activity and fatality data for bats, separated by geographic region. Activity estimate given as bat passes per detector-night. Fatality estimate given as the number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Foot Creek Rim, WY (Phase I; 1999)			3.97	69	41.4
Judith Gap, MT (2009)			3.2	90	135
Milford I, UT (2010-2011)			2.05	58	145
					160.5
					(58.5
Milford I & II, UT (2011-2012)			1.67	107	Phase I, 102
					Phase II)
Foot Creek Rim, WY (Phase I; 2001-2002)	2.2 ^{A,B}	6/15/01-9/1/01	1.57	69	41.4
Foot Creek Rim, WY (Phase I; 2000)	2.2 ^{A,B}	6/15/00-9/1/00	1.05	69	41.4

A = Activity rate was averaged across phases and/or years

B = Activity rate calculated by WEST from data presented in referenced report

Appendix A (continued). Wind energy facilities in the Pacific Northwest and Rocky Mountain regions of North America with comparable activity and fatality data for bats. Data from the following sources:

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
Big Horn, WA (06-07)		Kronner et al. 2008	Klondike III (Phase I), OR (07-09)		Gritski et al. 2010
Biglow Canyon, OR (Phase I; 08)		Jeffrey et al. 2009b	Klondike IIIa (Phase II), OR (08-10)		Gritski et al. 2011
Biglow Canyon, OR (Phase I; 09)		Enk et al. 2010	Leaning Juniper, OR (06-08)		Gritski et al. 2008
Biglow Canyon, OR (Phase II; 09-10)		Enk et al. 2011b	Linden Ranch, WA (2010-2011)		Enz and Bay 2011
Biglow Canyon, OR (Phase II; 10-11)		Enk et al. 2012b	Marengo I, WA (2009-2010)		URS Corporation 2010b
Biglow Canyon, OR (Phase III; 10-11)		Enk et al. 2012a	Marengo II, WA (2009-2010)		URS Corporation 2010c
Combine Hills, OR (Phase I; 04-05)		Young et al. 2006	Milford I & II, UT (2011-2012)		Stantec 2011b
Combine Hills, OR (11)		Enz et al. 2012	Milford I, UT (2010-2011)		Stantec 2012b
Elkhorn, OR (08)		Jeffrey et al. 2009a	Nine Canyon, WA (2002-2003)		Erickson et al. 2003
Elkhorn, OR (10)		Enk et al. 2011a	Palouse Wind, WA (12-13)		Stantec 2013a
Foot Creek Rim, WY (Phase I; 99)		Young et al. 2003a	Pebble Springs, OR (09-10)		Gritski and Kronner 2010b
Foot Creek Rim, WY (Phase I; 00)	Gruver 2002	Young et al. 2003a, 2003b	Stateline, OR/WA (01-02)		Erickson et al. 2004
Foot Creek Rim, WY (Phase I; 01-02)		Young et al. 2003a, 2003b	Stateline, OR/WA (03)		Erickson et al. 2004
Goodnoe, WA (09-10)		URS Corporation 2010a	Stateline, OR/WA (06)		Erickson et al. 2007
Harvest Wind, WA (10-12)		Downes and Gritski 2012a	Summerview, Alb (05-06)		Brown and Hamilton 2006
Hay Canyon, OR (09-10)		Gritski and Kronner 2010a	Summerview, Alb (06; 07)	Baerwald 2008	Baerwald 2008
Hopkins Ridge, WA (06)		Young et al. 2007	Tuolumne (Windy Point I), WA (09-10)		Enz and Bay 2010
Hopkins Ridge, WA (08)		Young et al. 2009b	Vansycle, OR (99)		Erickson et al. 2000
Judith Gap, MT (06-07)		TRC 2008	Vantage, WA (10-11)		Ventus 2012
Judith Gap, MT (09)		Poultton and Erickson 2010	White Creek, WA (07-11)		Downes and Gritski 2012b
Kittitas Valley, WA (11-12)		Stantec Consulting Services 2012	Wild Horse, WA (07)		Erickson et al. 2008
Klondike, OR (02-03)		Johnson et al. 2003	Windy Flats, WA (10-11)		Enz et al. 2011
Klondike II, OR (05-06)		NWC and WEST 2007			

SITE CHARACTERIZATION STUDY REPORT

Four Mile Wind Project Benton County, Washington



Prepared for:

Four Mile MW LLC

Prepared by:

Andrea Chatfield and Joel Thompson

Western Ecosystems Technology, Inc.
2725 NW Walnut Boulevard
Corvallis, Oregon 97330

March 2018



EXECUTIVE SUMMARY

The proposed Four Mile Wind Project (Project) includes an area of approximately 35,186 acres (54.98 square miles) of private land in Benton County, Washington. Wpd Wind Projects, Inc. is proposing to develop this area under the auspices of a wholly-owned subsidiary, Four MW, LLC. This Site Characterization Study (SCS) is intended to fulfill the tasks described in the US Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (WEG) for Tier 2 site characterization and the USFWS Eagle Conservation Plan Guidance (ECPG) for Stage 1 site assessment, and guide formulation of focused field surveys for the Project. Specifically, the information contained herein reflects a desktop analysis of publicly available information that pertains to plants, animals, and habitat features that may be important considerations during Project planning and development. Environmental resources within the Project boundary (Project area) were examined through a search of existing data. In addition, an initial reconnaissance-level site visit was conducted in December 2017, to provide additional cursory, baseline information on landscape and habitat features potentially important during Project development.

The dominant land cover types within the Project are cultivated dry land wheat farming and shrub/scrub, together comprising over 95% of the Project area. No special status (state and/or federal listed or rare) plant species are known to occur within five miles of the Project; however, one rare and/or high quality plant community has been documented in the region but is not likely to occur within the Project boundary. Four Washington Department of Fish and Wildlife (WDFW) Priority Habitats/Habitat Features (emergent wetland, forest/shrub wetland, shrub-steppe, and cliff/bluff) have also been identified in the Project or surrounding area.

There are 15 diurnal raptor species and seven owl species that may occur in or near the Project area at some point during the year. Of the raptor species with potential to occur within the Project area, one species is state threatened (ferruginous hawk), two species are State candidates for listing (golden eagle and burrowing owl), and two species are state Priority Species (bald eagle and prairie falcon). Nesting habitat for tree-nesting raptor species (e.g., Swainson's hawk, red-tailed hawk, great horned owl) is present in scattered, isolated trees within the Project area and surrounding region, while ground-nesting species (e.g., burrowing owl, northern harrier, short-eared owl) have the potential to nest throughout the Project, and cliffs and cut banks to the north and east of the Project provide nesting substrate for species such as ferruginous hawk and barn owl.

Sixteen bat species have the potential to occur in and around the Project, with eight species having an approximate range and habitat requirements that overlap the Project area. The only listed or candidate bat species in Washington are Townsend's big-eared bat and Keen's myotis, both of which are State candidates for listing; however, Keen's myotis occupy only the extreme northwestern corner of the state and Townsend's big-eared bats are unlikely to occur within the Project due to a general lack of roosting and hibernating sites.

Three wildlife species listed as state threatened or endangered by the WDFW have at least some potential to occur within the Project: American white pelican, ferruginous hawk, and sandhill crane. An additional 12 species (six birds, four mammals, and two reptiles) are considered State candidates for listing. No species currently listed, or candidates for listing, under the USFWS Endangered Species Act have the potential to occur within the Project.

Based on this SCS, significant adverse impacts to special status species are not anticipated; however, due to the potential for occurrence of some sensitive wildlife and plant species/communities within the Project area, it is recommended that Tier 3 site-specific studies be conducted to further refine risk assessments for these species. The following Tier 3 studies are recommended prior to construction in order to more clearly assess the potential risk to sensitive plants and wildlife: vegetation/land cover mapping, year-round large bird/eagle use surveys, small bird use surveys, raptor nest surveys with particular emphasis on bald and golden eagles, bat acoustic surveys, and threatened, endangered and sensitive species surveys.

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INTRODUCTION

Many wind energy developers now choose to utilize the US Fish and Wildlife Service (USFWS) voluntary wind project development guidelines, which provide a template for a tiered planning process when exploring a potential wind energy project. The Land-based Wind Energy Guidelines (WEG; USFWS 2012) are intended to function in concert with the USFWS Eagle Conservation Plan Guidance (ECPG; USFWS 2013), and promote intentional tiered project development which strategically assesses and minimizes impacts to wildlife. This tiered approach includes: Tier 1 - Preliminary Site Evaluation; Tier 2 - Site Characterization; Tier 3 - Field Studies to Document Site Wildlife and Habitat and Predict Project Impacts; Tier 4 - Post-construction Studies to Document Impacts; Tier 5 - Other Post-construction Studies. Wpd Wind Project, Inc., operating under the auspices of Four Mile MW LLC, contracted Western EcoSystems Technology, Inc. (WEST) to develop a Tier 2 Site Characterization Study (SCS) for the proposed Four Mile Wind Project (Project). The overall purpose of the SCS is to identify the biotic and abiotic environmental characteristics of the Project, evaluate potential impacts to these resources from wind energy development, and determine what additional environmental resource surveys are warranted. Identification of resource issues early in the planning process allows developers of wind energy facilities to identify, avoid, and minimize future problems which may occur. The SCS will be used to guide the Tier 3 field studies necessary to evaluate identified resources of concern within the Project.

STUDY AREA

Regional Setting

The Project lies within the semi-arid Columbia Plateau Ecological region, which encompasses a large portion of south central Washington (Washington Biodiversity Council 2008). The Columbia Plateau tilts upward and southward into the Great Basin of eastern Oregon, western Idaho, and northern Nevada, and is bordered by the Cascades to the west, the Okanogan Highlands to the north, the Rockies to the east, and the Blue Mountains to the southeast. The Columbia and Snake rivers are the dominant topographic features of the Columbia Plateau; in Washington, the plateau is bisected by the Columbia River. Today, the areas with suitable soil are used for agriculture; crops include wheat (*Triticum* spp.), alfalfa (*Medicago sativa*), potatoes (*Solanum tuberosum*), grass hay, and vineyards. Other areas within the region are used for cattle grazing. In the Yakima Valley to the north and the Columbia Basin to the south, irrigated agriculture is prevalent and includes pastures, orchards, and vineyards. Hops (*Humulus lupulus*) and field crops are also commonly grown. In un-cultivated areas, this ecoregion is characterized by arid sagebrush- (*Artemisia* spp.) steppe and grassland. The regional climate can be typified as arid to semiarid with low precipitation, warm to hot dry summer, and relatively cold winters (Franklin 1973). Mean annual temperature in the region is 59° Fahrenheit (15° Celsius), with mean annual precipitation of 10 inches (25 centimeters; Franklin and Dryness 1973, Daly 2000).

Over the last two decades, the Columbia Plateau Ecoregion of eastern Washington and Oregon has experienced extensive wind energy development. In Washington alone, there are currently 20 operating wind energy facilities with a total installed capacity of 3,075 megawatts (MW), the majority of which are located in the Columbia Plateau (AWEA 2017). In Benton County, where the proposed Project is located, there is currently only one operating facility, the 96-MW Nine Canyon wind energy facility, located immediately adjacent to the northern boundary of the Project (Figure 3). Located just four mi (6.4 km) to the southeast of the Project, is the 300-MW Stateline wind energy facility in Walla Walla County, Washington and Umatilla County, Oregon.

Project Area

The proposed Project area encompasses approximately 35,186 acres (ac; 54.98 square miles [mi²]; Project area) within Benton County in southeastern Washington, approximately seven miles (mi; 11.3 kilometers [km]) south of the city of Kennewick (Figure 1). Topography within the Project area generally consists of rolling hills bisected by meandering canyons that drain primarily to the south into the Columbia River. Elevations within the Project range from 117 m (384 ft) along the eastern boundary of the Project to 624 m (2,047 ft) in the central portion of the Project (Figure 2). The eastern boundary of the Project lies adjacent to the Columbia River as it bends around the Project area from the north to the southwest (Figure 1). The original vegetation of the Project area was a bluebunch wheatgrass (*Pseudoroegneria spicata*)-Idaho fescue (*Festuca idahoensis*) zonal association, which was predominately grassland and shrub-steppe with deciduous riparian forest and scrub along drainages (Franklin and Dyrness 1973). Today, agriculture and livestock grazing have converted the area to a mosaic of cultivated wheat fields, grazed shrub-steppe, and Conservation Reserve Program (CRV) grasslands (Figure 3). A network of county and a few private roads traverse the Project area. Representative photos of the land cover types and landscape features within the Project area are included in Appendix A.

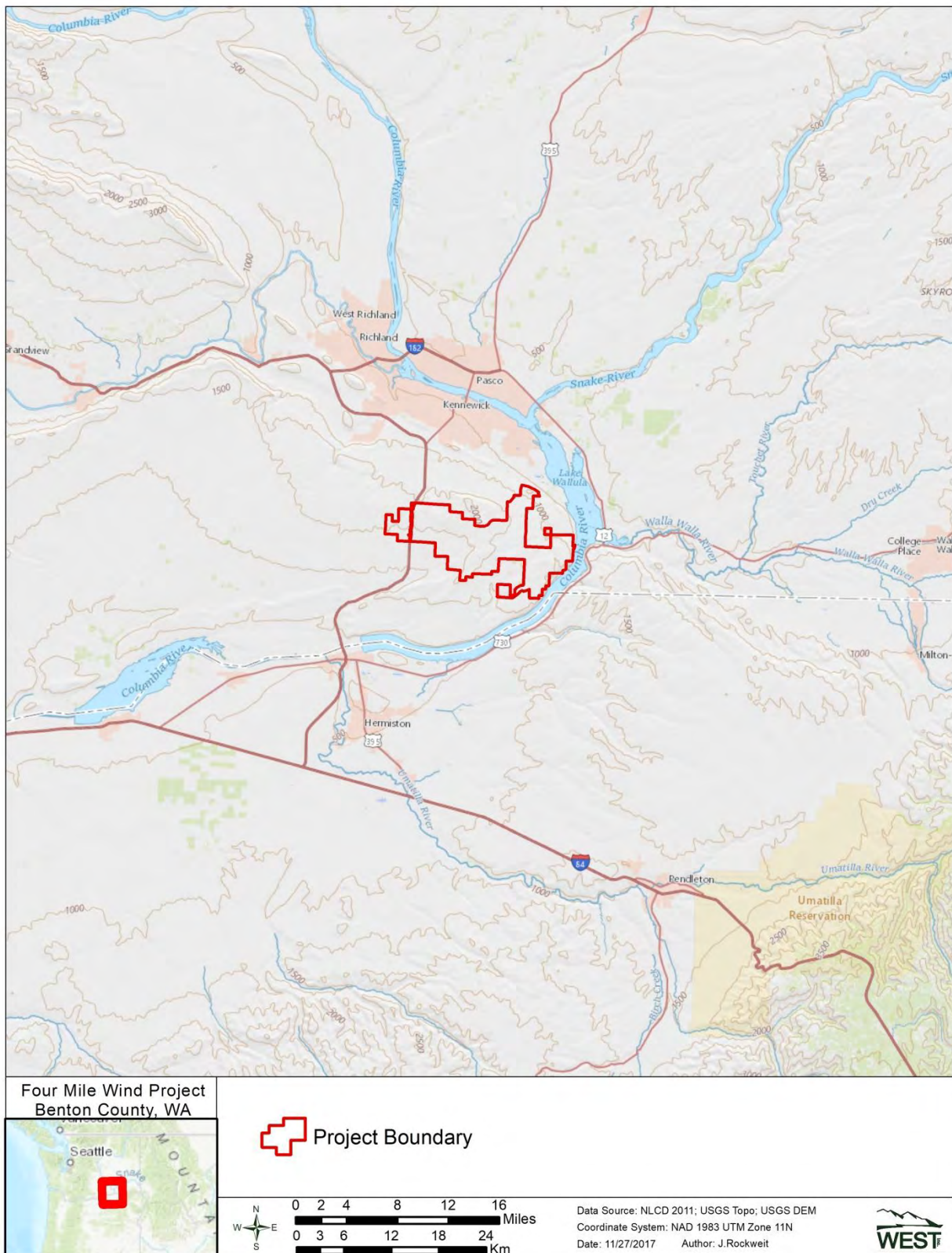


Figure 1. Location of the Four Mile Wind Project, Benton County, Washington.

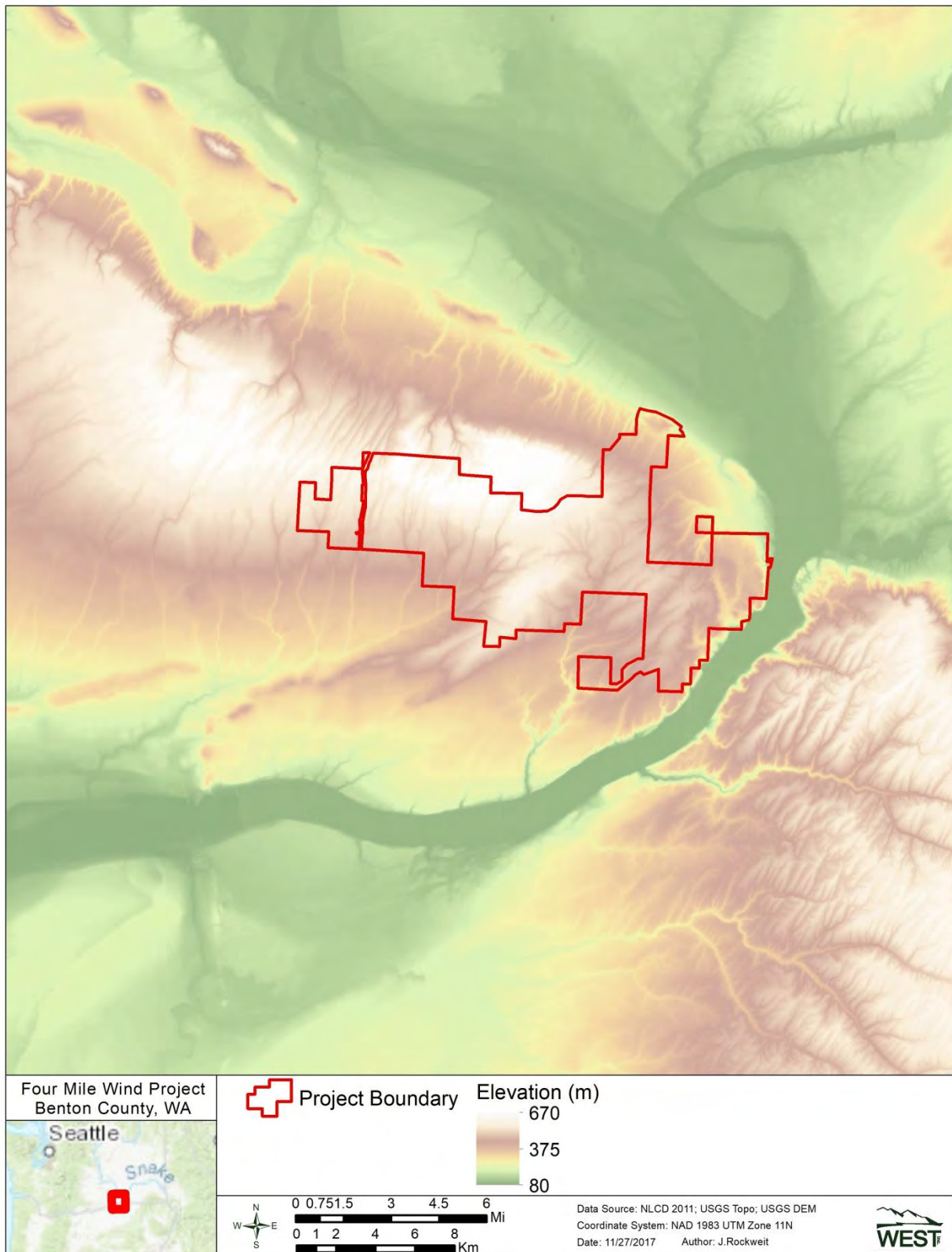


Figure 2. Digital elevation model of the Four Mile Wind Project area.

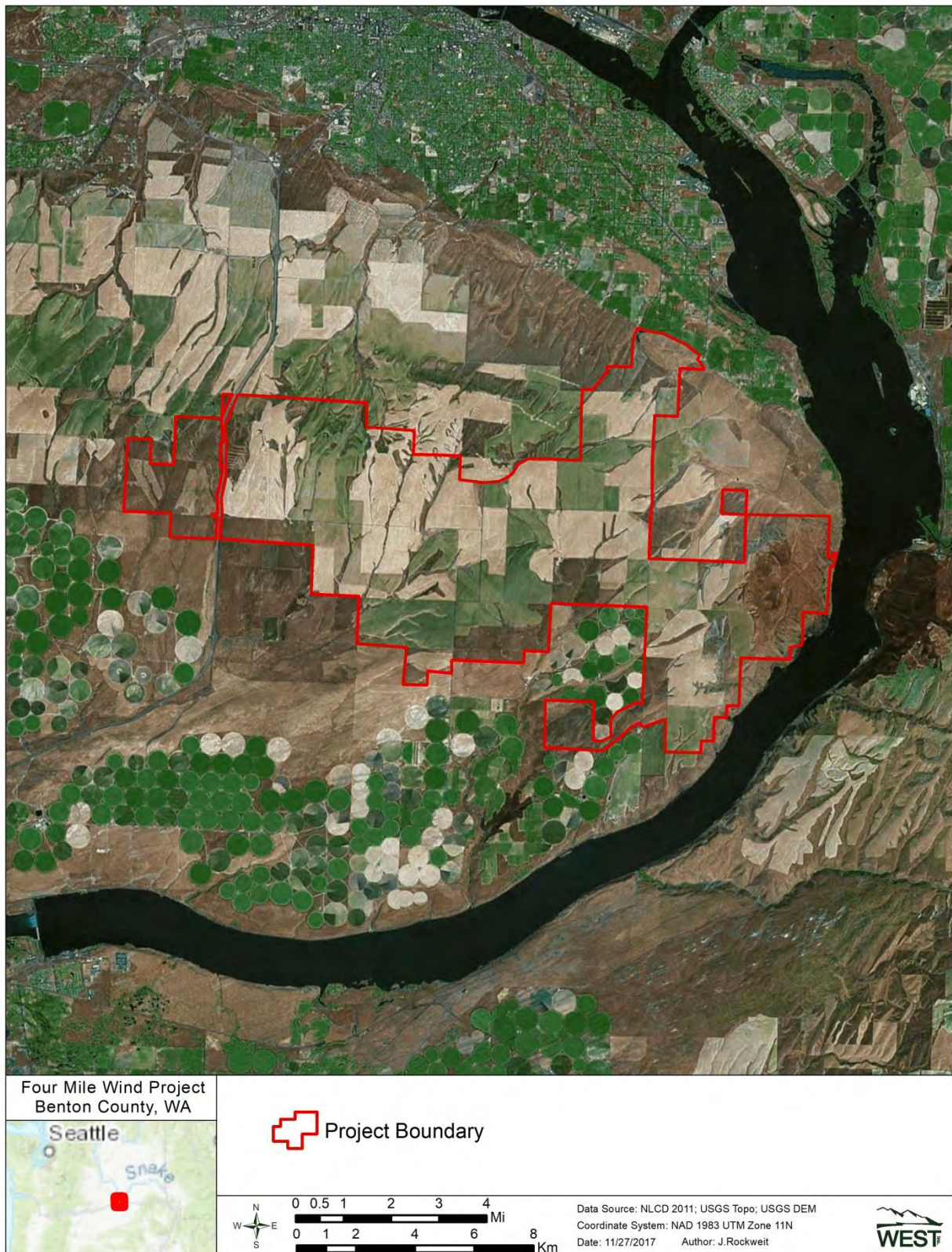


Figure 3. Aerial photograph of the Four Mile Wind Project area.

METHODS

Environmental resources within the Project and surrounding area were examined through a search of existing publicly available data and an initial reconnaissance-level site visit. The initial site visit occurred on December 11-12, 2017 and entailed a preliminary examination of the area from accessible public and private roads. Biological features and potential wildlife habitat assessed during the site visit included plant communities and wetlands, topographic and geological features, potential raptor nesting habitat, habitat for prey populations, and potential bat roosting and foraging habitat. Photographs of the Project area are presented in Appendix A.

Published literature, field guides, and public data sets were among the resources reviewed to identify known environmental resources within the Project area and surrounding region. The information presented in this analysis was obtained from the following sources:

- Bat Conservation International (BCI) species accounts and range maps (BCI 2017);
- List of Important Bird Areas (IBAs) by the National Audubon Society (Audubon 2017 2017);
- Priority Habitats and Species (PHS) database, maintained by the Washington Department of Fish and Wildlife (WDFW; 2017a);
- Published or available literature regarding wind-energy impacts to wildlife, with an emphasis on projects in the Columbia Plateau Ecoregion;
- Published literature, WDFW species status reports, and other publically-available information on the life history and range for special status species;
- State or federally protected nature preserves and lands protected by The Nature Conservancy (US Geological Survey [USGS] 2017a; The Nature Conservancy 2017);
- TNC and American Wind Wildlife Institute's (AWWI) Wind and Wildlife Landscape Assessment Tool (AWWI 2017);
- US Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) data (USDA Natural Resource Conservation Service [NRCS] 2017);
- USFWS Critical Habitat designations (USFWS 2016);
- USFWS National Wetland Inventory (NWI) data (USFWS NWI 2016);
- USFWS county-level species occurrence information (USFWS 2017);
- USGS National Land Cover Dataset (NLCD; USGS NLCD 2011);
- USGS topographic maps and digital elevation data (USGS 2017, USGS DEM 2016);
- Washington Natural Heritage Program (WNHP) spatial dataset of rare or at-risk plants and plant communities (WNHP 2017b);
- Washington State Species of Concern Lists, maintained by the WDFW (2017b); and

- WNHP online *Field Guide to the Rare Plants of Washington* (WNHP 2017a).

WEST determined the likelihood a sensitive animal or plant species may occur within the Project by considering the species' range, habitat suitability within the Project, species' mobility, population size, and records of occurrence within or adjacent to the Project. A similar assessment was made for sensitive plant communities and habitats. Based on these factors, the likelihood of occurrence was defined for each sensitive species/community using the following categories:

- None – Project outside the species known range, no suitable habitat within the Project, restricted mobility and small population size.
- Unlikely – Project outside the species known range and suitable habitat appears absent within the Project; however, due to the species mobility and population size, species may occur within the Project during migration or other times of the year.
- Possible – Project is located within the range of the species but contains marginal suitable habitat; species highly mobile and may occur year-round.
- Likely – Project is located within the range of the species and contains suitable habitat; records of species occurrence in the surrounding area but absent from the Project.
- Occurs – Records of species occurrence within the Project based on PHS and/or WNHP data or other survey data.

LAND COVER AND HABITATS

Land Use/Land Cover

The proposed Project area encompasses 35,185.89 ac (54.98 mi²). According to the USGS NLCD (2011; Homer et al. 2015), the dominant cover types within the Project area are cultivated cropland (18,997.53 ac [29.68 mi²]) and shrub/scrub (14,480.68 ac [22.63 mi²]) which cover 54.0% and 41.2% of the Project, respectively (Table 1; Figure 4). Much smaller areas of grassland/herbaceous cover types are present in the Project area (1,226.30 ac [1.92 mi²]), primarily in the eastern most portion of the Project, and comprise an additional 3.5% of the total Project acreage (Table 1; Figure 4). The remaining 1.3% of the Project is comprised of small amounts of developed areas (primarily roads; 474.41 ac [0.74 mi²]), open water (6.74 ac [0.01 mi²]), and woody wetlands (0.14 ac [< 0.01 mi²]; Table 1; Figure 4).

Table 1. Land use and habitat types present within the Four Mile Wind Project.

Cover Type	Acres	Percent Composition (%)
Cultivated Crops	18,997.63	54.0
Shrub/scrub	14,480.68	41.2
Grassland/Herbaceous	1,226.30	3.5
Developed, Open Space	453.35	1.3
Developed, Low Intensity	20.76	0.1
Open Water	6.74	< 0.1
Developed, Medium Intensity	0.30	< 0.1
Woody Wetlands	0.14	< 0.1
Total	35,185.89	100

Data obtained from USGS NLCD, compiled from satellite imagery (USGS NLCD 2011; Homer et al. 2015).

Wetlands and Riparian Areas

Digital NWI data (USFWS NWI 2016) are available for the Project area; however, formal wetland delineations have not been completed. According to the NWI, 0.8% of the Project area (279.43 ac [0.44 mi²]) is composed of wetland habitat, all of which is classified as riverine (Figure 5). While no larger rivers or streams are present within the Project area, The Columbia River wraps around the Project area with the eastern boundary of the Project lying adjacent to the River (Figure 5). A network of meandering shallow canyons with ephemeral water flow traverse the Project area, ultimately draining into the Columbia River to the north, east and south (Figure 5).

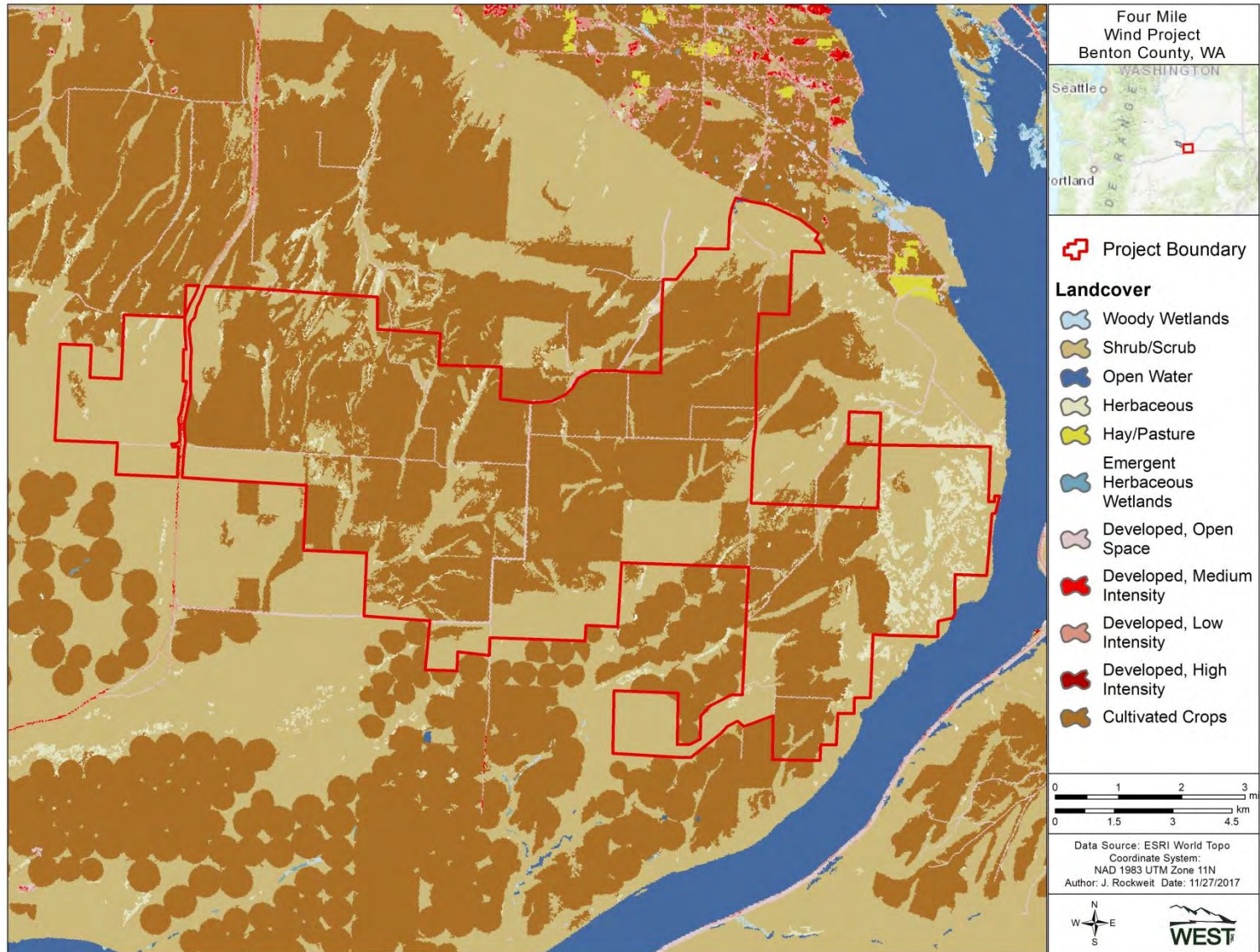


Figure 4. Land cover within the Four Mile Wind Project (USGS NLCD 2011; Homer et al. 2015).

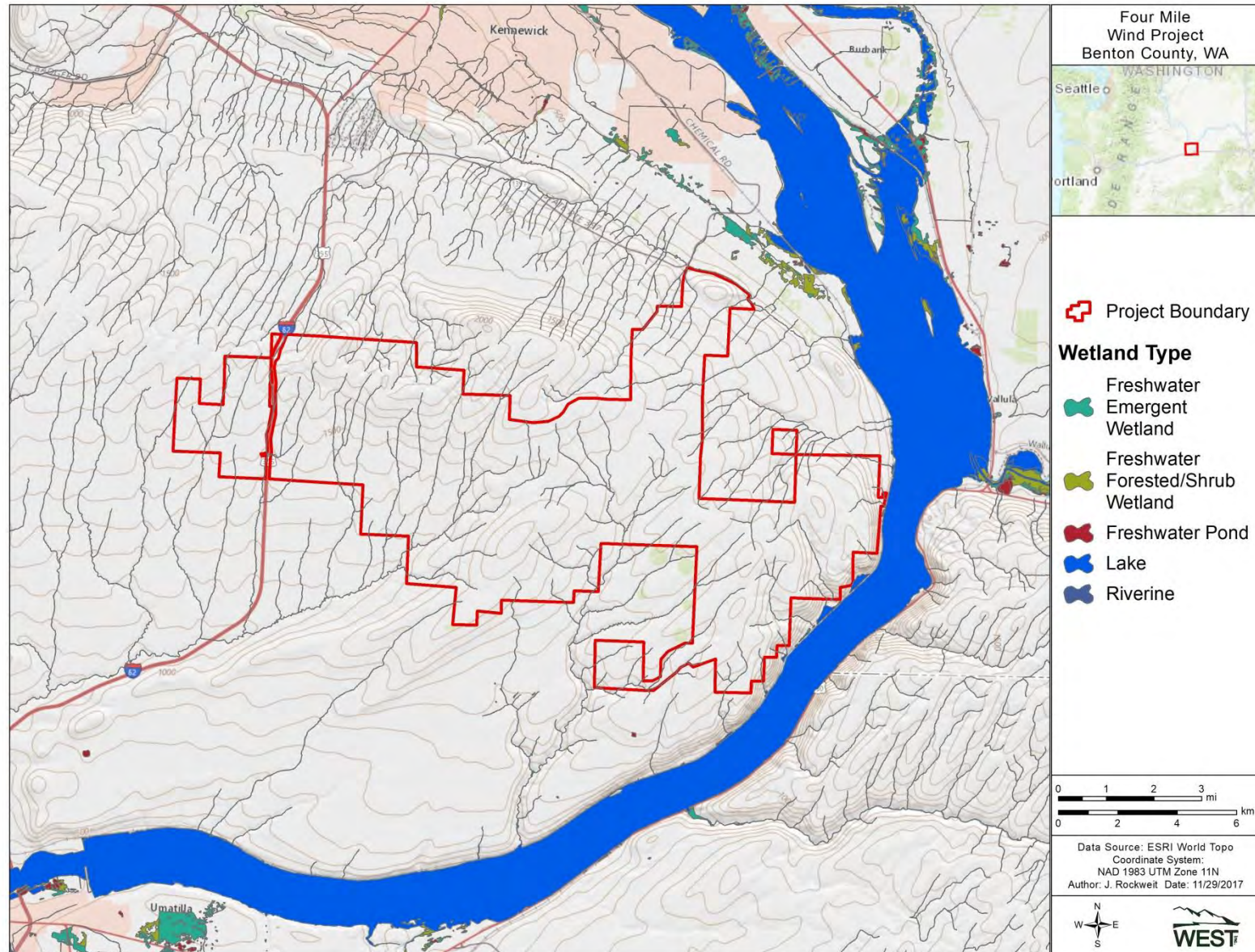


Figure 5. National Wetland Inventory map of the Four Mile Wind Project (USFWS NWI 2016).

Priority Habitats

The PHS List, maintained by the WDFW, is a catalog of habitats, habitat features and species considered to be priorities for conservation and management. Priority habitats are habitat types or elements with unique or significant value to a diverse assemblage of species. The PHS online database identified four Priority Habitats occurring within three mi (4.8 km) of the Project: freshwater emergent wetland, freshwater forested shrub, shrub-steppe, and cliffs/bluffs (Table 2; WDFW 2017a).

Table 2. Priority habitats occurring in the vicinity of the Four Mile Wind Project.

Habitat/Habitat Feature	Description	Potential for Occurrence in the Project area
Freshwater emergent wetland	Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water (WDFW 2008).	Possible. Small emergent wetlands documented within agricultural lands immediately to south of Project, as well as areas to the east and north (WDFW 2017a); some potential for small wetlands to occur in Project.
Freshwater forested shrub	Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water (WDFW 2008). Characterized by presence of trees and/or shrubs.	Unlikely. Small areas of forested/shrub wetland, associated with Columbia River, to north and east of Project, (WDFW 2017a); not likely to occur within Project area.
Shrub-steppe	Non-forested vegetation type consisting of one or more layers of perennial bunchgrasses and a conspicuous but discontinuous layer of shrub (WDFW 2008).	Present. Majority of Project is cultivated cropland and grazed shrubland; however, shrub-steppe has been documented in eastern portion of the Project and along several larger drainages within Projects (WDFW 2017a).
Cliff/bluffs	Characterized by land/rock that is greater than 25 feet high and occurs below 5,000 feet elevation (WDFW 2008).	Unlikely. Cliffs and bluffs do not appear to be present within Project area; however, they are documented along the Columbia River immediately to east and southeast of the Project (WDFW 2017a)

Data obtained from WDFW 2017a

Rare Plants and Plant Communities

The Washington Natural Heritage Program (WNHP) maintains a database containing information on the location of federal and/or state listed and rare plants and rare and/or high quality plant communities across the state (WNHP 2017b). According to a search of the online database no special status (state and/or federal listed or rare) plant species are known to occur within five miles of the Project. The WHNP does list a single rare and/or high quality plant community as occurring within five miles of the Project: Wyoming big sagebrush (*A. t. wyomingensis*)/bluebunch wheatgrass (Figure 6). This plant community has been identified in shrub-steppe habitat occurring within one mi (1.6 km) of the northern boundary of the Project

(Figure 6). It should be noted, however, that the WNHP dataset represents an ongoing and incomplete inventory of Washington's rare plants and ecosystems and does not preclude the need for field surveys. Due to the current agricultural land uses within the Project, native shrub-steppe habitat with the potential to support rare/high quality plant communities is unlikely to occur; however, vegetation and land cover mapping following WDFW habitat classification standards and consistent with the Washington Wind Power Guidelines (WDFW 2009) should be conducted to refine habitats present with the Project area and the potential for rare or sensitive plant species and communities.

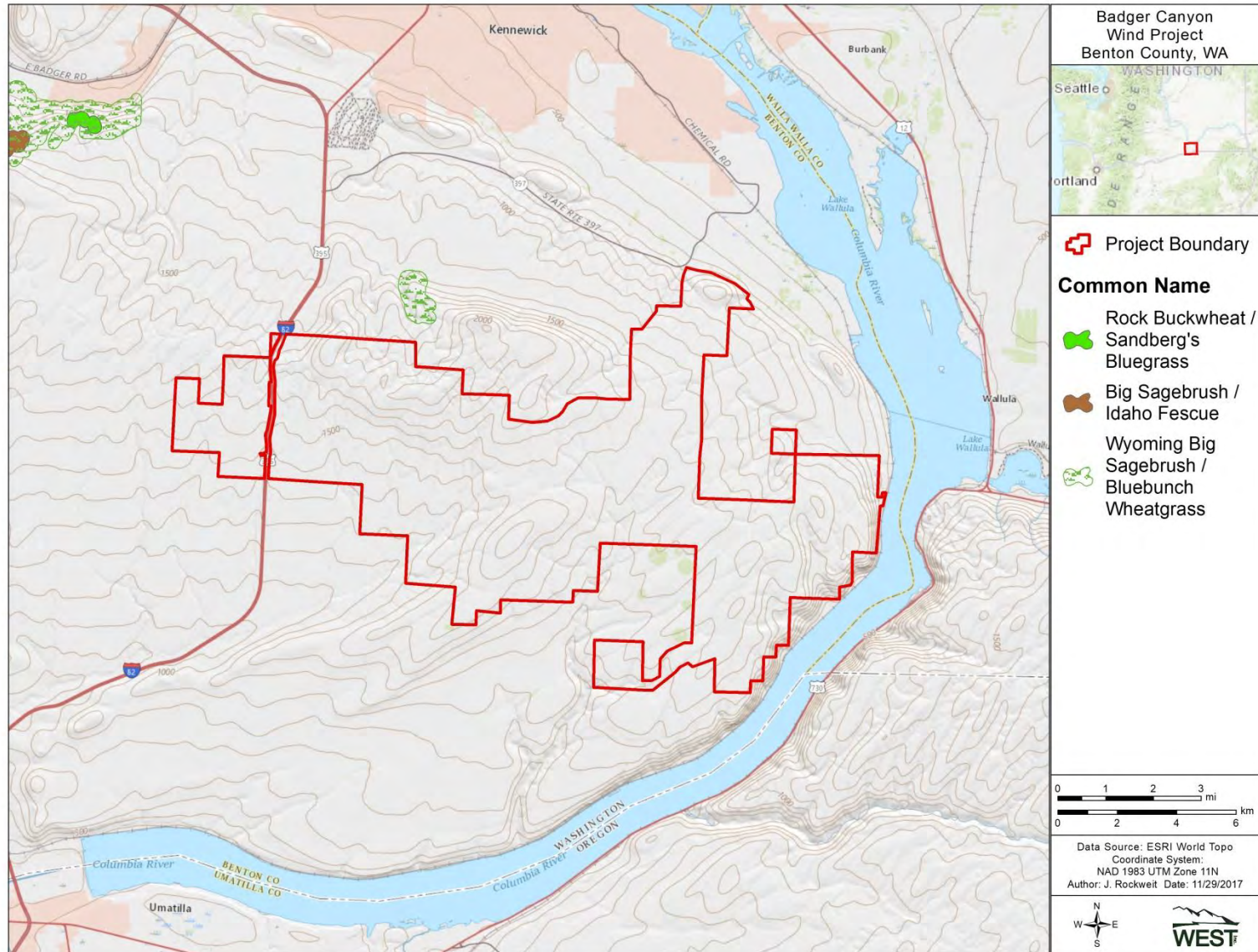


Figure 6. Known locations of rare plants and plant communities in the vicinity of the Four Mile Wind Project. Data from the Washington Natural Heritage Program (WNHP; 2017b).

WILDLIFE RESOURCES

Federal and State Listed Species

Based on review of State and federal special-status species lists and occurrence information (USFWS 2017, WDFW 2017a, WDFW 2017b), no wildlife species currently listed, or candidates for listing, under the USFWS Endangered Species Act (ESA) have the potential to occur within the Project. However, 16 State-listed or candidate wildlife species have at least some potential to occur in the Project, including ten bird species, four mammal species, and two reptile species (Table 3). Also included in the list are WDFW Priority Species (five birds and two mammals) which have been identified as priorities for conservation and management and are known to occur in the region (WDFW 2017a; Table 3). Additionally, while the bald eagle (*Haliaeetus leucocephalus*) is no longer a federal or State threatened species, it is included in the list as it is protected, along with the golden eagle, under the federal Bald and Golden Eagle Protection Act (BGEPA 1940). Impacts to eagles are of particular concern at wind energy facilities nation-wide and are discussed in greater detail in the sections below.

Of the 18 special-status species with potential to occur in the Project, six species (burrowing owl [*Athene cunicularia*], ferruginous hawk [*Buteo regalis*], loggerhead shrike [*Lanius ludovicianus*], prairie falcon [*Falco mexicanus*], sagebrush sparrow [*Artemisiospiza nevadensis*], and Townsend's ground squirrel [*Urocitellus townsendii townsendii*]) have been documented as occurring within two miles of the Project (WDFW 2017a). An additional nine species are likely or have potential to occur in the Project: American white pelican (*Pelecanus erythrorhynchos*), bald eagle, golden eagle (*Aquila chrysaetos*), sandhill crane (*Grus canadensis*), Vaux swift (*Chaetura vauxi*), black-tailed jackrabbit (*Lepus californicus*), white-tailed jackrabbit (*L. townsendii*), sagebrush lizard (*Sceloporus graciosus*), and striped whipsnake (*Masticophis taeniatus*). The remaining three species are unlikely to occur: greater sage grouse (*Centrocercus urophasianus*), sage thrasher (*Oreoscoptes montanus*), and Townsend's big-eared bat (*Corynorhinus townsendii*). General habitat requirements and the potential for occurrence for each of these species is presented below in Table 3.

Table 3. State and/or federal listed or candidate wildlife species, or state Priority Species, with potential to occur within the Four Mile Project

Species	Status	Habitat	Potential for Occurrence in the Project area
Birds			
American white pelican <i>Pelecanus erythrorhynchos</i>	ST	Breeds primarily on isolated islands in freshwater lakes and forages in shallow areas (Stinson 2016). Nests on Columbia River dredge islands near the Tri-Cities (Stinson 2016).	Possible. Suitable habitat not present within Project but may fly over area between foraging areas; known to nest on Badger Island approximately four miles east of the Project (Stinson 2016), and known to occur in Walla Walla River Delta IBA 2 miles east of Project (Audubon 2017).
Bald eagle <i>Haliaeetus leucocephalus</i>	BGEPA, PS	Nests in trees or cliffs near water, typically along shorelines, lakes, reservoirs, and rivers; feeds on fish and carrion.	Likely. Uncommon year-round visitor to area; known to nest along Columbia River to the east and north of Project.
Burrowing owl <i>Athene cunicularia</i>	SC, PS	Occurs in open areas; nests in burrows dug by badgers or other mammals; feeds on insects, small rodents, lizards, frogs, and small birds.	Possible. Common resident of Tri-Cities area from mid-April to early September (Ennor 1991); numerous documented breeding locations within several miles of the Project (WDFW 2017a); foraging and nesting habitat present throughout Project area.
Ferruginous hawk <i>Buteo regalis</i>	ST, PS	Occurs in open prairie habitat and commonly feeds on ground squirrels, rabbits, and hares; nests in trees, cut banks, cliffs, and rocky pinnacles (Ennor 1991)	Likely. Common in Tri-Cities area during breeding season; numerous nest sites documented within several miles of the Project, particularly along [REDACTED] 13 [REDACTED] of Project (WDFW 2017a).
Golden eagle <i>Aquila chrysaetos</i>	SC, BGEPA	Breeds in hilly or mountainous areas, nests on rocky cliffs or isolated large trees. Common prey species include ground squirrels, marmots, rabbits, and hares.	Present. While not known to nest in Benton County, may occur as uncommon visitor to area, particularly during spring and fall migration (Hayes 2013). Observed within Project during December site visit.
Loggerhead shrike <i>Lanius ludovicianus</i>	SC	Uses open habitats with scattered shrubs; typically nests in mature sagebrush habitat; feeds on insects, small mammals, birds, reptiles, and amphibians.	Likely. Documented at several locations to the north of the Project (WDFW 2017a); nesting and foraging habitat present, particularly in shrub-steppe habitat in east of Project, but also in agricultural areas throughout site.

Table 3. State and/or federal listed or candidate wildlife species, or state Priority Species, with potential to occur within the Four Mile Project

Species	Status	Habitat	Potential for Occurrence in the Project area
Prairie falcon <i>Falco mexicanus</i>	PS	Inhabits arid environments of eastern Washington and nests on cliffs usually associated with native steppe and shrub-steppe habitats. Known to breed in most counties in central and eastern Washington; largest wintering populations in Washington are in central Columbia Basin including Benton County (Hays and Dobler 2004).	Likely. Documented in numerous locations within several miles of Project area (WDFW 2017a). Potential to nest in cliffs along Columbia River and occur year round in the Project.
Sagebrush sparrow <i>Artemisiospiza nevadensis</i>	SC, PS	Restricted to open shrub lands and grasslands with mature big sagebrush stands; nests on the ground or in sagebrush; feeds on insects.	Possible. Suitable sagebrush habitat may be present within Project, particularly in eastern portion of site.
Greater sage grouse <i>Centrocercus urophasianus</i>	ST	Inhabits shrub-steppe where it is closely associated with sagebrush; majority of diet comprised of sagebrush, grasses, forbs, and insects; historically occurred throughout eastern Washington (WDFW 2012a).	Unlikely. Project falls outside of species' current range (WDFW 2012a); suitable shrub-steppe habitat appears limited in Project area.
Sage thrasher <i>Oreoscoptes montanus</i>	SC	Inhabits open, shrub-steppe habitats, preferring areas dominated by sagebrush or bitterbrush with native grasses intermixed. Post-breeding, often moves into thickets such as along creek drainages.	Possible. Some areas of suitable shrub-steppe habitat may be present with Project, particularly in eastern portion of site.
Sandhill crane <i>Grus canadensis</i>	SE	Nesting habitat ranges from open meadows to deep bogs and marshes; migration stopover and staging areas occur primarily near croplands where waste grains are available near wetlands.	Possible. Breeding in Washington occurs only in western Yakima and Klickitat counties (Stinson 2017); possible to occur during migration or as transients during post-breeding; cropland within Project may provide stopover habitat.
Vaux swift <i>Chaetura vauxi</i>	SC	Inhabits riparian thickets, woodlands, orchards, rocky cliffs, talus slopes, and rimrock areas (Ennor 1991)	Possible. Nesting and roosting habitat not present within Project area; may occur during migration; known to occur in Walla Walla River Delta IBA 2 miles east of the Project in large numbers during fall migration (Audubon 2017).
Mammals			
Black-tailed jackrabbit <i>Lepus californicus</i>	SC, PS	Occurs in sagebrush and rabbitbrush dominated habitats as well as areas of mixed grassland and shrub (WDFW 2012d);	Possible. Suitable habitat appears to be present; however, known to be rare within Project area (WDFW pers. comm.).

Table 3. State and/or federal listed or candidate wildlife species, or state Priority Species, with potential to occur within the Four Mile Project

Species	Status	Habitat	Potential for Occurrence in the Project area
Townsend's big eared bat <i>Corynorhinus townsendii</i>	SC	In Washington, occurs in a variety of arid and moist lowland habitats including shrub-steppe (WDFW 2012c); roosts in caves, lava tubes, mines, old buildings, and bridges.	Unlikely. Suitable roosting habitat appears to be absent from Project area; some potential to occur as a rare visitor; has not been documented as occurring in the southern Columbia Basin (WDFW 2012c).
Townsend's ground squirrel <i>Urocitellus townsendii</i> <i>townsendii</i>	SC, PS	Inhabits shrub-steppe, native grasslands, pastures, orchards, vineyards, highway margins, vacant lots, and the banks of canals; occurs only in Washington in the Columbia Basin west of the Columbia River, including throughout Benton County.	Likely. Known to occur at a number of locations in Project vicinity (WDFW 2017a); suitable habitat appears to be present.
White-tailed jackrabbit <i>Lepus townsendii</i>	SC	Occurs in open, grassy, or sagebrush plains; where the range of the two jackrabbits species overlaps, white-tailed jackrabbits tends to be more common in bunchgrass habitats with less shrub cover (WDFW 2012d).	Possible. Suitable habitat appears to be present; however, known to be rare in Project area (WDFW pers. comm.).
Reptiles			
Sagebrush lizard <i>Sceloporus graciosus</i>	SC	Associated with vegetated sand dunes and sandy habitats that support shrubs and have large areas of bare ground (WDFW 2012).	Possible. Project falls within species' range and suitable sandy habitat may be present within Project area.
Striped whipsnake <i>Masticophis taeniatus</i>	SC	Inhabits shrub-steppe habitats within the driest portions of the central Columbia Basin (WDFW 2012b).	Possible. Historical records for the species in Benton County (WDFW 2012b); suitable habitat may be present within the Project.

SE: state-listed endangered species; ST: state-listed threatened species; SC: state candidate species for listing; PS: state priority species; BGEPA: species protected under the Bald and Golden Eagle Protection Act (BGEPA 1940)

Species status from WDFW (2017b)

Birds

Bird Migration

The Project is located within the Pacific Flyway and numerous birds likely migrate across the landscape. The Project contains stopover habitat (i.e., habitat where migratory species may stop to rest, drink, and refuel) for raptors, songbirds, waterfowl, and shorebirds in the form of cropland and grazed shrubland with much smaller areas of grassland and wetland habitat. In general, high-quality stopover habitat such as riparian/wetland habitat, forest, and native shrub-steppe is absent from Project area. Based on USFWS NWI data there are approximately 280 ac of wetland habitat in the Project area, the majority of which is present within shallow canyons bisecting the Project's agricultural lands. There is some potential for migrating waterfowl, shorebirds, and waterbirds to use these areas seasonally, as well as flooded agricultural fields, as stopover habitats; however, given the limited amount of such habitat, use is not expected to be substantial.

Several factors influence the migratory paths of raptors; one of the most significant influences is geography. Ridgelines and the shorelines of large bodies of water are used by migrating raptors because they provide conditions necessary for energy-efficient travel over long distances (Liguori 2005) and serve as navigational aids. For these reasons, raptors tend to follow corridors or pathways along prominent ridges with defined edges or along shorelines during migration. While higher, north-south trending ridgelines are generally west of the Project area, there is some potential for escarpments along the Columbia River corridor to be used by both resident and migrating raptors. The Columbia River bends around the Project area and, at its closest point, lies adjacent to the eastern boundary of the Project (Figure 1). There is potential for raptors and other species such as waterfowl to use the river as a navigational aid during migration, and trees and associated habitats along the river likely provide perch sites and foraging areas for raptors and other species during migration. Additionally, portions of the Columbia River to the east and south of the Project have been identified as supporting concentrations of waterfowl (WDFW 2017a).

Passerines are by far the most abundant bird group in most terrestrial ecosystems and are the most commonly reported fatalities at wind energy facilities (NRC 2007). In inland areas, it is generally assumed that nocturnal migrating passerines move in broad fronts rather than along specific topographical features (Gauthreaux et al. 2003, NRC 2007). Many species of songbirds migrate at night and may collide with tall man-made structures, though no large mortality events on the scale of those observed at communication towers (National Wind Coordinating Committee [NWCC] 2004) have been documented at wind energy facilities in North America. Large numbers of passerines have collided with lighted communication towers and buildings when foggy conditions and spring or fall migration coincide. Birds appear to become confused by structural lighting during foggy or low-ceiling conditions and fly in circles around lighted structures until they become exhausted or collide with the structure (Erickson et al. 2001a). Most collisions at communication towers are attributed to the guy wires on these structures. At the adjacent Nine Canyon wind energy facility, a nocturnal migration radar study was conducted in fall 2000 and spring 2001 (Mabee and Cooper 2000, Erickson et al. 2001b). Results of the

study indicated that approximately 86% of targets passing over the project area flew at altitudes above the maximum proposed turbine height of 80 m (262 ft). Nocturnal migration studies at the Stateline and Vansycle wind energy facilities, approximately four and 15 mi (6.4 and 24.1 km) to the southeast of the Project, respectively, revealed similar mean flight altitudes (Mabee and Cooper 2004).

Avian collision fatality data from studies conducted at 30 wind energy facilities across North America were examined to estimate how many night migrants collide with turbines and towers and how aviation obstruction lighting relates to collision fatalities (Kerlinger et al. 2010). Fatality rates, adjusted for scavenging and searcher efficiency, of nighttime migrants at turbines 54 to 125 m (117 to 410 ft) in height ranged from less than one bird/turbine/year to approximately seven birds/turbine/year, with generally higher rates recorded in eastern North America and lower rates in the West. Multi-bird fatality events (defined as more than three birds killed in one night at a single turbine) were extremely rare and were not related to turbine lighting. The largest mortality events attributed to turbines at US wind energy facilities to date include 14 migrant songbirds found at two turbines during spring migration at Buffalo Ridge, Minnesota (Johnson et al. 2002), and 27 migrants at the Mountaineer facility in West Virginia (Kerns and Kerlinger 2004). The West Virginia mortalities apparently occurred during inclement weather and the fatalities occurred at a turbine near a heavily lit substation. Most migrant songbird casualties recorded during systematic carcass searches at turbines have been a single fatality found during a single search (Erickson et al. 2001a). Furthermore, no significant differences were detected when comparing songbird mortality at lit and unlit turbines. From this research, red flashing Federal Aviation Administration (FAA) lighting on turbines does not appear to be an attractant to nocturnal migrants and turbines appear to be at heights below typical migration flight elevations.

In the Pacific Northwest region of the US (i.e., Oregon and Washington), overall bird fatality rates at wind energy facilities have ranged from 0.16 birds/MW/year at the Marengo II facility in Columbia County, Washington to 8.45 birds/MW/year at the Windy Flats facility in Klickitat County, Washington (URS Corporation 2010b, Enz et al. 2011). During a one-year fatality monitoring study at the adjacent Nine Canyon facility, the overall bird fatality rate was estimated to be 3.59 bird fatalities/turbine/year or 2.76 birds/MW/year (Erickson et al. 2003). During the study, 36 bird fatalities (28 small birds and eight large birds) representing 13 species were found at turbine search plots during the study. The species most commonly found as fatalities were horned lark (*Eremophila alpestris*; 36 fatalities) and ring-necked pheasant (*Phasianus colchius*; five fatalities). Of the 36 bird fatalities reported during the study, 28 were passerine species with only six classified as nocturnal migrants (Erickson et al. 2003). During three years of fatality monitoring at the Stateline facility just over the river to the southeast, overall bird fatality rates were similar, ranging from 1.23 to 3.17 bird fatalities/MW/year (Erickson et al. 2004, 2007).

Important Bird Areas

The Audubon Society has identified Important Bird Areas (IBAs) throughout the Western Hemisphere that provide essential habitat for birds (Audubon 2017). These IBAs include sites for breeding, wintering, and migrating birds and can range from only a few acres to thousands of

acres in size. There are three recognized IBAs within 20 miles (32.2 km) of the Project: the Walla Walla River Delta to the east, the Yakima River Delta to the north, and the Umatilla to the southeast (Figure 7). While these IBAs are all more than two mi from the Project, given the location of the IBAs, birds moving between these areas have the potential to pass through or near the Project. Each IBA is described briefly below.

The Walla Walla River Delta, located at the confluence of the Walla Walla and Columbia Rivers, just two mi (3.2 km) east of the Project (Figure 7), comprises two broad mudflats and associated marshes which are part of the McNary National Wildlife Refuge. The IBA is located just north of the Wallula Gap which is considered a flight corridor for many migratory birds (Audubon 2017). The delta supports large number of pelicans, waterfowl, shorebirds, and gulls, as well as an extraordinarily high population of Vaux's swifts during fall migration (Audubon 2017).

The Yakima River Delta IBA, located approximately 10 mi (16.1 km) to the north of the Project (Figure 7), is centered on the confluence of the Yakima and Columbia Rivers. The IBA includes open freshwater, marsh, mudflat, and sand and gravel shore, supporting five species of state or federal listed or candidate species, up to 12 species of raptors, as well as many species of waterfowl, shorebirds and other water-dependent species. The site is also important for its riparian forests lining the river which provide perches for eagles, cormorants, herons, and kingfishers (Audubon 2017).

The Umatilla IBA, located about 17 miles (27.4 km) to the southwest of the Project (Figure 7), is comprised of the Umatilla National Wildlife Refuge. This IBA includes a varied mix of habitat including open water, sloughs, shallow marsh, seasonal wetlands, cropland, islands, and shrub-steppe. The IBA is vital to migrating waterfowl, bald eagles, colonial nesting birds and other migratory and resident wildlife in an area where wetlands and other natural habitats are otherwise scarce (Audubon 2017).

US Fish and Wildlife Service Birds of Conservation Concern

The USFWS lists 28 species as birds of conservation concern (BCC) within the Great Basin Bird Conservation Region (BCR), within which the Project is located (USFWS 2008). These species have been identified as vulnerable to population declines in the area by the USFWS (2008). Several species are also State and/or federal listed or candidate species or state priority species (e.g., ferruginous hawk, golden eagle, loggerhead shrike, sage thrasher, sagebrush sparrow) and are discussed in greater detail in the listed species section above. Although some of these BCC species may use habitats in the Project vicinity during migration or nesting (e.g., wetlands, shrub-steppe habitat), the majority of the Project area is comprised of agricultural lands with limited ecological value to most BCCs in the region.

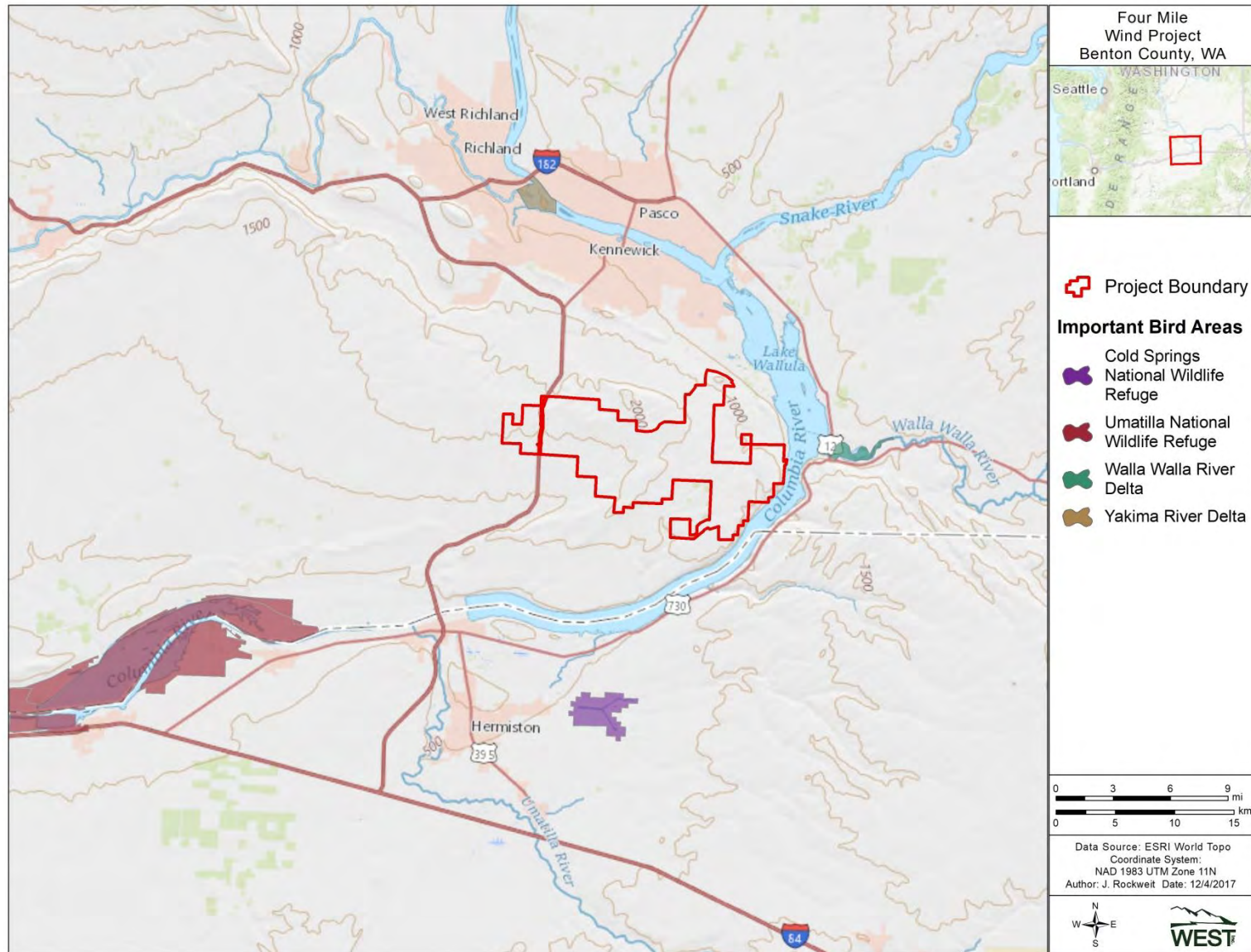


Figure 7. Location of Important Bird Areas occurring in the vicinity of the Four Mile Wind Project, Benton County, Washington.

Raptors

Diurnal raptors occur in most areas with the potential for wind energy development and have shown susceptibility to the potentially adverse impact of wind energy development (NRC 2007). Fifteen diurnal raptor species and seven owl species have at least some potential to occur within the Project area for at least part of the year. Of these, eight species are likely to breed within the Project or surrounding area and likely occur regularly within the Project: northern harrier (*Circus cyaneus*), Swainson's hawk (*Buteo swainsoni*), red-tailed hawk (*B. jamaicensis*), ferruginous hawk, American kestrel (*Falco sparverius*), barn owl (*Tyto alba*), great-horned owl (*Bubo virginianus*), and burrowing owl. One additional species, rough-legged hawk (*B. lagopus*) is a common winter resident of the area. Eight species are considered uncommon permanent residents and/or breeders in the region; however, suitable nesting and foraging habitat is generally absent from the Project area and these species are likely to occur only as uncommon to rare visitors to the Project: osprey (*Pandion haliaetus*), golden eagle, bald eagle, peregrine falcon (*F. peregrinus*), prairie falcon (*F. mexicanus*), long-eared owl (*Asio otus*), short-eared owl (*A. flammeus*), and western screech owl (*Megascops kennicottii*). Five additional species may occur during migration or as uncommon winter residents in the region: sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*A. cooperii*), northern goshawk (*A. gentilis*), merlin (*F. columbarius*), and snowy owl (*B. scandiacus*). Of the raptor species potentially occurring within the Project, one is State threatened (ferruginous hawk), two are State candidates for listing (golden eagle and burrowing owl), and four species are considered WDFW Priority Species (bald eagle, burrowing owl, ferruginous hawk, and prairie falcon; WDFW 2017b).

Based on fatality monitoring studies conducted at 29 operating wind energy facilities in the Pacific Northwest with publically available data, diurnal raptor fatality rates have ranged from zero to 0.47 raptors/MW/year (Young et al. 2006, Erickson et al. 2000, Johnson et al. 2003, URS Corporation 2010, Enk et al. 2010, Gritski and Kronner 2010, Downes and Gritski 2012). During a one-year fatality monitoring study at the adjacent Nine Canyon facility in 2002-2003, only two raptors (one American kestrel and one short-eared owl) were found within search plots resulting in an estimated raptor fatality rate of 0.05 raptors/MW/year (Erickson et al. 2003). At the nearby Stateline wind energy facility, annual diurnal raptor fatality rates were estimated to range from 0.09 to 0.11 raptors/MW/year, based on three years of monitoring (Erickson et al. 2004, 2007). Raptor species (including owls) found as fatalities at Stateline consisted of 11 red-tailed hawks, seven American kestrels, two ferruginous hawks, one Swainson's hawk, one barn owl, and one short-eared owl (Erickson et al. 2004, 2007). To date, the most common raptor species documented during fatality searches conducted at wind energy facilities in the Pacific Northwest have been American kestrels and red-tailed hawks (WEST, unpublished database). Based on publically available reports compiled by WEST (WEST, unpublished database), only five ferruginous hawk fatalities and one burrowing owl fatality have been reported in Washington and Oregon.

Eagles

Both bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (BGEPA; 1940), and in Washington, the golden eagle is a state candidate for listing (WDFW

2017b). Currently, the relative level of eagle use of the Project area is unknown, though both bald and golden eagles are known to occur in the region. While nesting habitat for both species is absent from the Project area, both species may forage throughout the site, particularly during winter or migration seasons. The golden eagle is considered an uncommon year-round resident of the Columbia Plateau (Seattle Audubon Society [SAS] 2017). Based on statewide golden eagle nest surveys conducted in 2013, 158 breeding pairs of golden eagles are estimated in the state (Hayes 2013). The majority of nesting territories in the state occurred in Okanogan County and the Columbia Plateau ecoregion; however, WDFW reported no known nest sites in Benton County (Hayes 2013).

Alternatively, the bald eagle is considered a fairly common resident of the Columbia Plateau in winter, but only occurs rarely in summer (SAS 2017). As of 2015, the total number of known bald eagle territories in the state was 1,334, with the number of nests increasing annually each year since 2005 (Kalasz and Buchanan 2016). Bald eagles typically nest near large bodies of water, such as lakes or larger rivers; however, they also require trees that are sufficiently large and have the branch structure necessary to support an eagle nest. Based on data from the Washington Survey Data Management database, historical bald eagle nesting territories are located along the Columbia River, approximately three and 12 miles (4.8 and 19.3 km) to the east and northwest of the Project, respectively (Kalasz and Buchanan 2016). Nest sites and breeding season foraging habitat for bald eagles are absent from the Project; however, due to the proximity of the eastern boundary of the Project area to the Columbia River and a historical bald eagle nesting territory, there is at least some potential for bald eagles to use the Project during the breeding season. Bald eagles are more likely to occur in the Project during the winter, potentially foraging on carrion once their primary prey (fish) becomes more scarce (Kalasz and Buchanan 2016).

For reasons not well-understood, golden eagles are known to have a higher susceptibility to collisions with wind turbine rotors than are bald eagles (Allison 2012). A small number of wind projects in five western states, all located within high-quality golden eagle breeding habitat, have produced substantially larger numbers of golden eagle fatalities, with fatality rate estimates as high as 15-70 golden eagles per year (Allison 2012). Nonetheless, most wind energy facilities that have been constructed within the golden eagle's geographic range, including all wind energy projects that have been constructed outside of golden eagle breeding habitat, have resulted in very small numbers of recorded fatalities (zero to three total per project; Allison 2012). Within the Pacific Northwest region of the US (i.e., Washington and Oregon), six golden eagle fatalities have been reported in publicly available reports from four different wind energy facilities (URS 2010, Enk et al. 2011, Enz and Bay 2012, Enz et al. 2012). To date, no bald eagle fatalities have been reported in publicly available reports at facilities in the Pacific Northwest (WEST, unpublished database). Over the course of a year-long pre-construction avian use study conducted at the adjacent Nine Canyon wind energy facility, only one golden eagle and one unidentified eagle were observed (Erickson et al. 2002). No eagle fatalities were documented during a one-year post-construction fatality monitoring study at the Nine Canyon facility (Erickson et al. 2003). While the publicly available data suggests eagle mortality at wind energy facilities in the Pacific Northwest may be relatively low, publicly available data is limited

to relatively short fatality monitoring studies (1-2 years typically) at projects that have in many cases been operational for less than 10 years.

Year round eagle/large bird use surveys, consistent with the USFWS ECPG (USFWS 2013) and WEG (USFWS 2012), will help estimate use of the Project area by eagles and other raptor species.

Potential Raptor Nesting Habitat

Limited nesting habitat is available for raptors within the Project area. Scattered isolated trees, primarily associated with current or abandoned farmsteads, are present throughout the Project and may provide nest sites for red-tailed hawks, Swainson's hawks, and great-horned owls. Grasslands, pasture and cropland may provide habitat for ground-nesting burrowing owls and northern harriers. Cliffs, bluffs, and cut banks, though generally absent from Project area, are present in the surrounding region and likely provide nest sites for ferruginous hawks and barn owls. Riparian forest habitat along the Columbia River likely supports the highest density of nesting raptors within several miles of the Project.

A raptor nest survey, including surveys for bald and golden eagle nests within a 10-mile radius of the Project area, and surveys for all raptor nests within two miles of the Project area, would help evaluate potential impacts to nesting raptors from the construction and operation of the Project.

Areas of Potentially High Prey Density

Small- and medium-sized mammals comprise the primary prey base for many raptor species, although birds and insects may also contribute to the diet of many raptor species. Large aggregations of prey species (e.g., prairie dog colonies) are not present in the Project area; however there are a number of other rodent (e.g., ground squirrels and chipmunks), lagomorphs (e.g., black-tailed jackrabbit), and passerines (i.e., songbirds), particularly those associated with agricultural lands, that are likely to occur throughout the Project. Rodents may be most concentrated along field edges and roads (Preston 1990, Rosenzweit 1989). Waterfowl and waterbirds are also potential prey for eagles and other large raptors; however, perennial and ephemeral water sources in and near the Project area are limited. Flooded agricultural fields may provide foraging opportunities for large raptors during wet periods, and grain fields may attract small mammals which in turn may attract foraging raptors. Larger streams, rivers and lakes which provide fish for raptors such as bald eagles and osprey are absent from the Project; however, the Columbia River lies immediately to the east of the Project.

Bats

Due to the lack of full understanding of bat populations in North America, species and relative abundance of bats occurring within the Project area are difficult to determine. Based on range maps and species accounts from BCI (2017), 16 species of bat are known to occur in Washington, with eight species having an approximate range and habitat requirements that include the Project area: pallid bat (*Antrozous pallidus*), big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), California bat (*Myotis*

californicus), little brown bat (*M. lucifugus*), dark-nosed small-footed myotis (*M. melanorhinus*), and canyon bat (*Parastrellus hesperus*). While roosting habitat for the majority of bat species is generally absent from the Project area, each of the species listed above have the potential to forage within, or migrate through, the Project area. The only listed or candidate bat species in Washington are Townsend's big-eared bat and Keen's myotis (*M. keenii*), both of which are state candidates for listing (WDFW 2017); however, Keen's myotis occupy only the extreme northwestern corner of the state and Townsend's big-eared bats are unlikely to occur within the Project due to a general lack of roosting and hibernating sites.

Studies conducted at wind energy facilities have documented use of areas within and around these facilities by resident or breeding bats during the summer reproductive period; however, these species are rarely found as casualties at turbines (Johnson 2005). To date, most bat casualties at wind energy facilities in the Columbia Plateau have been migratory species (e.g., hoary and silver-haired bats; Johnson and Erickson 2011), which conduct relatively long fall migrations between summer roosts and wintering areas. For unknown reasons, bat mortality rates are disproportionately high during the fall. However, it may be that tree-roosting bats fly at lower altitudes above ground level (AGL) during spring migration than during fall migration. For example, hoary bats fly one to five m (three to 16 ft) above the ground while migrating through New Mexico in the spring, but apparently not in the fall (Cryan and Veilleux 2007). Similarly, a hoary bat collided with an aircraft above Oklahoma at an altitude of 8,000 ft (2,438 m) in October of 2001 (Peurach 2003), which may support the theory that bats generally fly at higher altitudes in the fall.

In the Pacific Northwest, bat fatality rates at wind energy facilities have varied widely, ranging from 0.12 bats/MW/year at the Kittitas Valley facility in Kittitas County, Washington (Stantec 2012) to 4.23 bats/MW/year at the Palouse facility in Whitman County, Washington (Stantec 2013). During the one-year post-construction fatality monitoring study at the adjacent Nine Canyon facility, the bat fatality rate was estimated at 2.47 bats/MW/year (Erickson et al. 2003), which falls near the middle of the range of fatality rates for the Pacific Northwest. Similarly, at the nearby Stateline facility, bat fatalities rates have ranged from 0.95 to 2.29 bats/MW/year (Erickson et al. 2004, 2007). Consistent with the results from other studies in the Pacific Northwest and across the county, 20 of the 27 total bat fatalities (74%) documented at Nine Canyon, were found during the late summer/early fall period and all 27 fatalities comprised just two species: silver-haired bat and hoary bat (Erickson et al. 2003). At Stateline, Silver-haired and hoary bats comprised nearly 96% of bat fatalities (Erickson et al. 2004, 2007).

SUMMARY

Table 4 summarizes key wildlife considerations for the Project. Of the wildlife species protected by or under review through the federal ESA, none have the potential to occur within the Project area. Three species with state threatened or endangered status have at least some potential to occur in the Project area including: American white pelican, ferruginous hawk, and sandhill crane. An additional 12 species designated as state candidates for listing also have potential to occur within the Project including six birds, four mammals, and two reptiles. Both the golden and

bald eagle, afforded additional protection under the federal BGEPA, have the potential to occur within the area. No state and/or federal special-status plant species are known to occur within five mi of the Project; however, one rare/high quality plant community has been documented approximately a mile north of the Project, and several WDFW Priority Habitats or Habitat Features are known to occur within several miles of the Project. Due to the current land use within the Project, the likelihood of special status plants and rare/high quality plant communities and habitats occurring within the Project area is low due to the current predominant land use; though some remnant patches of native shrub-steppe habitat may be present, particularly within the eastern portion of the Project.

Fifteen diurnal raptor species and seven owl species have the potential to occur as residents and/or migrants in the Project area at some point during the year. Nesting habitat within the Project is limited to scattered, isolated trees and pasture/cropland (for ground-nesting raptors), but is more abundant in the surrounding landscape in trees and along cliffs, and cut banks.

The Project area is located within the Pacific Flyway and numerous birds likely migrate through the region. The Project area is characterized by rolling hills that generally would not be expected to concentrate or funnel raptors during migration; however, escarpments along the Yakima and Columbia Rivers located to the north and east of the Project may receive higher use by both resident and migrating raptors. Additionally, trees and riparian habitats associated with the rivers likely provide perch sites and foraging habitat for migrating raptors, waterfowl, and other species. Portions of the Columbia River within several miles of the Project have been designated by the WDFW as waterfowl concentration areas. Stopover habitat for songbirds, waterfowl, and shorebirds in the form of cropland/pasture and smaller amounts of shrubland is present with the Project area; however, these areas are generally not considered high-quality stopover habitat and are abundant across the landscape.

Relatively high bat mortality at other wind energy facilities in North America is a concern, and some species that appear to be at greatest risk, such as hoary and silver-haired bats, are likely to occur in the Project area, particularly during fall migration. At least eight bat species have the potential to occur within the Project area at some time during the year. While roosting habitat is generally lacking within the Project area for most of these species, the Project's pastures, croplands, shrublands, and limited riparian/wetland habitat may provide foraging and drinking habitat for some resident bat species.

Table 4. Summary of the potential for wildlife and plant conflicts in the proposed Four Mile Wind Project¹; VH = Very High, H = High, M = Moderate, and L = Low

Issue	VH	H	M	L	Notes
Raptor nest sites			✓		Limited habitat for nesting raptors in Project area; higher potential for nesting in canyons and cliffs to north and east of the Project; potential for ferruginous hawk and burrowing owl nests (state listed/candidate species). Historical bald eagle nest approximately three miles east of Project.
Concentrated raptor flight areas			✓		A number of raptors are likely to use the Project area. Columbia River just east of Project may concentrate raptors during migration; escarpments above river may receive higher raptor use during migration and/or winter.
Avian migratory pathways				✓	Project area located along the Pacific Flyway, but high-quality stopover habitat generally absent; extensive riparian/wetland habitat absent. Potential use by migrating passerines, but not likely used as concentrated migration pathway or stopover area.
Raptor prey species			✓		Potential for rodents, lagomorphs, and prey bird species to occur within Project area, but not likely in high concentrations.
Federal protected wildlife species				✓	No federal listed, candidate, or under review species currently have the potential to occur within the Project; both bald and golden eagles, protected under the federal BGEPA have the potential to occur.
State protected wildlife species		✓			Sixteen state-listed or candidate species have at least some potential to occur.
Uniqueness of habitat				✓	Habitat and land use within the Project area is predominately agricultural. Four WDFW Priority Habitats/Habitat Features and one WNHP rare/high quality plant community is found in Project vicinity. Three IBAs are within 20 miles of Project.
Rare plants/ecosystems				✓	No state and/or federal special-status plant species known to occur within 5 miles of the Project area; one rare/high quality plant community known to occur in region.
Bats			✓		At least eight bat species have at least some potential to occur within the Project area, one of which is a state candidate for listing. Bat species that have shown relatively high levels of fatalities at wind energy facilities are likely to be present.

¹Summarized for the Four Mile Wind Project as a whole but the habitat of the Project area varies in its ability to support species of concern.

USFWS Land-Based Wind Energy Guidelines Tier 2 Questions

Chapter 3 of the USFWS WEG (2012) includes seven Tier 2 questions which should be addressed during site characterization efforts. A contextual review of these questions after synthesis of a SCS report may help identify areas where existing data do not sufficiently address potential impacts to biological resources which may occur through development of a wind energy facility, and should serve to guide formulation of project-specific Tier 3 study plans

intended to fill data gaps. This Four Mile SCS attempts to answer the Tier 2 questions through a desktop review of publicly available information. However, some data gaps remain; recommended field studies intended to fill data gaps are included in the following section (Conclusion and Next Steps). It is also useful to consider the seven Tier 2 questions individually in the context of this SCS; although the previous Summary section includes much pertinent information, it does not specifically relate SCS report findings to Tier 2 questions. The following list describes how this report has addressed specific Tier 2 questions, where information related to these questions can be found in this report, and what if any data gaps remain:

1. Are known species of concern present on the proposed site, or is habitat (including designated critical habitat) present for these species?

No federal listed wildlife species have the potential to occur within the Project and no designated critical habitat is present within the Project or surrounding area. Sixteen State listed or candidate species (10 birds, four mammals, and two reptiles) have at least some potential for occurrence in the Project (see Listed Species section). No State and/or federal special-status plant species are known to occur within five mi of the Project. Tier 3 field studies will help confirm presence or absence of many of these species (see Conclusion and Next Steps section).

2. Does the landscape contain areas where development is precluded by law or designated as sensitive according to scientifically credible information?

A desktop review of publicly available information did not reveal any areas on the landscape where development is precluded by law. Four WDFW Priority Habitats are known to occur within 2 miles of the Project: emergent wetland, forest/shrub wetland, shrub-steppe and cliffs/bluffs. Tier 3 field studies will help determine the presence or absence of any sensitive areas in the Project (see Conclusion and Next Steps section).

3. Are there plant communities of concern present or likely to be present at the site?

No State and/or federal special-status plant species are known to occur within five mi of the Project. One rare/high quality plant community is known to occur approximately one mile north of the Project (see Rare Plants and Plant Communities section). Tier 3 field studies will help determine the occurrence of plant communities of concern at the Project (see Conclusion and Next Steps section).

4. Are there known critical areas of congregation of species of concern, including, but not limited to: maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopover or corridors, leks, or other areas of seasonal importance?

There are no known critical areas of congregation of species of concern within the Project area and desktop analyses do not suggest any are likely to occur. Several portions of the Columbia River, within three miles of the Project, are recognized as

concentrated waterfowl areas. Tier 3 field studies will help determine the presence or absence of critical congregation areas in the Project (see Conclusion and Next Steps section).

5. Using best available scientific information has the developer or relevant federal, state, tribal, and/or local agency identified the potential presence of a population of a species of habitat fragmentation concern?

The Project area consists exclusively of private lands managed for crop production and livestock grazing. As such, modern land use of the Project has already led to a fragmented landscape (see Table 1; Figures 3 and 4), and it is unlikely that populations of species with high fragmentation concern are present.

6. Which species of birds and bats, especially those known to be at risk by wind energy facilities, are likely to use the proposed site based on an assessment of site attributes?

Many species of birds and bats are likely to use the Project area at some point during the year (see Raptors, Bird Migration, and Bats sections). There are 15 diurnal raptor species and seven owls which have the potential to occur within the Project. Of these, eight species may breed within the Project or Project vicinity, including the ferruginous hawk (state threatened) and burrowing owl (state candidate), as well as several other sensitive bird species. Diurnal raptors and some owls are known to be at risk by wind energy facilities. There are at least eight species of bats with the potential to occur in the Project (see Bats section) including both hoary and silver-haired bats, which are known to be at risk by wind energy facilities. Tier 3 field studies will help refine the species present which are known to be at risk from wind energy facilities.

7. Is there a potential for significant adverse impacts to species of concern based on the answers to the questions above, and considering the design of the proposed project?

While the Project design has not yet been determined, based on the general location of the proposed Project and following a desktop review of publicly available information pertaining to the Project area, the potential for significant adverse impacts to species of concern due to development of the Project appears to be low. However, a number of pre-construction baseline biological studies are recommended in order to properly characterize site-specific wildlife use and evaluate the biotic resources in the Project area (see Conclusion and Next Steps section).

CONCLUSION AND NEXT STEPS

Based on this SCS, the Project does not appear to have a high potential for conflict with the majority of wildlife and plant issues listed in Table 4. Regardless, a number of pre-construction baseline wildlife and botanical studies are recommended for the Project with the purpose of characterizing wildlife use (particularly avian and bat use) within the Project area, estimating

impacts of the proposed facility on sensitive wildlife and botanical resources, and to assist with siting turbines to minimize impacts to the extent practicable. Baseline studies recommended at this time are presented in Table 5 and include the following:

- Vegetation and land cover mapping following WDFW habitat classification standards and consistent with the Washington Wind Power Guidelines (WDFW 2009).
- Year round large bird/eagle use surveys consistent with recommendations presented in the USFWS ECPG (USFWS 2013), designed to characterize use of the Project area by large birds, with an added emphasis on bald and golden eagles.
- Small bird use surveys, consistent with recommendations presented in the WEG (USFWS 2012) and the Washington Wind Power Guidelines (WDFW 2009), designed to evaluate small bird use of the Project area.
- Nesting raptor surveys with an emphasis on bald and golden eagles and other sensitive raptor species as recommended in the WEG (USFWS 2012), ECPG (USFWS 2013), and Washington Wind Power Guidelines (WDFW 2009).
- Bat acoustic monitoring at one meteorological tower location during the spring, summer, and fall using methods recommended in the WEG (USFWS 2012) and the Washington Wind Power Guidelines (WDFW 2009).
- Threatened, endangered, and sensitive species (TESS) surveys, inclusive of rare plants, following methods consistent with the Washington Wind Power Guidelines for surveying and evaluating impacts to TESS and natural communities (WDFW 2009).

The large bird/eagle and small bird use surveys listed above should be sufficient to provide a baseline risk assessment for bird species possibly occurring within the Project area and the need for additional studies or more detailed spatial distribution mapping. Early and regular consultation with the USFWS and WDFW is recommended, as it is possible that additional species-specific surveys for sensitive bird, mammal, reptile, or plant species may be encouraged by these agencies. The following Table (Table 5) includes a column for Tier 2 questions. This is intended to highlight how recommended Tier 3 field studies will address information gaps identified during Tier 2 site characterization, and ties directly to information presented in the preceding USFWS Land-Based Wind Energy Guidelines Tier 2 section.

Table 5. Recommended Pre-construction Wildlife and Botanical Studies for the Four Mile Wind Energy Project.

Study	Purpose	Information Gaps Addressed from USFWS Tier 2 Question(s)	Timing
Vegetation/land cover mapping	To identify potentially suitable habitat for state or federal sensitive species and to calculate habitat mitigation ratios resulting from potential habitat disturbance.	Questions 1-3	Spring or summer
Large bird / Eagle use surveys	To assess spatial and temporal use of the Project area by bald and golden eagles and other raptor species	Question 1, Question 4, Question 6, Question 7	Year-round
Small bird use surveys	To assess spatial and temporal avian use of the Project area, with a focus of small bird use	Question 1, Question 4, Question 5, Question 6	Spring and fall migration periods
Nesting raptor surveys	To locate nests that may be subject to disturbance and/or displacement effects from Project construction and/or operation, particularly nests of bald or golden eagles or other sensitive raptor species	Question 1, Question 4, Question 5, Question 6, Question 7	Twice during late winter through early summer breeding season
Bat acoustic surveys	To estimate the level of, and seasonal and spatial patterns of, bat activity within the Project area	Question 1, Question 5, Question 6, Question 7	A continuous spring, summer, and fall survey period
TESS survey	To determine the presence, as well as the spatial distribution, of any state and federal threatened, endangered, or sensitive wildlife or rare plant species.	Question 1, Question 2, Question 3, Question 5, Question 7	Spring and early summer when target species are most readily identified (e.g., nesting or flowering)

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**Appendix A. Photographs Taken During Tier 2 Site Visit to the Four Mile Wind Project on
December 11-12, 2017**



Photo 1. Taken from meteorological (met) tower location (FM1) in eastern portion of Project, looking north.



Photo 2. Taken from met tower location (FM1) in eastern portion of the Project, looking southeast.



Photo 3. Taken from met tower location (FM2) in south-central portion of Project, looking north toward Nine Canyon.



Photo 4. Taken at met tower location (FM2) in south-central portion of Project, looking east.



Photo 5. Taken at met tower location (FM4) in northeastern corner of Project, looking south.



Photo 6. Taken at met tower location (FM4) in northeastern corner of Project, looking north.



Photo 7. Taken from southeastern portion of Project.



ENVIRONMENTAL & STATISTICAL CONSULTANTS

2725 NW Walnut Boulevard Corvallis, OR 97330
Phone: 307-634-1756 ♦ www.west-inc.com ♦ Fax: 307-637-6981

DATE: November 14, 2018 *Public Draft - For Distribution*

TO: Joseph Wood and Jeffrey Wagner, wpd Wind Projects Inc.

FROM: Andrea Chatfield and Samantha Brown, WEST, Inc.

RE: Results of the 2018 vegetation and land cover mapping for the Four Mile Wind Project Study Area, Benton County, Washington.

INTRODUCTION

Four Mile MW LLC (Four Mile) is proposing to develop the Four Mile Wind Project (Project) in Benton County, Washington. Four Mile contracted Western EcoSystems Technology, Inc. (WEST) to conduct a vegetation and land cover assessment in the area where the Project is proposed. This assessment was performed as recommended in the Washington Department of Fish and Wildlife (WDFW) Wind Power Guidelines (WDFW 2009). The resulting information can be used to identify potentially suitable habitat for sensitive plant and wildlife species, to help guide surveys for sensitive species within development corridors, and for informing mitigation requirements for temporary and permanent impacts to habitat resulting from Project development. This memorandum summarizes the methodology and results of the 2018 vegetation and land cover assessment for the Project.

SITE DESCRIPTION

Regional Setting

The Study Area lies within the semi-arid Columbia Plateau Ecological region, which encompasses a large portion of south central Washington (Washington Biodiversity Council 2008). The Columbia Plateau tilts upward and southward into the Great Basin of eastern Oregon, western Idaho, and northern Nevada, and is bordered by the Cascade Mountains to the west, the Okanogan Highlands to the north, the Palouse Hills to the east, and the Blue Mountains to the southeast. The Columbia and Snake rivers are the dominant topographic features of the Columbia Plateau; in Washington, the Plateau is bisected by the Columbia River. Today, the areas with suitable soil are used for agriculture; crops include wheat (*Triticum* spp.), alfalfa (*Medicago sativa*), potatoes (*Solanum tuberosum*), grass hay, and vineyards. Other areas within the region are used for livestock grazing. In the Yakima Valley to the north and the Columbia Basin to the south, irrigated agriculture is prevalent and includes pastures, orchards, and vineyards. Hops (*Humulus lupulus*) and field crops are also commonly grown. In uncultivated areas, this ecoregion is characterized by arid sagebrush- (*Artemisia* spp.) steppe and grassland. The regional climate can be typified as arid to semiarid with low precipitation, warm

to hot dry summer, and relatively cold winters (Franklin and Dryness 1973). Mean annual temperature in the region is 59° Fahrenheit (15° Celsius), with mean annual precipitation of 10 inches (25 centimeters; Franklin and Dryness 1973, Daly 2000).

Study Area

The proposed Study Area encompasses 35,987 acres (14,563 hectares) of private and state-owned land within Benton County in southeastern Washington, approximately seven miles (11.3 kilometers) south of the city of Kennewick (Figure 1). Topography within the Study Area generally consists of rolling hills bisected by meandering canyons that drain primarily to the south and east into the Columbia River. Elevations range from approximately 630 feet (192 meters [m]) along the northeastern boundary of the Study Area to 2,010 feet (613 m) in the northwest. The eastern boundary of the Study Area lies adjacent to the Columbia River as it bends around the Study Area from the north to the southwest (Figure 1).

The native vegetation of the Study Area consisted of a bluebunch wheatgrass (*Pseudoroegneria spicata*)-Idaho fescue (*Festuca idahoensis*) zonal association, which was predominately grassland and shrub-steppe with deciduous riparian forest and scrub along drainages (Franklin and Dryness 1973). Today, agriculture and livestock grazing have converted the area to a mosaic of cultivated wheat fields and grasslands managed under the US Department of Agriculture Farm Service Agency's Conservation Reserve Program (CRP), with a few smaller patches of remnant shrub-steppe habitat throughout. In general, shrub-steppe is located in topographically steep area, such as along drainages, where crop cultivation is not possible. A network of county and a few private roads traverse the Study Area.

METHODS

The objective of the 2018 vegetation and land cover assessment was to characterize and map the general vegetation and cover types across the Study Area. Land cover types mapped were consistent with those described by the WDFW (2009) and included the following:

- Shrub-steppe – areas dominated by shrubs less than 16.4 feet (5.0 m) tall;
- Grassland – uncultivated areas with herbaceous vegetation including CRP grasslands;
- Agriculture – cultivated cropland and pasture;
- Developed – urban areas, stand-alone structures/residences/farms, highways, and other disturbed areas.

The above land cover types were initially mapped using aerial imagery and remotely sensed data that included the National Landcover Dataset (USGS 2011) and National Wetland Inventory (USFWS 2018) which were then field-verified by a qualified WEST biologist. Following field-verification, a WEST Geographic Information System (GIS) specialist digitized the final habitat designations to create a vegetation/land cover map of the Study Area.

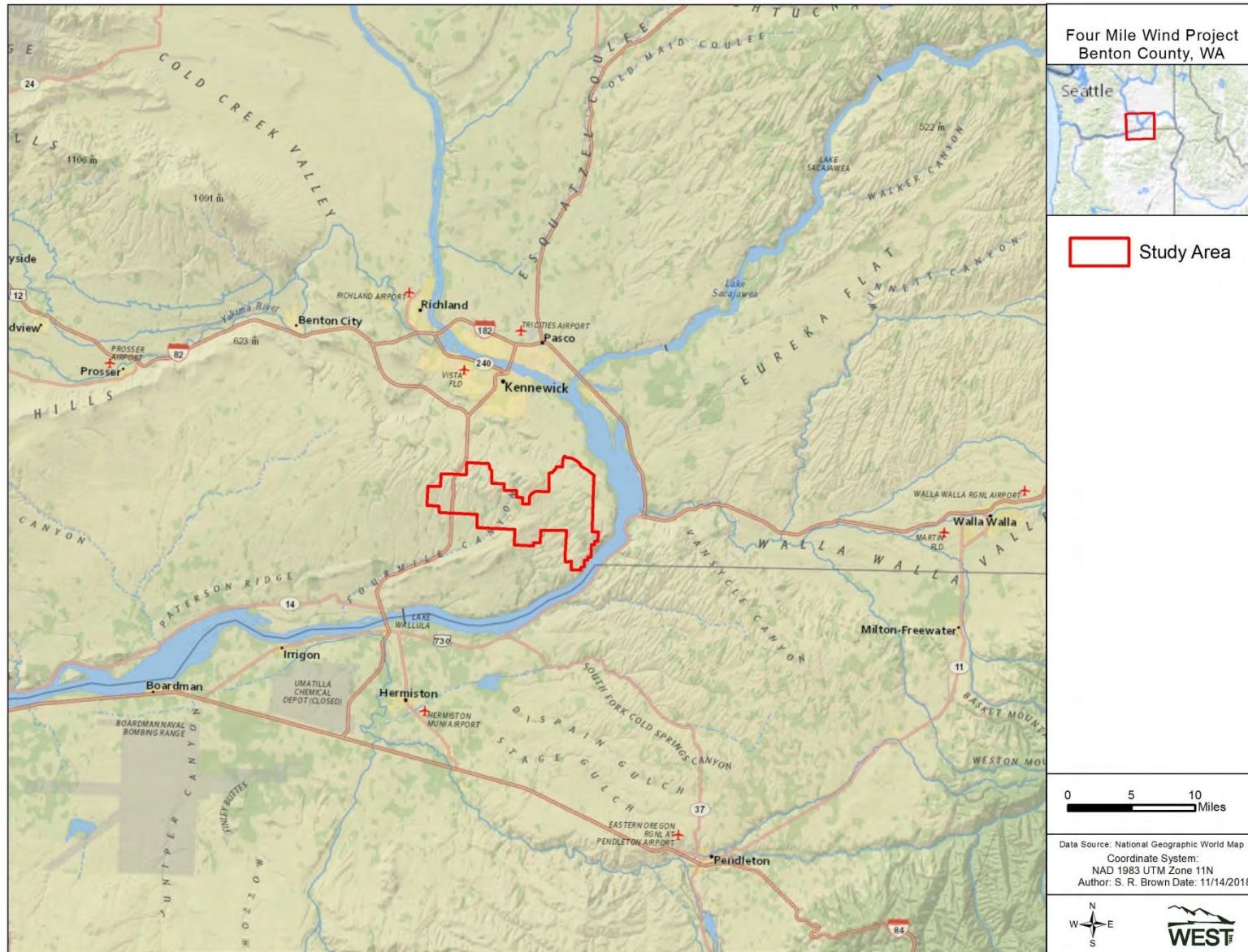


Figure 1. Location of the Four Mile Wind Project, Benton County, Washington.

RESULTS

Based on the mapping effort, four vegetation/land cover types were identified within the Study Area (Table 1). The predominant land cover type was agriculture, encompassing 53.2% of the total Study Area. Agricultural areas within the Study Area were primarily cultivated croplands consisting of dryland wheat, and were more extensive in the central portions of the Study Area. This was followed by grasslands which encompassed a further 29.5% of the Study Area (Table 1; Figure 2). Smaller areas of remnant shrub-steppe (16.5% of the Study Area) were located primarily in the northeast and west of the Study Area (Figure 2). Developed areas, including Highway 82 and individual structures, residences, and farms, were scattered throughout the area and composed the remaining 0.9% of the Study Area (Table 1; Figure 2).

Table 1. Vegetation/land cover types, acreages, and percent coverage within the Four Mile Wind Project Study Area, Benton County, Washington.

Vegetation/Land Cover Type	Total Acres	Percent Coverage
Agriculture	19,130.00	53.2
Grassland/CRP*	10,605.90	29.5
Shrub-Steppe	5,935.85	16.5
Developed	315.27	0.9
Total	35,987.02	100

*CRP=Conservation Reserve Program lands

Based on the WDFW Wind Power Guidance, no mitigation is required for impacts (temporary or permanent) to agriculture (cropland or pasture) or developed/disturbed areas which are considered Class IV habitats and have generally low value to wildlife and native plants (WDFW 2009). The remaining two land cover types, shrub-steppe and grassland (including CRP lands), are considered Class III habitats requiring a 0.1:1 mitigation ratio for temporary impacts (in addition to restoring the temporarily impacted habitat) and a 1:1 ratio for permanent impacts. Shrub-steppe and grassland vegetation communities provide important breeding and foraging habitat for a number of sensitive wildlife species, and shrub-steppe is classified as a priority habitat in Washington (WDFW 2009). Grasslands within the Study Area are likely classified into one of two categories: 1) areas along the margins of tilled agricultural fields or along drainages which are too steep to be cultivated or 2) parcels that are currently enrolled in the CRP. In general, it is unknown which non-cultivated grassland parcels are CRP lands as this information is not publicly available; however, for the purposes of habitat mitigation, CPR lands and grasslands are functionally similar and are both considered Class III habitats (WDFW 2009).

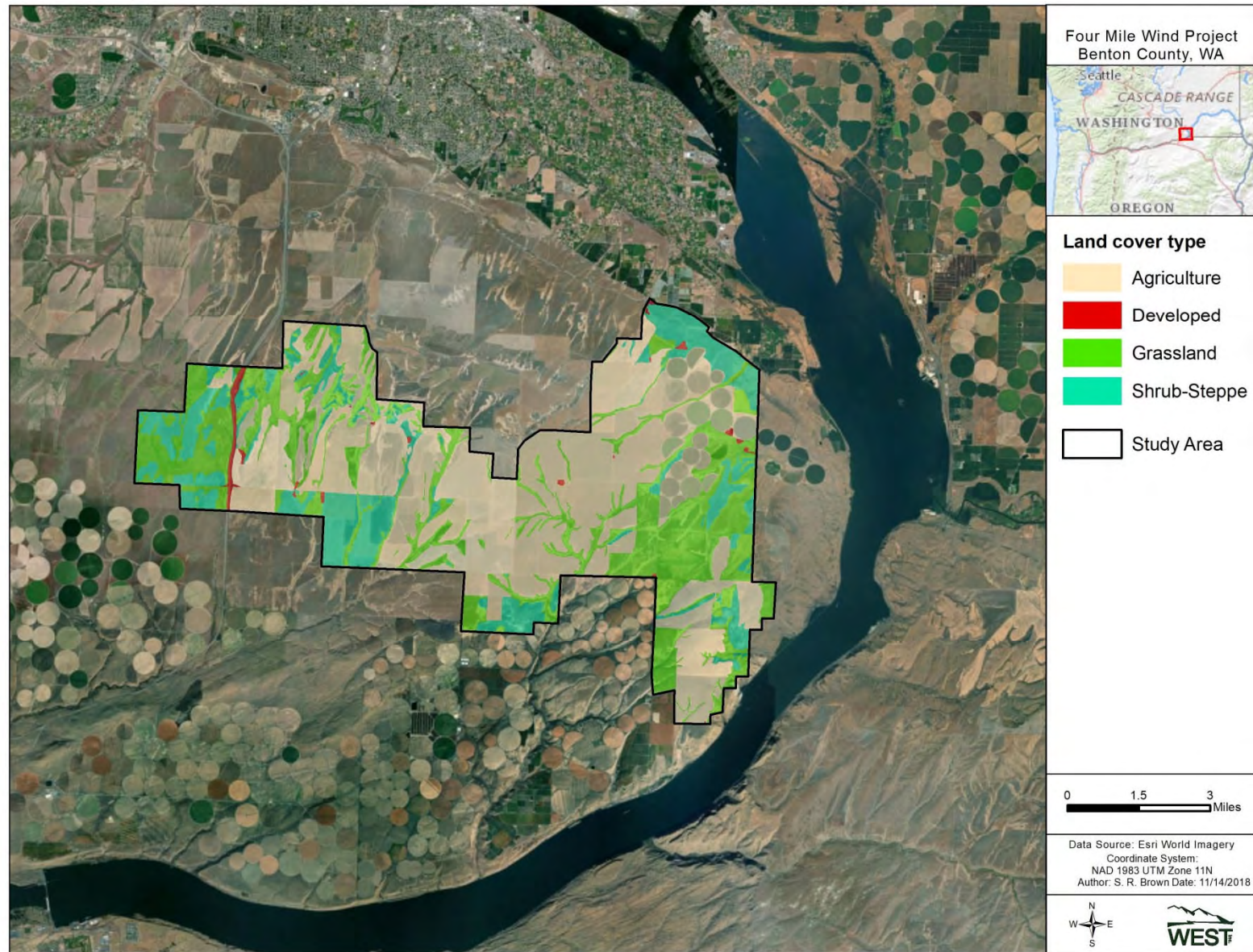


Figure 2. Land cover types mapped within the Four Mile Wind Project Study Area, Benton County, Washington.

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2725 NW Walnut Boulevard Corvallis, OR 97330
Phone: 307-634-1756 ♦ www.west-inc.com ♦ Fax: 307-637-6981

DATE: October 17, 2018

TO: Joseph Wood and Jeffrey Wagner, wpd Wind Projects Inc.

FROM: Andrea Chatfield and Samantha Brown, WEST, Inc.

RE: Results of the 2018 Townsend's ground squirrel (*Uroditellus townsendii*) habitat assessment for the proposed substation at the Four Mile Wind Project, Benton County, Washington.

Introduction

Four Mile MW LLC (Four Mile) is proposing to develop the Four Mile Wind Project (Project) in Benton County, Washington. Four Mile contracted Western EcoSystems Technology, Inc. (WEST) to conduct a habitat assessment for Townsend's ground squirrel (*Uroditellus townsendii*) within an approximately 25-acre (10.1-hectare) parcel (Study Area) proposed for construction of the Project's substation (Figure 1). This memorandum summarizes the methodology and results of the Townsend's ground squirrel habitat assessment conducted within the Study Area in October 2018.

Status and Natural History

Townsend's ground squirrel (occurring south of the Yakima River) is a candidate for state listing, and is also considered a Priority Species in Washington (WDFW 2018a, 2018b). Townsend's ground squirrel is a ground dwelling species that constructs and utilizes burrows within high desert shrubland and grasslands habitats (NatureServe 2016). The species typically inhabits arid shrub-steppe and native grasslands; however, pastures, orchards, vineyards, highway margins, and vacant city lots are also used (WDFW 2011). Burrows, which are often grouped into large colonies, are used for shelter, protection from predators, and food storage, as well as for hibernation for up to eight months of the year (WDFW 2011). The ground squirrel's diet largely comprises green herbaceous vegetation, including Sandberg's bluegrass (*Poa secunda*), western tansymustard (*Descurainia secunda*), lupine (*Lupinus laxiflorus*), and woollypod milkvetch (*Astragalus purshii*; WDFW 2011). Historically, the Townsend's ground squirrel's range encompassed several states including Washington, Oregon, Idaho, and Nevada but with habitat loss, degradation, and fragmentation, it is estimated that less than 10% of its original habitat remains (NatureServe 2016). Most of the species' geographic range has been converted to agriculture, and much of the remaining shrub-steppe is being degraded by cheatgrass (*Bromus tectorum*) and other exotic annuals. The species is now restricted to the Columbia Basin in Washington, west of the Columbia River (WDFW 2011), and has been documented at a number of locations within several miles of the Project area (WDFW 2018a).

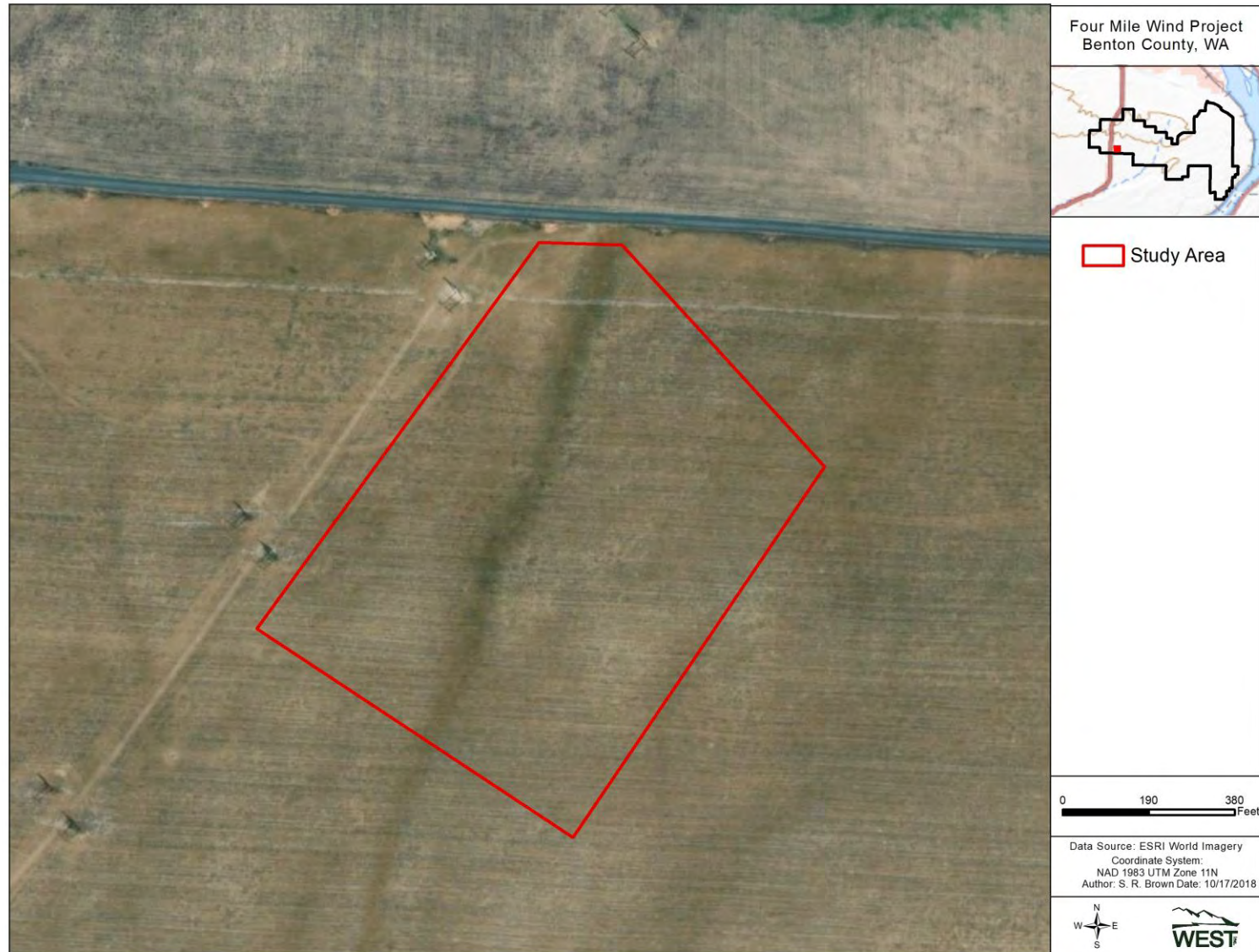


Figure 1. Location of the Study Area evaluated during the 2018 Townsend's ground Squirrel habitat assessment at the Four Mile Wind Project, Benton County, Washington.

Study Area

The Study Area consists of an approximately rectangular 25-acre parcel of privately-owned land in the southwestern portion of larger Project area (Figure 1). The Study Area is located about 50 feet (ft; 15 meters [m]) south of Beck Road and 100 ft (30 m) east of an existing transmission line (Figure 1). Land use within the Study Area is agriculture, consisting entirely of cultivated wheat (*Triticum* spp.) fields (Photo 1). Topography of the Study Area is generally flat with an average elevation of approximately 1,420 ft (433 m).

Methods

The objective of the habitat assessment was to evaluate the Study Area with respect to suitability for Townsend's ground squirrel occupancy, while also surveying the Study Area for any signs of ground squirrel presence. Prior to the field survey, a desktop assessment was conducted using information on modeled suitable habitat and habitat connectivity for Townsend's ground squirrel provided by the Washington Wildlife Habitat Connectivity Working Group (WHCWG; 2012). This was followed by a field survey, conducted on October 4, 2018, by a trained WEST field biologist who surveyed the 20-acre parcel by walking meandering parallel transects spaced approximately 160 ft (50 m) apart throughout the Study Area. While walking the transects, the biologist scanned the surrounding area for signs (burrows, tracks, scat, calls, and visual observations) of Townsend's ground squirrel activity within the Study Area. While the field survey was conducted outside of the species' period of activity above ground (typically February – June), it was assumed ground squirrel burrows with sign of recent use would be evident within the Study Area, if present.

Results

Based on modelling of suitable habitat and connectivity for Townsend's ground squirrel by the WHCWG, the Study Area falls outside of designated Habitat Concentration Areas or areas of connectivity for Townsend's ground squirrel. According to the WHCWG habitat model, the Study Area is classified as having a habitat value of 0-0.25, the lowest habitat value on a scale of 0 (lowest) to 1 (highest; WHCWG 2012). A field survey of the Study Area confirmed this assessment. The entire Study Area, as well as areas immediately surrounding the Study Area, are composed of tilled agricultural lands (Photo 1). Cultivated croplands are not considered suitable habitat for Townsend's ground squirrel, and no signs of Townsend's ground squirrel were observed within the Study Area. Several burrows were recorded within the Study Area but were determined to be too small for ground squirrels and exhibited signs of use by kangaroo rats (*Dipodomys* spp.; Photo 2).

Conclusion

Based on Townsend's ground squirrel habitat modelling, lands within the Study Area provide low-value habitat for the species. During the field survey, no sign of Townsend's ground squirrel was observed during the field survey and suitable shrubland or grassland habitat is not present within, or in areas adjacent to the Study Area. Based on the desktop review and field survey, the species is not expected to occur within the Study Area.



Photo 1. Overview of cultivated wheat field encompassing the entirety of the Study Area.



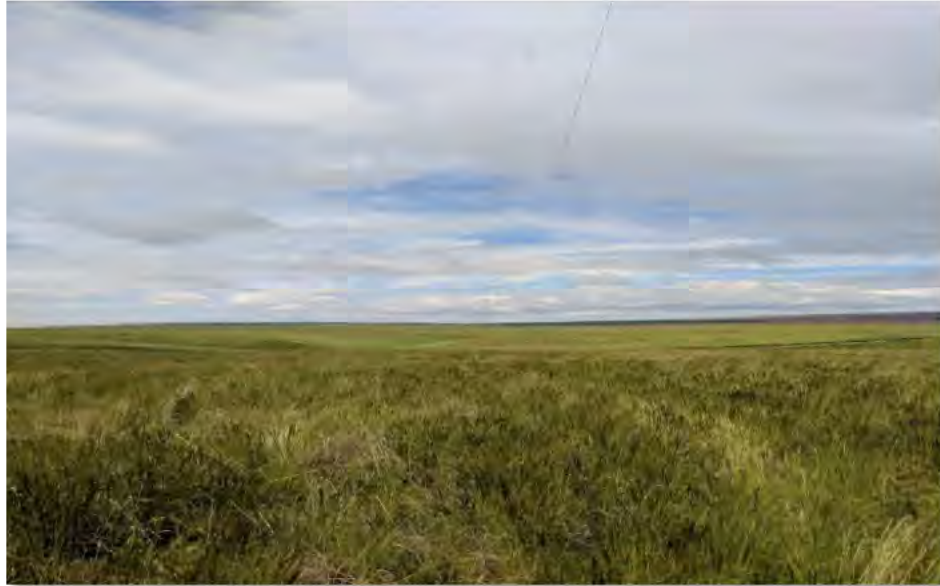
Photo 2. Active kangaroo rat (*Dipodomys* spp) burrow documented within the Study Area.

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Bat Activity Study for the Badger Canyon Wind Project Benton County, Washington

**Final Report
May 11 – October 29, 2018**



Prepared for:

Four Mile MW LLC

205 SE Spokane Street, Suite 300
Portland, Oregon 97202

Prepared by:

Quentin Hays, Samantha Brown, and Andrea Chatfield

Western EcoSystems Technology, Inc.
2725 Northwest Walnut Boulevard
Corvallis, Oregon 97330

November 30, 2018



Privileged and Confidential - Not For Distribution

EXECUTIVE SUMMARY

In May 2018 Western EcoSystems Technology, Inc. (WEST) initiated a bat activity study at the proposed Four Mile Wind Project (Project) in Benton County, Washington. WEST designed bat acoustic surveys at the Project to evaluate levels of bat activity and species' use of the area during the period of expected peak activity (i.e., late spring through fall).

WEST conducted acoustic surveys in the area where the Project is proposed (Study Area) from 11 May through 29 October 2018. Two Wildlife Acoustics SM3 full-spectrum acoustic detectors, each outfitted with two microphones, were deployed at Project meteorological (met) towers in areas representative of future turbine locations. At each detector, one microphone was deployed near the ground, at approximately 5 feet (ft; 1.5 meters [m]), while the other microphone was raised on the met tower to approximately 148 ft (45 m) above ground level. The ground microphone is considered a ground sampling station, while the raised microphone is considered a raised sampling station. Both met towers were located in grassland habitat, which is the dominant land cover type within the Study Area, although sampling stations FM2g and FM2r were in relatively close proximity to cultivated cropland as well as a farm building and associated infrastructure.

During the 335 detector-nights surveyed, the average bat activity rate (\pm standard error) documented at the ground sampling stations was 1.02 ± 0.11 bat passes per detector-night, while the raised sampling stations recorded an average bat activity rate of 1.15 ± 0.12 bat passes per detector-night. Approximately 93% of bat passes were produced by low-frequency, tree-roosting bats; automated identification of bat calls using Kaleidoscope Pro 4.2.0 determined that silver-haired bats were the most frequently detected species, occurring on approximately 25% of detector-nights. Five high-frequency bat species (California bat, canyon bat, little brown bat, long-legged bat, and western long-eared bat) were detected during the study period. Neither Townsend's big-eared bat nor pallid bat, both of which are Washington state candidate species, were detected during the study. No federal or state-listed bat species were documented.

The overall bat activity rate within the Study Area, averaged between ground sampling stations (FM1g and FM2g; 1.02 bat passes per detector-night), was below the Rocky Mountains regional average of 4.02 bat passes per detector-night, which is the closest region with publicly available activity data; no activity data from the Pacific Northwest is available for comparison. The average fatality rate for the Rocky Mountains region is 4.90 bats/megawatt (MW)/year, significantly higher than the average fatality rate in the Pacific Northwest, which is 1.19 bats/MW/year. If risk patterns at the Project are similar to patterns observed elsewhere in the Pacific Northwest and Rocky Mountains, it is likely that fatality rates at the Project would be similarly low.

STUDY PARTICIPANTS

Western EcoSystems Technology

Andrea Chatfield	Project Manager
Quentin Hays	Lead Biologist
Samantha Brown	Report Compiler
Donald Solick	Bat Biologist
Larisa Bishop-Boros	Bat Biologist/Data Analyst
Samantha Brown	GIS Technician
Casi Lathan	Project Tracking and Data Manager
David Klein	Technical Editing Manager
Katie Wynne	Technical Editing Coordinator
Carissa Goodman	Technical Editor
Joshua Parrott	Field Technician

REPORT REFERENCE

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INTRODUCTION

Western EcoSystems Technology, Inc. (WEST) completed a study of bat activity at the proposed Four Mile Wind Project (Project) in accordance with recommendations in the US Fish and Wildlife Service (USFWS) *Land-Based Wind Energy Guidelines* (USFWS 2012) and the Washington Department of Fish and Wildlife (WDFW) *Wind Power Guidelines* (WDFW 2009). Although it remains unclear whether bat activity patterns in baseline acoustic data predict post-construction fatality risk (Hein et al. 2013a), ultrasonic detectors do collect information on spatial distribution, timing, and species composition that can provide insight into the possible impacts of wind development on bats in a particular area (Kunz et al. 2007a, Britzke et al. 2013) and inform potential collision minimization strategies for a particular project (Weller and Baldwin 2012). WEST conducted acoustic surveys to estimate levels of bat activity and to determine which bat species occur in the area where the Project is proposed (Study Area). The following report describes the results of acoustic surveys conducted within the Study Area from 11 May through 29 October 2018.

STUDY AREA

The Study Area encompasses approximately 35,987 acres (14,563 hectares) of private and state-owned land within Benton County in southeastern Washington, approximately seven miles (11.3 kilometers) south of the city of Kennewick (Figure 1). Topography within the Study Area consists of rolling hills bisected by meandering canyons that drain primarily to the south and east into the Columbia River. Elevations range from approximately 630 feet (ft; 192 meters [m]) along the northeastern boundary of the Study Area to 2,010 ft (613 m) in the northwest. The eastern boundary of the Study Area lies adjacent to the Columbia River as it bends around the Study Area from the north to the southwest.

Land cover within the Study Area primarily consists of wheat associated with dry-land agriculture, with a smaller amount of uncultivated grassland managed as part of the US Department of Agriculture Farm Service Agency's Conservation Reserve Program. Small areas of shrub-steppe are located in topographically steep areas, such as along drainages where cultivation of crops is not possible. A few scattered trees, primarily associated with farms and residences, are distributed throughout the Study Area. These trees, as well as some structures in developed areas, may provide roosting habitat for bats.

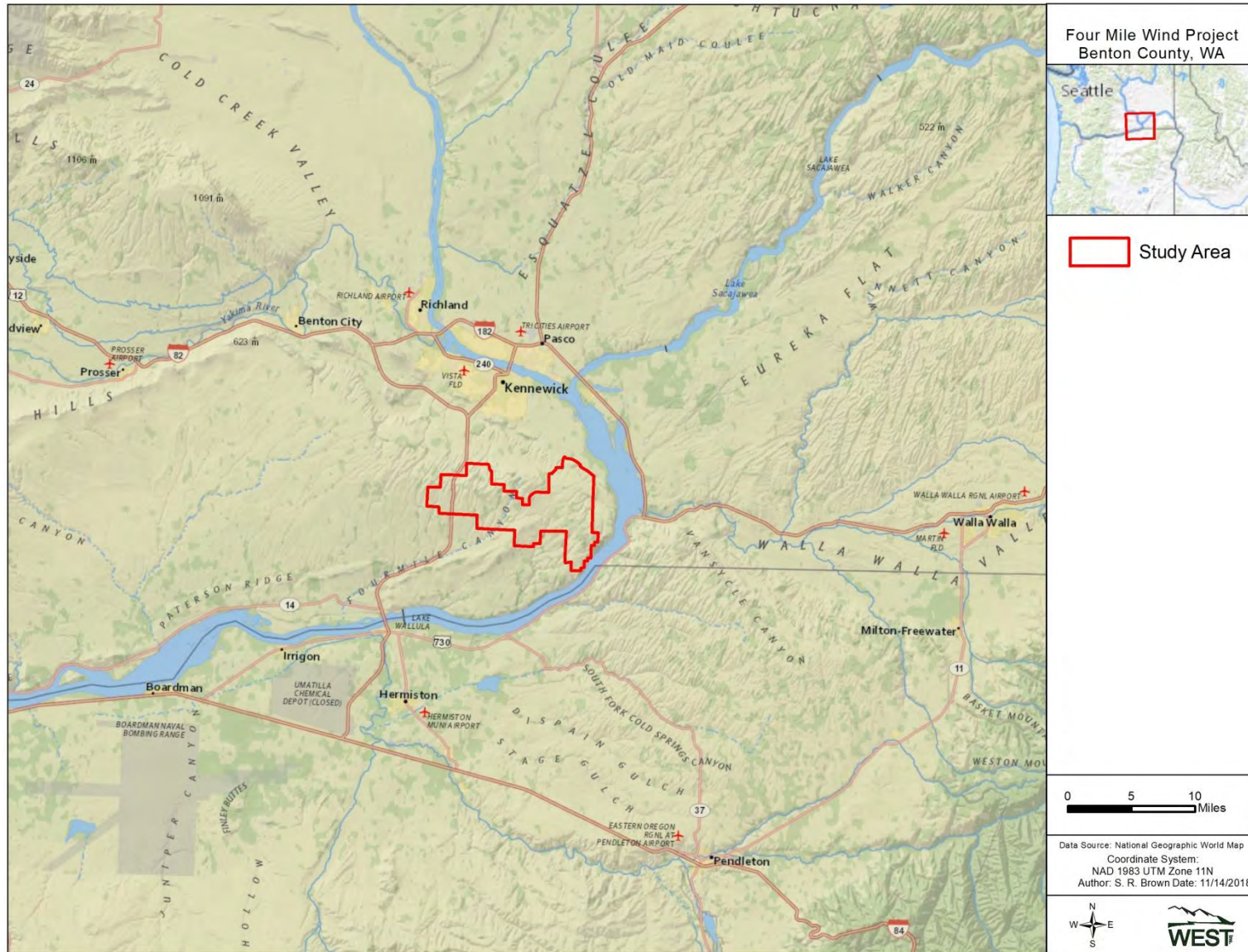


Figure 1. Location of the Four Mile Wind Project Study Area, Benton County, Washington.

Overview of Bat Diversity

Thirteen species of bats potentially occur in the Study Area (Hayes and Wiles 2013, International Union for the Conservation of Nature [IUCN] 2017; Table 1). None of these species are federally listed under the Endangered Species Act of 1973 and none are listed as threatened, endangered, or sensitive by the state of Washington (WDFW 2016). However, the Townsend's big-eared bat (*Corynorhinus townsendii*) and pallid bat (*Antrozous pallidus*), both of which have the potential to occur within the Study Area, are state candidate species (WDFW 2016).

Table 1. Bat species with potential to occur within the Four Mile Wind Project Study Area categorized by echolocation call frequency (International Union for Conservation of Nature [IUCN] 2017).

Common Name	Scientific Name
High-Frequency (> 30 kilohertz [kHz])	
California bat	<i>Myotis californicus</i>
canyon bat ¹	<i>Parastrellus hesperus</i>
little brown bat ¹	<i>Myotis lucifugus</i>
long-legged bat ¹	<i>Myotis volans</i>
western long-eared bat ¹	<i>Myotis evotis</i>
western small-footed bat ⁴	<i>Myotis ciliolabrum</i>
Yuma bat	<i>Myotis yumanensis</i>
Low-Frequency (15 – 30 kHz)	
big brown bat ¹	<i>Eptesicus fuscus</i>
hoary bat ^{1,2}	<i>Lasiurus cinereus</i>
pallid bat ³	<i>Antrozous pallidus</i>
silver-haired bat ^{1,2}	<i>Lasionycteris noctivagans</i>
Townsend's big-eared bat ³	<i>Corynorhinus townsendii</i>
Very Low-Frequency (< 15 kHz)	
spotted bat	<i>Euderma maculatum</i>

Source: Hayes and Wiles (2013)

¹species known to have been killed at wind energy facilities (species reported by: Anderson et al. 2004, Kunz et al. 2007b, Baerwald 2008, Miller 2008)

²Long-distance migrant

³Washington state candidate species (WDFW 2016)

METHODS

Bat Acoustic Surveys

WEST conducted acoustic surveys to estimate levels of bat activity within the Study Area during the period of known activity for migratory and resident bats in eastern Washington. A Wildlife Acoustics Song Meter (SM3) full-spectrum acoustic detector was deployed at each of two Project meteorological (met) towers on 11 May and documented bat activity within the Study Area through 29 October 2018. Both detectors were outfitted with two microphones; at each detector, one microphone was deployed near the ground, at approximately 5 feet (ft; 1.5 meters [m]), while the other microphone was raised on the met tower to approximately 148 ft (45 m) above ground level. The ground microphone is considered a ground sampling station (g), while the raised microphone is considered a raised sampling station (r); a total of four sampling stations were utilized during the study (FM1g, FM1r, FM2g and FM2r). Both met towers were located in grassland habitat,

which is the dominant land cover type within the Study Area and representative of future turbine locations, although sampling stations FM2g and FM2r were in relatively close proximity to cultivated cropland as well as a farm building and associated infrastructure. Large weatherproof boxes housed the detectors and external deep-cycle batteries for protection from weather and wildlife.

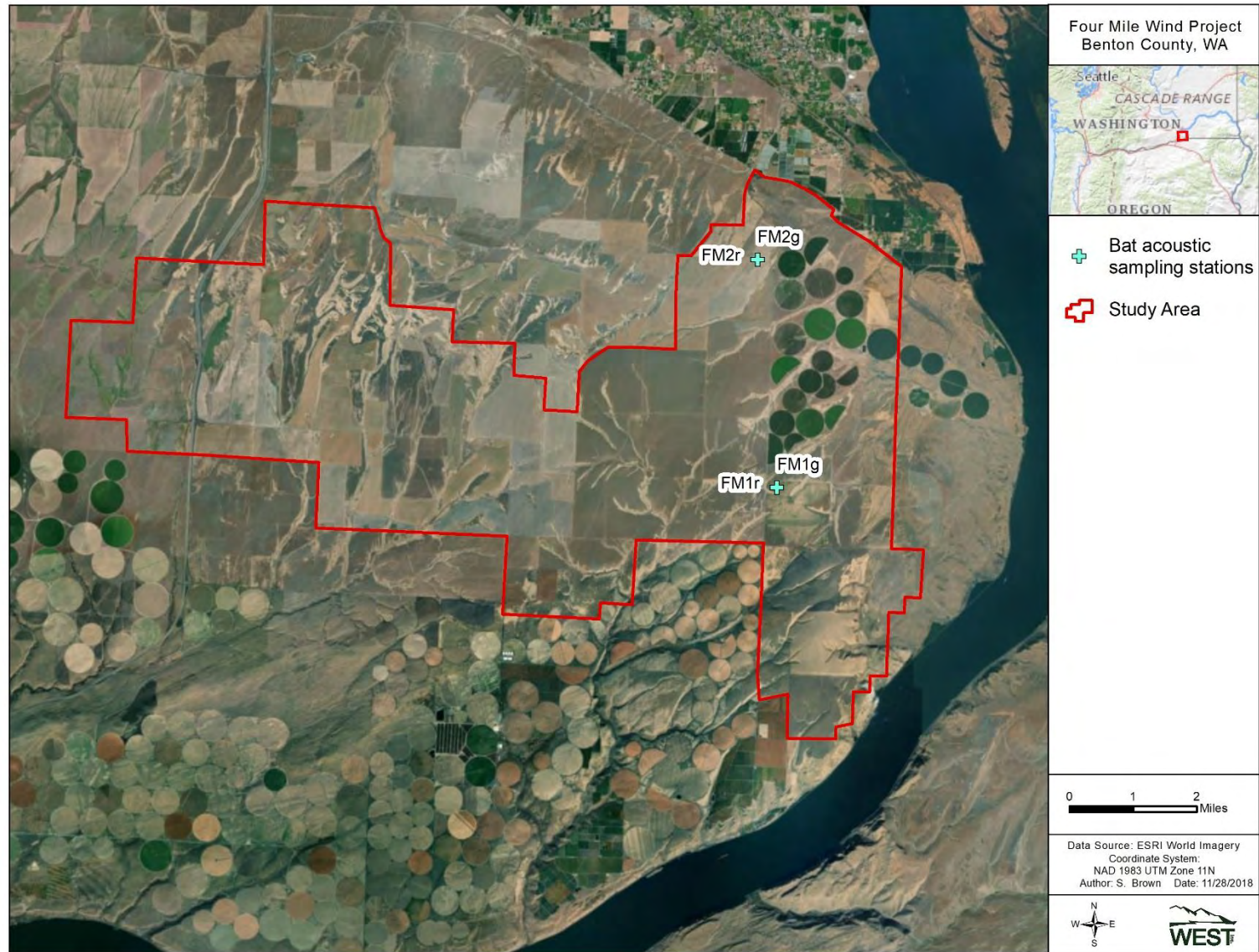


Figure 2. Location of sampling stations used during the bat activity study at the Four Mile Wind Project Study Area, Benton County, Washington.

Data Collection and Call Analysis

The Wildlife Acoustics Song Meter SM3 is a full-spectrum bat detector that records complete acoustic waveforms by sampling sound waves at 192 kilohertz (kHz). This high sampling rate enables the detector to make high-resolution recordings of sound amplitude data at all frequencies up to 96 kHz. High-quality recordings produced by the SM3 detector provide more information for making species-level identifications.

SM3 detectors use an omnidirectional microphone to detect and record bat echolocation calls that are then stored as files on one to four Secure Digital cards. During analysis, all recorded files were converted from full spectrum to zero cross (division ratio 8) using software program Kaleidoscope Pro (version 4.2.0; Wildlife Acoustics, Concord, Massachusetts). Noise files (e.g., wind or insect noise) were automatically filtered by Kaleidoscope into a Noise subfolder and not reviewed or included in results. All ultrasonic files were then viewed in Analook® software as digital sonograms that showed changes in echolocation call frequency over time. Frequency versus time displays were used to determine call frequency category and when possible, the species of bat that generated the calls.

For each detector station, bat passes were sorted into two groups based on minimum frequency. High-frequency (HF) bats, such as western long-eared bat (*Myotis evotis*), have minimum echolocation or social call frequencies greater than 30 kHz. Low-frequency (LF) bats, such as big brown bats (*Eptesicus fuscus*), silver-haired bats (*Lasionycteris noctivagans*), and hoary bats (*Lasiurus cinereus*), typically produce calls with minimum frequencies below 30 kHz.

For species identification purposes, files identified as HF and LF were run through an automated acoustic identification program, Kaleidoscope Pro (version 4.2.0; Wildlife Acoustics, Maynard, Massachusetts). The Bats of North America classifier (version 4.2.0; Wildlife Acoustics) was used at the recommended sensitivity setting of neutral (zero) to select for the 13 bat species that potentially occur within the Study Area (Table 1).

Statistical Analysis

The standard metric for measuring bat activity, the number of bat passes per detector-night, was used as an index of bat activity within the Study Area. A bat pass was defined as a sequence of at least two echolocation calls (pulses) produced by an individual bat with no pause between calls of more than one second (Fenton 1980, White and Gehrt 2001, Gannon et al. 2003). A detector-night was defined as one detector operating for one entire night. The terms bat pass and bat call are used interchangeably. Bat passes per detector-night was calculated for all bats, for HF bats, and for LF bats. Bat pass rates represent indices of bat activity and do not represent numbers of individuals. The number of bat passes was determined by an experienced bat biologist using Analook®.

Mean bat activity was calculated by detector station and overall. The period of peak sustained bat activity was defined as the seven-day period with the highest average bat activity. This and all multi-detector averages were calculated as unweighted averages of total activity at each detector.

Risk Assessment

Collision with wind turbine blades is the primary risk to bats at operating wind energy facilities (Arnett et al. 2008). The intent of the risk assessment is to use pre-construction bat activity data and other relevant information to describe the potential for bat fatalities at the Project. The intent of the risk assessment is not to predict the number of fatalities, but rather provide context for data collected within the Study Area. To assess the potential risk to bats at the Project, bat activity data collected within the Study Area in 2018 were compared to existing publicly available activity data from other wind energy facilities in the Rocky Mountains region. No publicly available bat activity data exists from the Pacific Northwest; data from the Rocky Mountains represent the closest region available for comparison.

Forecasting collision risk for bats at the Project is challenging for several reasons. First, there are relatively few publicly available studies presenting both pre-construction bat activity and post-construction fatality data, and the ecological differences among geographically dispersed facilities could limit the strength of inference. Further, as explained in detail below, there is no clear correlation between pre-construction bat activity and post-construction fatality data. Second, among studies with both pre-construction bat activity and post-construction fatality data, most pre-construction data were collected during the fall (i.e., the period of greatest risk) using Anabat™ zero-cross detectors (Titely Scientific™, Columbia, Missouri) placed near the ground. In contrast, this study used SM3 full-spectrum detectors near the ground and elevated near the rotor-swept area. Finally, the primary limitation of conducting a qualitative risk assessment for the Project is the difference in data collected by Anabat (used at most other projects) and SM3 detectors (used at the Project). Full-spectrum detectors, such as the SM3 units used at the Project, may record more bat passes per detector-night on average than the Anabat (zero-cross) units used for data collection at the majority of wind farms. Full-spectrum detectors have more sensitive microphones that sample more airspace, as well as different data processing algorithms (Solick et al. 2011, Adams et al. 2012), which may combine to result in higher activity rates than those measured by Anabat detectors. For this reason, activity levels recorded by SM3 detectors are not directly comparable to activity levels recorded by Anabat detectors, though trends in spatial and temporal activity rates collected by Anabat detectors can serve to contextualize trends in data collected using SM3 detectors. Differences in data collection technology (i.e., full-spectrum versus zero-cross detectors), and the resultant possibility that use of SM3 detectors rather than Anabat units at the Project led to increased collection of bat acoustic data should be considered. Inclusion of Anabat data in this report is for general discussion purposes only.

It is generally thought that pre-construction bat activity rates are positively related to post-construction bat fatalities (Kunz et al. 2007b). However, to date, few studies of wind energy facilities that have recorded both bat passes per detector night and bat fatality rates are publicly available (Appendix A). Given the limited availability of pre- and post-construction data sets, differences in protocols among studies (Ellison 2012), and significant ecological differences among geographically diverse facilities, the relationship between pre-construction activity and measured post-construction fatality rates has not been definitively established. In Canada, Baerwald and Barclay (2009) found a significant positive association between pass rates measured at 30 m (98 ft) above ground level and fatality rates for hoary and silver-haired bats

across five sites in southern Alberta. However, on a continental scale, a similar relationship has proven difficult to establish. The relatively few studies that have estimated both pre-construction activity and post-construction fatalities show results that trend toward a positive association between activity and fatality rates, but lack statistically significant correlations. Hein et al. (2013a) compiled study results that included both pre- and post-construction data from the same projects, as well as pre- and post-construction data from facilities within the same regions to assess if pre-construction acoustic activity predicted post-construction fatality rates. Based on data from 12 sites, Hein et al. (2013a) did not find a statistically significant relationship ($p = 0.07$), although the trend was in the expected direction (i.e., higher activity was generally associated with higher fatalities and vice-versa). For these reasons, the current approach to assessing risk to bats using pre-construction acoustic data requires a qualitative analysis of activity levels, spatial and temporal relationships, species composition, and comparison to known regional activity and/or fatality patterns.

RESULTS

Bat Acoustic Surveys

Bat Activity

Bat activity was documented at four sampling stations within the Study Area for a total of 670 detector-nights between 11 May and 29 October 2018 (Table 2). The overall operational rate for all sampling stations was 97% of the study period, due to a battery failure at FM1 during a week in late May – early June. Bat activity was higher at ground sampling station FM2g, with an average activity rate of 1.41 bat passes per detector-night, than at FM1g, which documented an average activity rate of 0.63 bat passes per detector-night (Table 2, Figure 3). This is accounted for by a greater number of both HF and LF bat passes recorded at FM2g, likely due to the sampling station's relative proximity to human structures, which provide roosting habitat, as well as to varied topographic features north of FM1g, which also provide increased roosting habitat. However, the average activity rate recorded at FM2g was still markedly lower than the average activity rate recorded in the Rocky Mountains region (i.e., 4.02 bat passes per detector-night), and the activity rate averaged between both ground sampling stations was 1.02 (Table 2, Figure 3), again markedly lower than the Rocky Mountains region. The period of peak bat activity at the Project occurred from 16 September through 24 September 2018 (Figure 4).

Table 2. Results of bat acoustic surveys by sampling station conducted at the Four Mile Wind Project Study Area from 11 May – 29 October 2018. Passes are separated by call frequency: high frequency (HF) and low frequency (LF).

Detector Station	Type	Habitat	Number of HF Bat Passes	Number of LF Bat Passes	Total Bat Passes	Detector-Nights	Bat Passes/Night*
FM1g	ground	grassland	8	95	103	163	0.63±0.12
FM1r	raised	grassland	2	152	154	163	0.94±0.11
FM2g	ground	grassland	41	202	243	172	1.41±0.17
FM2r	raised	grassland	4	230	234	172	1.36±0.14
Total			55	679	734	670	1.09 ± 0.11

* ± bootstrapped standard error.

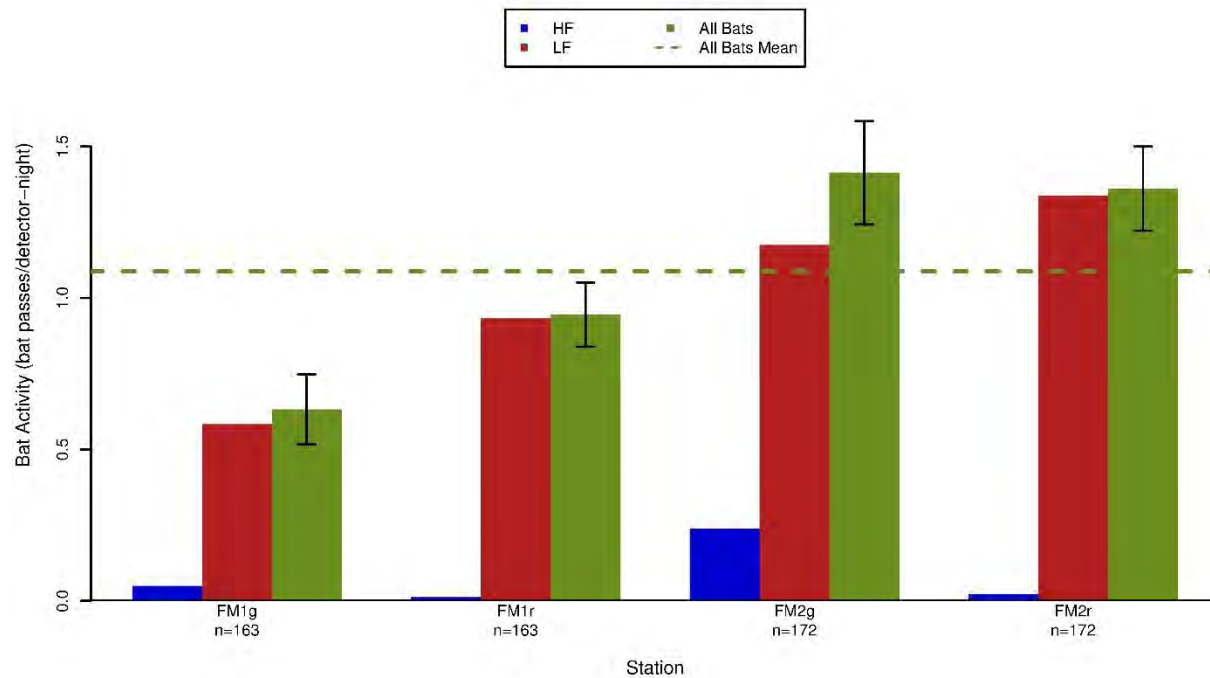


Figure 3. Bat passes per detector-night for high-frequency (HF), low-frequency (LF) and all bats recorded at the Four Mile Wind Project Study Area from 11 May – 29 October 2018. Bootstrapped standard errors are represented by black error bars on the 'All Bats' columns.

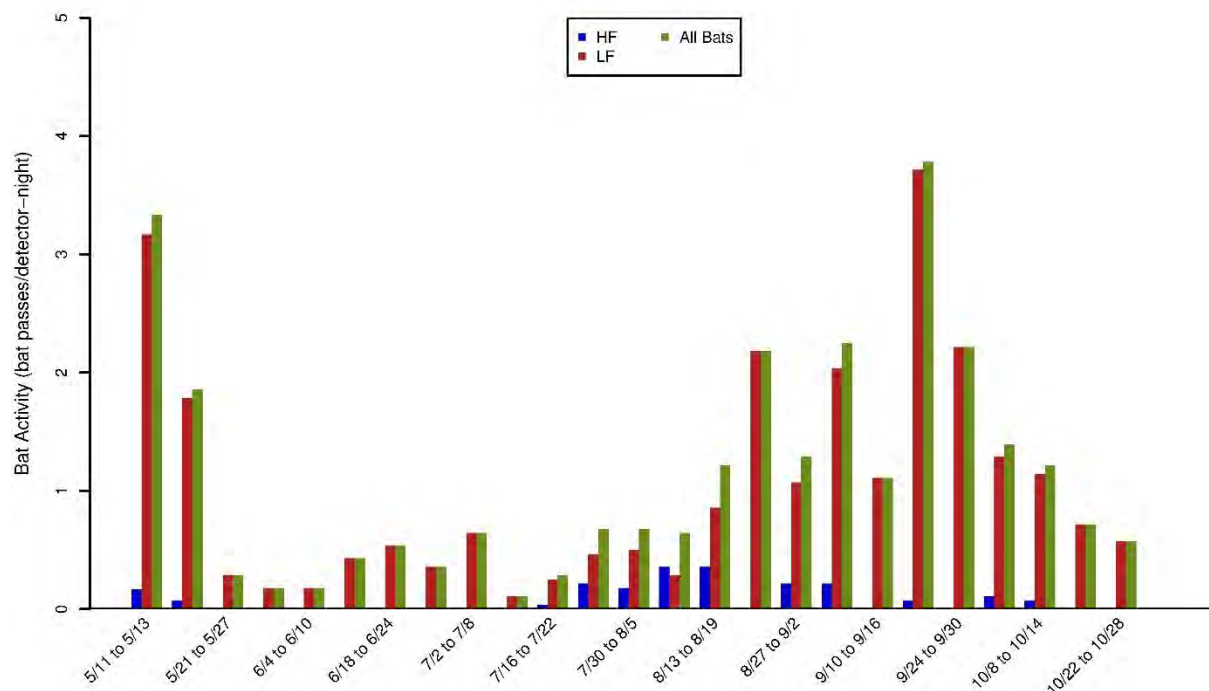


Figure 4. Weekly patterns of bat activity for high-frequency (HF), low-frequency (LF), and all bats at the Four Mile Wind Project Study Area from 11 May – 29 October 2018.

Species Composition

At all sampling stations, approximately 92.5% of bat passes were classified as LF (e.g., silver-haired bat, hoary bat, big brown bat), and approximately 7.5% of bat passes were classified as HF (i.e., California bat [*M. californicus*], canyon bat [*Parastrellus hesperus*], little brown bat [*M. lucifugus*], long-legged bat [*M. volans*], and western long-eared bat; Table 3). Results from Kaleidoscope Pro automated call identification were reviewed by an experienced bat biologist: bat calls for eight of the 13 species identified as having potential to occur within the Study Area were confirmed (Table 1; Table 3). Silver-haired bat was the primary species documented during the study period, detected on approximately 25% of detector-nights (Table 3). Hoary bat and big brown bat were the next most commonly detected species, occurring on approximately 14% and 5% of detector-nights, respectively (Table 3). Canyon bat was the most frequently detected HF bat, documented on approximately 2% of detector-nights, followed by little brown bat, which was documented on approximately 1% of detector-nights. California bat, long-legged bat and western long-eared bat were all documented on less than 1% of detector-nights during the study period (Table 3). Townsend's big-eared bat and pallid bat calls were not confirmed during the study period; no federal or state-listed bat species were detected.

Table 3. Nights (and percent) species present by sampling station at the Four Mile Wind Project Study Area from 11 May – 29 October 2018.

Common Name	FM1g*	FM1r*	FM2g*	FM2r*	Total
High-Frequency (> 30 kHz)					
California bat	0 (0%)	0 (0%)	1 (1%)	0 (0%)	1 (<1%)
canyon bat	1 (1%)	0 (0%)	10 (6%)	0 (0%)	11 (2%)
little brown bat	3 (2%)	0 (0%)	5 (3%)	0 (0%)	8 (1%)
long-legged bat	0 (0%)	0 (0%)	2 (1%)	0 (0%)	2 (<1%)
western long-eared bat	1 (1%)	0 (0%)	0 (0%)	0 (0%)	1 (<1%)
Low-Frequency (< 30 kHz)					
big brown bat	4 (2%)	6 (4%)	13 (8%)	8 (5%)	31 (5%)
hoary bat	5 (3%)	23 (14%)	20 (12%)	43 (25%)	91 (14%)
silver-haired bat	29 (18%)	40 (25%)	45 (26%)	55 (32%)	169 (25%)

*Nights species present
kHz = kilohertz

DISCUSSION AND RISK ASSESSMENT

Bat fatalities have been discovered at most monitored wind energy facilities in North America and globally (Arnett et al. 2016), with bat fatality rates in the US ranging from zero (Chatfield and Bay 2014) to 40.2 bats/megawatt (MW)/year (Hein et al. 2013b). In 2012, an estimated 600,000 bats died as a result of interactions with wind turbines in the US (Hayes 2013), and hoary bat population viability may be threatened by fatalities caused by wind turbines (Frick et al. 2017). Proximate causes of bat fatalities are primarily due to collisions with moving turbine blades (Grodsky et al. 2011, Rollins et al. 2012), but to a limited extent may also be caused by barotrauma (Baerwald et al. 2008). The underlying reasons bats approach wind turbines are still largely unknown (Cryan and Barclay 2009, Reimer et al. 2018).

Several key findings from the bat activity study at the Project are consistent with known patterns from other studies in the western US. First, the eight bat species confirmed within the Study Area are known from throughout the region and the most commonly detected species (silver-haired and hoary bats) are migratory tree-roosting bats, a pattern consistent with known trends. Second, the period of peak activity during the study period occurred in the fall, consistent with known patterns from the region and throughout the western US. Third, bat activity rates documented within the Study Area were relatively consistent with activity rates from the closest region with publicly available data (i.e., Rocky Mountains region).

Approximately 93% of bat passes recorded within the Study Area were produced by three LF bat species (i.e., silver-haired bat, hoary bat, big brown bat), which were documented on 25%, 14%, and 5% of detector-nights, respectively. Low-frequency bats, including silver-haired and hoary bats are the most commonly reported fatalities at many wind energy facilities in the US (Arnett et al. 2008, Arnett and Baerwald 2013, Thompson et al. 2017). Given these results and trends seen elsewhere in the US, LF bats including silver-haired bat and hoary bats would likely have the highest risk of collision at the Project.

Bat activity within the Study Area peaked in mid September, which is consistent with known patterns from the region and throughout the western US. During the fall, migratory bats may begin moving toward wintering areas, and many species initiate reproductive behaviors (Cryan 2008). This period of increased landscape-scale movement and reproductive behavior is often associated with increased levels of bat fatalities at operational wind energy facilities (Arnett et al. 2008; Arnett and Baerwald 2013, Thompson et al. 2017). If risk patterns at the Project are consistent with known trends, it is likely that most fatalities would occur during the fall.

Overall, bat activity Within the Study Area (1.09 bat passes per detector-night) was well below the Rocky Mountains regional average of 4.02 bat passes per detector-night (Appendix A), which is the closest region with publicly available activity data (no activity data from the Pacific Northwest is available for comparison). Corresponding post-construction bat fatality rates for the Rocky Mountains region range from 1.05 to 11.42 bats/MW/year, with an average of 4.90 bats/MW/year (Appendix A). As the relationship between pre-construction activity rates and post-construction fatality rates has not been definitively established (Hein et al. 2013; see Risk Assessment in Methods section p. 6-7), fatality rates documented at other facilities in the Pacific Northwest, where a majority of wind energy facilities are located along the Columbia Plateau, were used to assess potential risk to bats at the Project. At these Pacific Northwest facilities, bat fatality rates have ranged from 0.12 to 4.23 bats/MW/year with an average fatality rate of 1.19 bats/MW/year (Appendix A). This is considerably lower than that documented in the Rocky Mountains region. If risk patterns at the Project are similar to patterns elsewhere in the Pacific Northwest, it is likely that fatality rates at the Project would be similarly low.

CONCLUSION

To date, post-construction monitoring studies of wind energy facilities in North America show that: a) collision mortality is greatest for migratory tree-roosting species (e.g., hoary bat and silver-haired bat; Thompson et al. 2017), which make up approximately 78% of reported bat fatalities; b) the majority of fatalities occur during the fall migration season (Thompson et al. 2017); and c) most fatalities occur on nights with relatively low wind speeds (e.g., less than 6.0 m per second [19.7 ft per second]; Arnett et al. 2008, 2013; Arnett and Baerwald 2013). Finally, a recent meta-analysis suggests that bat mortality rates at wind facilities increase as relative grassland cover (or open cover) decreases (Thompson et al. 2017), suggesting that facilities or turbines in forested areas have higher fatality rates than facilities or turbines that lack surrounding tree cover. Given these trends and the results from the bat activity study within the Study Area in 2018, it is likely that bat mortality at the Project, once operational, would be: a) low, similar to other Pacific Northwest facilities; b) consist primarily of migratory, tree-roosting species (i.e., silver-haired bat, hoary bat); and c) occur mainly in the fall.

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Appendix A. Pacific Northwest and Rocky Mountain Fatality Summary Tables

Appendix A. Wind energy facilities in the Pacific Northwest and Rocky Mountains region of North America with comparable activity and fatality data for bats, separated by geographic region. Activity estimate given as bat passes per detector-night. Fatality estimate given as the number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Four Mile (2018)	1.02	5/11/18 – 10/29/18			
<i>Pacific Northwest</i>					
Mean	--		1.19	99	134.1
Palouse Wind, WA (2012-2013)			4.23	58	104.4
Biglow Canyon, OR (Phase II; 2009-2010)			2.71	65	150
Nine Canyon, WA (2002-2003)			2.47	37	48.1
Stateline, OR/WA (2003)			2.29	454	299
Elkhorn, OR (2010)			2.14	61	101
White Creek, WA (2007-2011)			2.04	89	204.7
Biglow Canyon, OR (Phase I; 2008)			1.99	76	125.4
Leaning Juniper, OR (2006-2008)			1.98	67	100.5
Big Horn, WA (2006-2007)			1.9	133	199.5
Combine Hills, OR (Phase I; 2004-2005)			1.88	41	41
Linden Ranch, WA (2010-2011)			1.68	25	50
Pebble Springs, OR (2009-2010)			1.55	47	98.7
Hopkins Ridge, WA (2008)			1.39	87	156.6
Harvest Wind, WA (2010-2012)			1.27	43	98.9
Elkhorn, OR (2008)			1.26	61	101
Vansycle, OR (1999)			1.12	38	24.9
Klondike III (Phase I), OR (2007-2009)			1.11	125	223.6
Stateline, OR/WA (2001-2002)			1.09	454	299
Stateline, OR/WA (2006)			0.95	454	299
Tuolumne (Windy Point I), WA (2009-2010)			0.94	62	136.6
Klondike, OR (2002-2003)			0.77	16	24
Combine Hills, OR (2011)			0.73	104	104
Hopkins Ridge, WA (2006)			0.63	83	150
Biglow Canyon, OR (Phase I; 2009)			0.58	76	125.4
Biglow Canyon, OR (Phase II; 2010-2011)			0.57	65	150
Hay Canyon, OR (2009-2010)			0.53	48	100.8
Windy Flats, WA (2010-2011)			0.41	114	262.2
Klondike II, OR (2005-2006)			0.41	50	75
Vantage, WA (2010-2011)			0.4	60	90
Wild Horse, WA (2007)			0.39	127	229
Goodnoe, WA (2009-2010)			0.34	47	94
Marengo II, WA (2009-2010)			0.27	39	70.2
Biglow Canyon, OR (Phase III; 2010-2011)			0.22	76	174.8
Marengo I, WA (2009-2010)			0.17	78	140.4
Klondike IIIa (Phase II), OR (2008-2010)			0.14	51	76.5
Kittitas Valley, WA (2011-2012)			0.12	48	100.8
<i>Rocky Mountains</i>					
Mean	4.02		4.90	70	85.0
Summerview, Alb (2006; 2007)	7.65 ^A	07/15/06-07-09/30/06-07	11.42	39	70.2
Summerview, Alb (2005-2006)			10.27	39	70.2
Judith Gap, MT (2006-2007)			8.93	90	135

Appendix A. Wind energy facilities in the Pacific Northwest and Rocky Mountains region of North America with comparable activity and fatality data for bats, separated by geographic region. Activity estimate given as bat passes per detector-night. Fatality estimate given as the number of fatalities per megawatt (MW) per year.

Wind Energy Facility	Bat Activity Estimate	Bat Activity Dates	Fatality Estimate	No. of Turbines	Total MW
Foot Creek Rim, WY (Phase I; 1999)			3.97	69	41.4
Judith Gap, MT (2009)			3.2	90	135
Milford I, UT (2010-2011)			2.05	58	145
					160.5
					(58.5
Milford I & II, UT (2011-2012)			1.67	107	Phase I, 102
					Phase II)
Foot Creek Rim, WY (Phase I; 2001-2002)	2.2 ^{A,B}	6/15/01-9/1/01	1.57	69	41.4
Foot Creek Rim, WY (Phase I; 2000)	2.2 ^{A,B}	6/15/00-9/1/00	1.05	69	41.4

A = Activity rate was averaged across phases and/or years

B = Activity rate calculated by WEST from data presented in referenced report

Appendix A (continued). Wind energy facilities in the Pacific Northwest and Rocky Mountain regions of North America with comparable activity and fatality data for bats. Data from the following sources:

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
Big Horn, WA (06-07)		Kronner et al. 2008	Klondike III (Phase I), OR (07-09)		Gritski et al. 2010
Biglow Canyon, OR (Phase I; 08)		Jeffrey et al. 2009b	Klondike IIIa (Phase II), OR (08-10)		Gritski et al. 2011
Biglow Canyon, OR (Phase I; 09)		Enk et al. 2010	Leaning Juniper, OR (06-08)		Gritski et al. 2008
Biglow Canyon, OR (Phase II; 09-10)		Enk et al. 2011b	Linden Ranch, WA (2010-2011)		Enz and Bay 2011
Biglow Canyon, OR (Phase II; 10-11)		Enk et al. 2012b	Marengo I, WA (2009-2010)		URS Corporation 2010b
Biglow Canyon, OR (Phase III; 10-11)		Enk et al. 2012a	Marengo II, WA (2009-2010)		URS Corporation 2010c
Combine Hills, OR (Phase I; 04-05)		Young et al. 2006	Milford I & II, UT (2011-2012)		Stantec 2011b
Combine Hills, OR (11)		Enz et al. 2012	Milford I, UT (2010-2011)		Stantec 2012b
Elkhorn, OR (08)		Jeffrey et al. 2009a	Nine Canyon, WA (2002-2003)		Erickson et al. 2003
Elkhorn, OR (10)		Enk et al. 2011a	Palouse Wind, WA (12-13)		Stantec 2013a
Foot Creek Rim, WY (Phase I; 99)		Young et al. 2003a	Pebble Springs, OR (09-10)		Gritski and Kronner 2010b
Foot Creek Rim, WY (Phase I; 00)	Gruver 2002	Young et al. 2003a, 2003b	Stateline, OR/WA (01-02)		Erickson et al. 2004
Foot Creek Rim, WY (Phase I; 01-02)		Young et al. 2003a, 2003b	Stateline, OR/WA (03)		Erickson et al. 2004
Goodnoe, WA (09-10)		URS Corporation 2010a	Stateline, OR/WA (06)		Erickson et al. 2007
Harvest Wind, WA (10-12)		Downes and Gritski 2012a	Summerview, Alb (05-06)		Brown and Hamilton 2006
Hay Canyon, OR (09-10)		Gritski and Kronner 2010a	Summerview, Alb (06; 07)	Baerwald 2008	Baerwald 2008
Hopkins Ridge, WA (06)		Young et al. 2007	Tuolumne (Windy Point I), WA (09-10)		Enz and Bay 2010
Hopkins Ridge, WA (08)		Young et al. 2009b	Vansycle, OR (99)		Erickson et al. 2000
Judith Gap, MT (06-07)		TRC 2008	Vantage, WA (10-11)		Ventus 2012
Judith Gap, MT (09)		Poultton and Erickson 2010	White Creek, WA (07-11)		Downes and Gritski 2012b
Kittitas Valley, WA (11-12)		Stantec Consulting Services 2012	Wild Horse, WA (07)		Erickson et al. 2008
Klondike, OR (02-03)		Johnson et al. 2003	Windy Flats, WA (10-11)		Enz et al. 2011
Klondike II, OR (05-06)		NWC and WEST 2007			

Avian Use Surveys at the Badger Canyon Wind Project, Benton County, Washington

**Final Report
June 2018 – May 2019**



Prepared for:
Badger Canyon MW LLC
205 SE Spokane Street, Suite 300
Portland, Oregon 97202

Prepared by:
Andrea Chatfield, Joel Thompson, Catherine Read, and Diem Pham
Western EcoSystems Technology, Inc.
2725 NW Walnut Boulevard
Corvallis, Oregon 97330

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EXECUTIVE SUMMARY

Badger Canyon MW LLC (Badger Canyon) is proposing to develop the Badger Canyon Wind Project (Project) in Benton County, Washington. To support the development of the Project, Badger Canyon contracted Western EcoSystems Technology, Inc. to conduct a pre-construction avian use study in the area where the Project is proposed (Study Area). The principle objective of the study was to assess the temporal and spatial use of the Study Area by large and small birds, including eagles and other species of regulatory or conservation concern.

Fixed-point avian use surveys were conducted at 28 points located throughout the Study Area from June 7, 2018 to May 28, 2019. Two separate surveys were conducted at each point every month: a 10-minute (min) small bird survey immediately followed by a 60-min large bird survey. Over the course of the study, 327 large bird surveys were completed and a total of 2,794 large bird observations representing 24 species were recorded. Large bird use was highest in fall, largely due to higher use by waterbirds and waterfowl during this season. Diurnal raptor use was also highest in fall (2.81 birds/plot/60-min survey), and lowest in winter (0.53). Nine separate diurnal raptor species were recorded during surveys, the most common of which was northern harrier (169 observations), which composed over a third (34%) of all diurnal raptor observations. This was followed by Swainson's hawk (93 observations), rough-legged hawk (84 observations), and red-tailed hawk (74 observations). Only a single eagle, a bald eagle observed in spring, was recorded during the study. Diurnal raptors were observed at all 28 points; however, relatively higher raptor use was recorded in the southeast portion of the Study Area, with the highest use recorded at Point 21 (3.08 birds/plot/60-min survey). Annual mean raptor use at the Project was scaled to 20-min to compare with other wind energy sites in Washington and Oregon that implemented similar protocols and had data for three or four seasons. Diurnal raptor use at the Project (0.73 raptors/plot/20-min) was well within the range of estimated raptor use at these other regional facilities.

Over the course of the 327 small bird surveys conducted during the study, a total of 2,233 small bird observations, representing 15 separate species, were recorded. The most abundant small bird species recorded was horned lark (2,061 observations) which composed 92.3% of all small bird observations. Three species, savannah sparrow, western meadowlark, and barn swallow composed an additional 5.0% of small bird observations. The highest small bird use was recorded in winter (13.81 birds/plot/10-min survey), followed by spring (6.11), fall (5.93), and summer (3.35). Small bird use varied widely across the 28 survey points, ranging from 1.45 to 22.58 birds/10-min survey.

During surveys or incidentally, six bird species of concern were recorded within the Study Area including one state-endangered species (sandhill crane), one state-threatened species (American white pelican), and one state candidate for listing (loggerhead shrike). Each of these species, in addition to prairie falcon and tundra swan, is also considered a state Priority Species. Bald eagles are protected under the federal Bald and Golden Eagle Protection Act.

To date, overall fatality rates for birds at wind energy facilities in the Pacific Northwest with publicly available data have been variable, ranging from 0.16 to 8.45 birds/megawatt (MW)/year, with fatality rates for diurnal raptors ranging from zero to 0.47 bird/MW/year. The Study Area is dominated by agricultural cover types (i.e., cultivated cropland) of limited value to most avian species, particularly species of conservation concern. While several species of concern were documented during the study, these observations were not unexpected for the region and these species are believed to be at relatively low risk from Project development and operation given their use of the Study Area, and known interactions with turbines in the region. There is nothing in the data collected within the Study Area to date that would suggest the Project would fall outside of the range of impacts observed at other wind energy facilities in Oregon and Washington.

STUDY PARTICIPANTS

Andrea Chatfield	Project Manager
Joel Thompson	Senior Reviewer
Carmen Boyd	Project Tracking and Data Manager
Diem Pham	Statistician
Catherine Read	Data Analyst
Mysti Martin	GIS Technician
Katie Wynne	Technical Editor
Kori Hutchison	Field Supervisor
Joshua Parrott	Field Technician

REPORT REFERENCE

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INTRODUCTION

Badger Canyon MW LLC (Badger Canyon) is proposing to develop the Badger Canyon Wind Project (Project) in Benton County, Washington. To support the development of the Project, Badger Canyon contracted Western EcoSystems Technology, Inc. (WEST) to conduct a pre-construction avian use study in the area where the Project is proposed (Study Area). Study methodology was based upon the recommendations in the US Fish and Wildlife Service (USFWS) 2012 *Final Land-Based Wind Energy Guidelines* (WEG; USFWS 2012), Appendix C(1)(a) of the 2013 USFWS *Eagle Conservation Plan Guidelines* (ECPG; USFWS 2013), the USFWS 2016 *Revisions to Regulations for Eagle Incidental Take and Take of Eagle Nests* (Final Eagle Rule; 81 FR 91494 [December 16, 2016]), and the Washington Department of Fish and Wildlife (WDFW) Wind Power Guidelines (WDFW 2009). The principle objective of the study was to assess the temporal and spatial use of the Study Area by large and small birds, including eagles and other species of concern (USFWS 2012). This report summarizes methods and results from the year-long avian use study conducted at the proposed Project.

STUDY AREA

The Study Area encompasses 14,791 hectares (36,550 acres) of privately owned land within Benton County in southeastern Washington, approximately 3.9 kilometers (km; 2.4 miles [mi]) south of Benton City and 19.2 km (12.0 mi) west of the city of Kennewick (Figure 1). Topography is gently sloping, with elevations ranging from 351 meters (m; 1,150 feet [ft]) in the southwest corner of the Study Area to 567 m (1,860 ft) along the eastern edge of the Study Area. The Horse Heaven Hills, an anticline ridge of the Yakima Folds, lies along the northeastern border of the Study Area. On the southern side of the ridge, the landscape transitions to relatively rolling topography with shallow, meandering canyons that drain southwest into the Columbia River. At its closest point, the Columbia River runs approximately 12.9 km (8.0 mi) to the northeast of the Study Area and wraps around the Study Area to the east and south (Figure 1). The Yakima River flows eastward into the Columbia approximately 3.2 km (2.0 mi) to the north of the Study Area (Figure 1).

Historically, the native vegetation of the Study Area consisted of a bluebunch wheatgrass (*Pseudoroegneria spicata*)-Idaho fescue (*Festuca idahoensis*) zonal association, which was predominately grassland and shrub-steppe with deciduous riparian forest and scrub along drainages (Franklin and Dyrness 1973). Today, native grassland and shrub-steppe habitats have been replaced by tilled dry-land agriculture (primarily wheat) with a smaller amount of uncultivated grassland, the majority of which is managed as part of the US Department of Agriculture Farm Service Agency's Conservation Reserve Program. Based on vegetation and land cover mapping conducted within the Study Area, four vegetation/land cover types were identified within the Study Area (Chatfield and Brown 2018). The predominant cover type was agriculture, encompassing 81.8% of the total Study Area (Figure 2). Agricultural areas within the Study Area are primarily cultivated cropland consisting of dryland wheat. This was followed by grasslands which encompassed a further 16.5% of the Study Area (Figure 2). Smaller areas of remnant shrub-

steppe (1.4% of the Study Area) were located primarily along drainages in the southeastern corner of the Study Area (Figure 2). Very small areas of development (mainly individual structures, residences, or farm buildings) are scattered throughout the Study Area, and compose the remaining 0.2% of the Study Area (Figure 2). Although the areas containing shrub-steppe are relatively small, shrub-steppe is considered an important habitat type for avian species, providing critical nesting and foraging opportunities (WDFW 2009). Trees primarily associated with farms and residences are scattered throughout the Study Area.

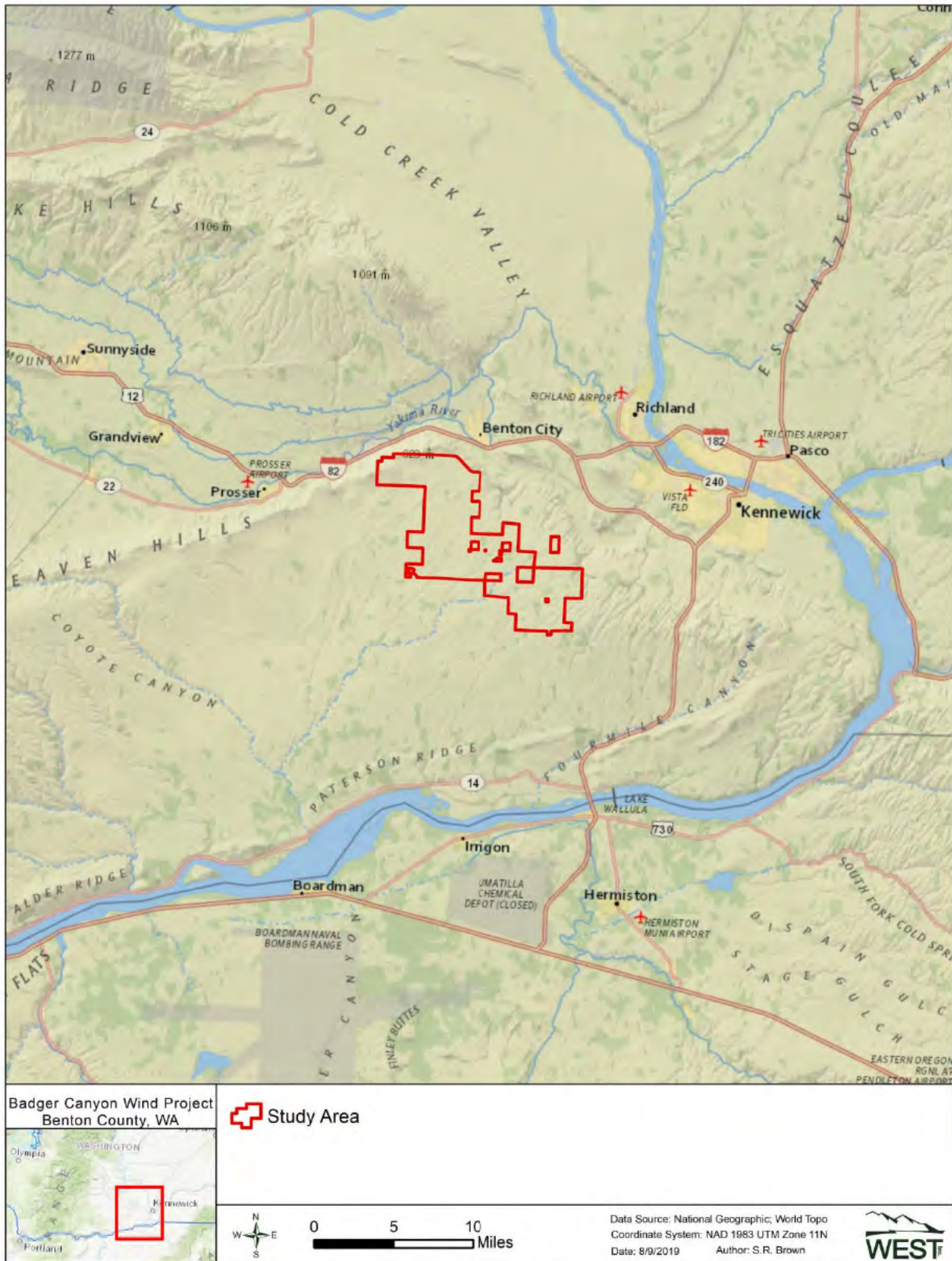


Figure 1. Location of the proposed Badger Canyon Wind Project, Benton County, Washington.

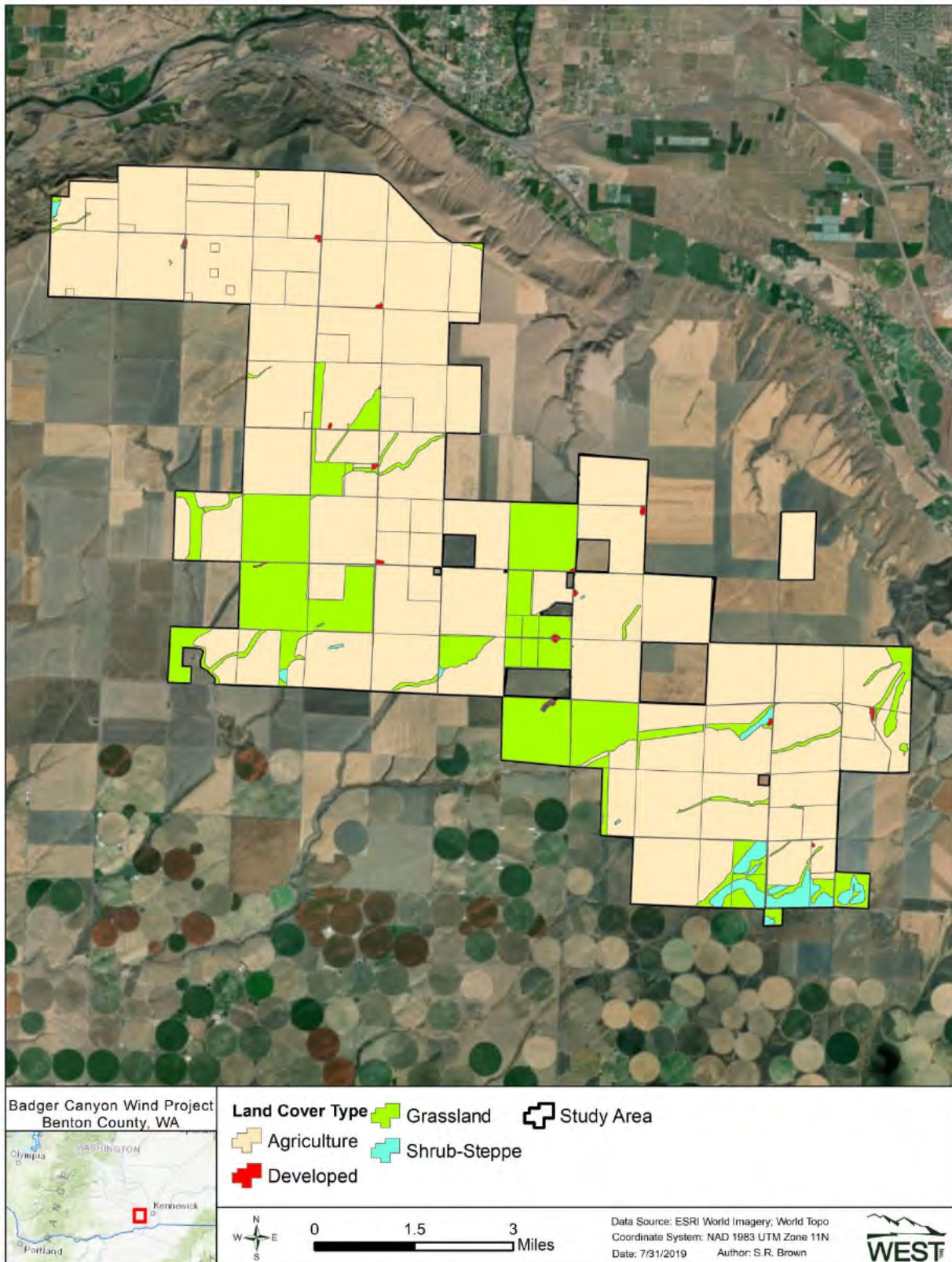


Figure 2. Land cover types and coverage within the Badger Canyon Wind Project Study Area, Benton County, Washington.

METHODS

Because of the need to collect information recommended by the USFWS specifically for eagles, the study design and survey methods primarily followed guidance from the ECPG and the Final Eagle Rule; however, this guidance is also appropriate for collecting data on other large bird species (e.g., other diurnal raptors, waterfowl, waterbirds). Because of the additional need to collect information on small bird species, small bird surveys were incorporated into the study design using guidance from the WEG and WDFW Wind Power Guidelines. Methods described below, therefore, are common for all birds (i.e., large and small birds, eagles, and other species of concern) except as noted.

Species of concern are defined per the WEG as any species that 1) is either a) listed as an endangered, threatened or candidate species under the Endangered Species Act, subject to the Migratory Bird Treaty Act (1918) or Bald and Golden Eagle Protection Act (BGEPA; 1940); b) is designated by law, regulation, or other formal process for protection and/or management by the relevant agency or other authority; or c) has been shown to be significantly adversely affected by wind energy development, and 2) is determined to be possibly affected by the Project (USFWS 2012).

Large birds are defined as waterbirds, waterfowl, shorebirds, gulls/terns, diurnal raptors (i.e., kites, accipiters, buteos, eagles, falcons, northern harrier, and osprey), owls, vultures, upland game birds, doves/pigeons, goatsuckers, large corvids (e.g., magpies, crows, and ravens). Small birds are defined as cuckoos, swifts/hummingbirds, woodpeckers, kingfishers, and passerines.

Study Design

Twenty-eight survey points were established in the Study Area to achieve a minimum of 30% coverage as recommended in the Final Eagle Rule (81 FR 91494 [December 16, 2016]; Figure 3). Each point was centered on a circular survey plot with an 800-m (2,625-ft) radius for large birds (including eagles) and 100-m (328-ft) radius for small birds (Reynolds et al. 1980, USFWS 2013, 81 FR 91494 [December 16, 2016]).

Surveys at all 28 points were conducted once per month during all seasons, as specified in the ECPG (USFWS 2013) and Final Eagle Rule (81 FR 91494 [December 16, 2016]), from June 7, 2018 to May 28, 2019. Seasons were defined: summer (June 1 – August 31), fall (September 1 – November 30), winter (December 1 – February 28), and spring (March 1 – May 31). Surveys were conducted during daylight hours and survey times at survey points were randomized to cover all daylight hours during a season. Surveys were conducted under all weather conditions except when visibility was less than 800 m horizontally and 200 m (656 ft) vertically.

Survey Methods

All Birds

Surveys at each point were conducted for a period of 70 minutes (min), with only small birds recorded during the first 10 min of the survey period, and only large birds (including eagles) recorded for the remaining 60 min of the survey period. Biologists recorded the following information for each survey: date, start and end time, and weather (i.e., temperature, wind speed, wind direction, precipitation, and percent cloud cover). Additionally, the following data were recorded for each group of birds observed:

- Observation number
- Species (or best possible identification)
- Number of individuals
- Sex and age class (if identifiable)
- Distance from survey plot center to the nearest 5-m (16-ft) interval (first & closest)
- Flight height above ground level (AGL) to the nearest 5-m interval (first, lowest, and highest)
- Flight direction (first observed)
- Habitat
- Activity (e.g., flying, perched)
- Observation type (visual or aural)
- Flight paths and perch locations of eagles, other diurnal raptors, waterbirds, and waterfowl

Eagles

Data were collected based on the recommendations in the ECPG (USFWS 2013) and the Final Eagle Rule (81 FR 91494 [December 16, 2016]) if a bald eagle (*Haliaeetus leucocephalus*) or golden eagle (*Aquila chrysaetos*) was observed during the survey period. Biologists recorded eagle behavior (i.e., flight height, distance from observer, activity) each minute, at the top of the minute, to provide an instantaneous count for every eagle observed, and age class (juvenile [1st year], immature or sub-adult [2nd to 4th year], adult [\geq 5th year]).

Incidental Observations

Incidental wildlife observations are wildlife seen outside of the standardized survey periods but within the Study Area and are focused on federal- or state-protected species, unusually large congregations of individuals, species not yet recorded during surveys, or eagle attractants (e.g., ground squirrel [*Urocitellus* spp.] colonies, areas with concentration of carrion). Data recorded for incidentally observed species were similar to that recorded during scheduled surveys, with the exception that minute by minute data were not recorded for eagles observed incidentally.

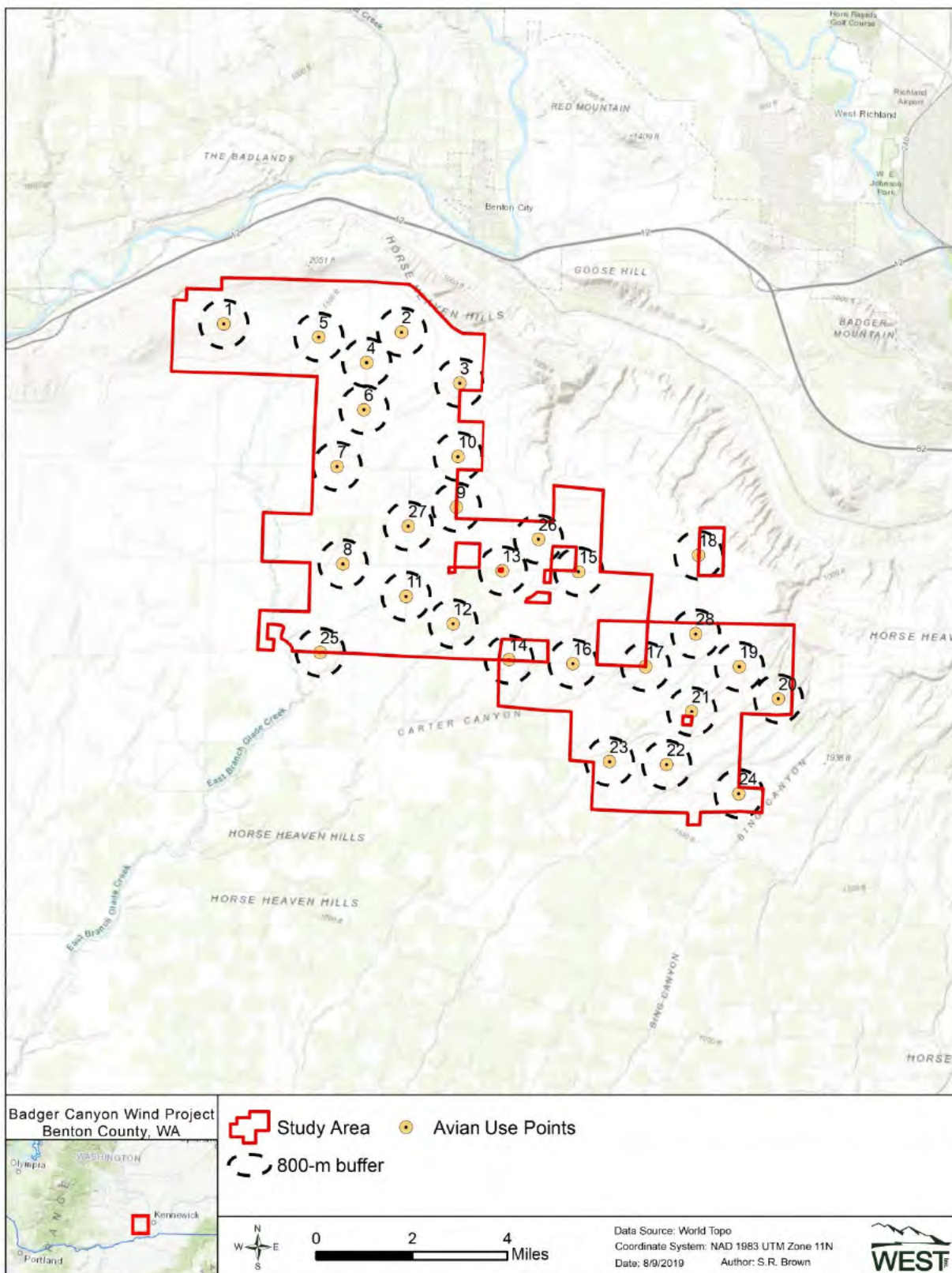


Figure 3. Location of survey points and plots used during fixed-point avian use surveys at the Badger Canyon Wind Project from June 7, 2018 to May 28, 2019.

Data Management

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following surveys, biologists were responsible for inspecting data forms for completeness, accuracy, and legibility. If errors or anomalies were found within the data, follow-up measures were implemented including discussions and review of field data with field technicians and/or project manager. Any errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms where appropriate changes and measures were implemented, no matter what stage of analysis. Multiple reviews were conducted as part of the QA/QC process.

Data Compilation and Storage

A Microsoft® SQL database was specifically developed to store, organize, and retrieve survey data. Project data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis and all data forms and electronic data files were retained for reference.

Statistical Analysis

A visit was defined as surveying all of the survey plots once and could occur across multiple dates but had to be completed in a single season (e.g., spring). If extreme weather conditions prevented all plots from being surveyed during a visit, then a visit might not have constituted a complete survey of all plots. A survey was defined as a single 10-min or 60-min count of birds. In some cases, a count of bird observations may represent repeated observations of the same individual. Only observations within the survey plot were included for data analysis.

Mean Use, Percent of Use, and Frequency of Occurrence

Mean use is the average number of birds observed per plot per survey for small or large birds. Small bird use (per 100-m plot per 10-min survey) and large bird use (per 800-m plot per 60-min survey) is calculated by: 1) summing birds per plot per visit, 2) averaging number of birds over plots within a visit, and 3) averaging number of birds across visits within a season. Overall mean use was calculated as an average of seasonal values weighted by the number of days in each season. Percent of use was calculated as the percentage of small or large bird use that was attributable to a particular bird type or species. Frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed.

Mean use and frequency of occurrence describe different aspects of relative abundance, in that mean use is based on the number of birds (i.e., large groups can produce high estimates), whereas frequency of occurrence is based on the number of groups (i.e., it is not influenced by group size). Qualitative comparisons were made with these metrics among bird types, seasons, and survey points to help one understand how birds are using the Project area over time and space.

Flight Height

Bird flight heights are important metrics to assess relative potential exposure to turbine blades and were used to calculate the percentage of large birds, small birds, and eagles observed flying within the rotor-swept height (RSH) of proposed turbines. A RSH of 25 to 150 m (82 to 492 ft) AGL was assumed for the purpose of the analysis. Flight height recorded during the initial observation was used to calculate mean flight height and the percentage of birds flying within the RSH.

Spatial Use

Mean use was calculated by survey point for large birds, small birds, and eagles to make spatial comparisons among the survey points. Additionally, flight paths of eagles, other diurnal raptors, waterbirds, and waterfowl were mapped during large bird use surveys to qualitatively show flight path location compared to Project area characteristics (e.g., topographic features) to identify if there were areas of concentration or consistent flight patterns within the Study Area.

Eagles

Eagle observations during surveys were summarized to provide flight heights (see Flight Height) and flight path maps (see Spatial Use). Minute data were examined to count eagle exposure minutes, defined as the number of minutes an eagle was observed in flight within the risk cylinder (defined as the area within 800 m of the survey point and up to 200 m AGL during the 60-min survey periods). The eagle exposure minutes per observation hour were reported by survey plot and month to enable spatial and temporal assessments of eagle exposure minutes recorded in the Study Area. Observations of perched eagles and those outside of survey plots were not considered eagle exposure minutes; however, the perch locations and flight paths of all eagles were mapped to qualitatively assess areas of eagle use within the Study Area.

RESULTS

Overall, 327 avian use surveys were conducted for large birds and 327 surveys were conducted for small birds (Table 1). Survey results are summarized below, supplemented by the appendices, which present species-level detail on numbers of groups and observations within the survey plot by season (Appendices A1 and A2), avian use, percent of use, and frequency of occurrence by season (Appendices B1 and B2), and mean use by survey point (Appendix C).

Table 1. Summary of survey effort at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

Season ¹	Large Birds		Small Birds	
	# Visits ²	# Surveys ³	# Visits ²	# Surveys ³
Summer	3	83	3	83
Fall	3	84	3	84
Winter	3	76	3	76
Spring	3	84	3	84
Overall	12	327	12	327

¹ Season dates: Summer (June 1 – August 31), Fall (September 1 – November 30), Winter (December 1 – February 28), Spring (March 1 – May 31).

² A visit was defined as surveying all of the survey plots once within the Study Area and could occur across multiple dates but had to be completed in a single season.

³ A survey was defined as a single 10-min or 60-min count of birds.

Large Birds

Twenty-four large bird species were observed or heard over the 327 hours of surveys during the year-long study. The greatest number of species was recorded in spring (17), followed by fall (12), winter (10), and summer (nine; Appendix A1). The most abundant large bird species were Canada goose (*Branta canadensis*; 806 observations in 17 separate groups) and sandhill crane (*Antigone canadensis*; 715 observations in seven separate groups; Appendix A1). Together, these two species composed 54.4% of all large bird observations and 72.2% of large bird observations in fall (Appendix A1). Diurnal raptors, represented by nine separate species, accounted for 17.8% of all large bird observations. The most abundant raptor species were northern harrier (*Circus hudsonius*; 169 observations), Swainson's hawk (*Buteo swainsoni*; 93 observations), rough-legged hawk (*B. lagopus*; 84 observations), and red-tailed hawk (*B. jamaicensis*; 74 observations; Appendix A1).

Mean Use, Percent of Use, and Frequency of Occurrence

Mean use, percent of use, and frequency of occurrence were calculated by season for large bird types (Figures 4a, 4b, 4c) and species (Appendices B1). Large bird mean use (observations/800-plot/60-min survey) was highest during fall (20.45), followed by spring (5.02), winter (4.99), and summer (3.07; Figure 4a; Appendix B1). Relatively high use in fall was largely attributed to higher use by waterbirds and waterfowl (8.01 and 6.76 observations/800-m plot/60-min survey, respectively) during that season (Figure 4a, Appendix B1). Among large bird types, diurnal raptors composed the greatest percentage of use in summer and spring (39.9% and 27.5%, respectively), while waterbirds composed the greatest percentage of use in fall (39.2%), and waterfowl composed the majority of use in winter (63.2%; Figure 4b, Appendix B1). Diurnal raptors and large corvids were the most frequently observed large bird types during all seasons, with diurnal raptors recorded during 32.1% to 79.8% of surveys seasonally and large corvids observed during 36.4% to 57.1% of surveys seasonally (Figure 4c; Appendix B1). Alternatively, waterbirds were recorded during less than 4.0% of surveys each season and waterfowl during less than 10.0% of surveys each season (Figure 4c; Appendix B1).

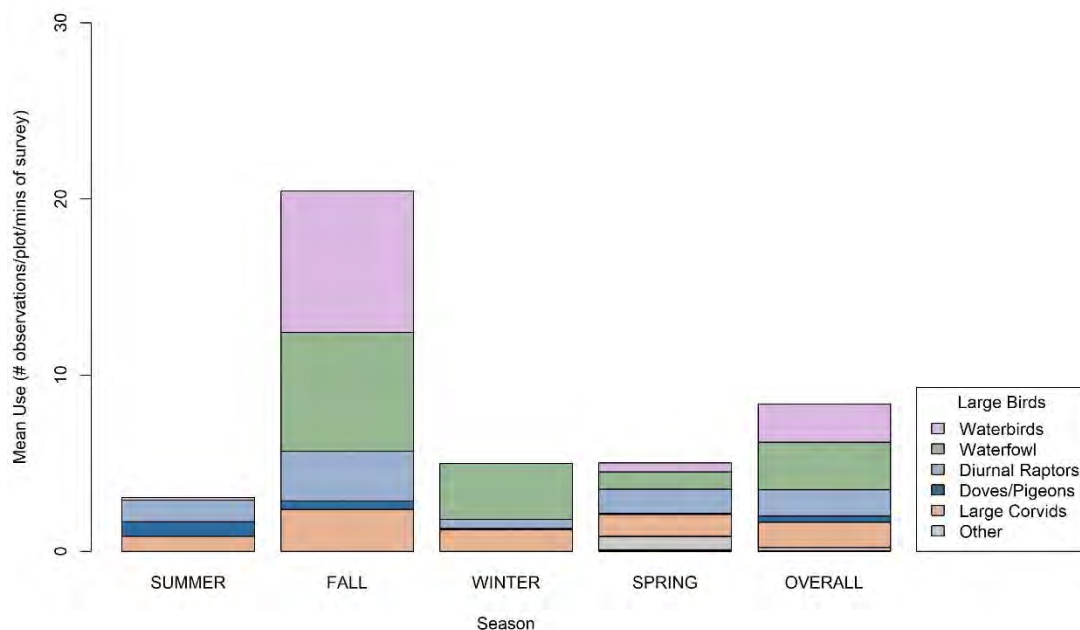


Figure 4a. Large bird mean use by season and bird type at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

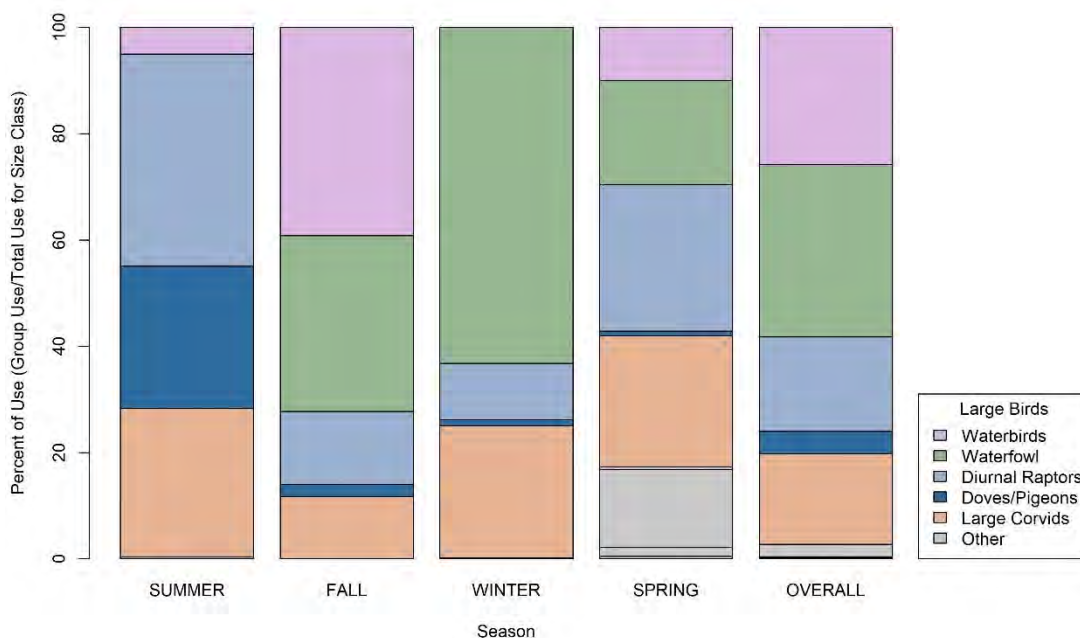


Figure 4b. Large bird percent of use by season and bird type at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

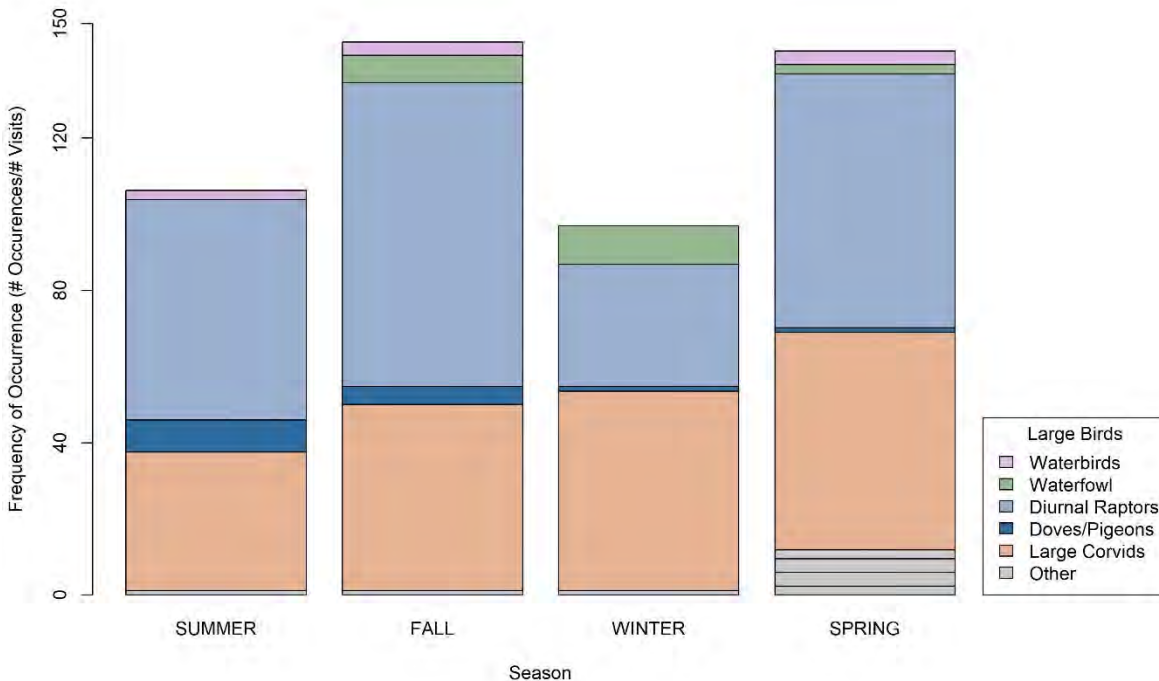


Figure 4c. Large bird frequency of occurrence by season and bird type at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

Bird Flight Height

Mean large bird flight heights ranged from 18 m (60 ft) for doves/pigeons to 241 m (791 ft) for waterbirds. Bird types recorded most frequently within the RSH included vultures (100%), doves/pigeons (72.8%), and waterfowl (66.3%; Table 2). Overall, diurnal raptors were recorded flying within the RSH during 50.3% of observations, with 48.7% recorded below the RSH, and 0.9% recorded above (Table 2). Among diurnal raptor subtypes, the single eagle and accipiter observations were flying within the RSH, and the majority (80.9%) of buteos were recorded within the RSH, while northern harriers and falcons were most often observed flying below the RSH (Table 2). Nearly all (96.3%) of waterbird observations were recorded above the RSH (Table 2).

Table 2. Flight height characteristics by bird type and raptor subtype during 60-minute large bird use surveys at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

Bird Type	# Groups	# Obs.	Mean Flight Height (m)	% Obs. Flying	% within Flight Height Categories		
	Flying	Flying			<25 m	25-150 m ^a	>150 m
Waterbirds	9	728	241	100	0	3.7	96.3
Waterfowl	20	906	113	100	3.9	66.3	29.8
Shorebirds	3	6	23	85.7	83.3	16.7	0
Gulls/Terns	5	62	37	100	74.2	25.8	0
Diurnal Raptors	434	439	36	88.5	48.7	50.3	0.9
<i>Accipiters</i>	1	1	30	100	0	100	0
<i>Buteos</i>	231	236	57	88.7	17.4	80.9	1.7
<i>Northern Harrier</i>	166	166	9	98.2	89.8	10.2	0
<i>Eagles</i>	1	1	80	100	0	100	0
<i>Falcons</i>	35	35	21	59.3	68.6	31.4	0
Owls	0	0	-	0	-	-	-
Vultures	2	2	75	100	0	100	0
Upland Game Birds	0	0	-	0	-	-	-
Doves/Pigeons	14	114	18	96.6	27.2	72.8	0
Large Corvids	223	432	26	91.9	42.1	57.9	0
Large Birds Overall	710	2,689	37	96.2	19.1	44.7	36.3

^a. The likely "rotor-swept height" for potential collision with a turbine blade, or 25 to 150 m (85 to 492 feet) above ground level.

obs.=observations

Spatial Variation

Mean Use by Point

Large bird use varied widely across survey plots, ranging from 0.55 observations/survey at Point 9 to 36.75 at Point 23 (Appendix C). High variability in large bird use across the Study Area was largely driven by waterbird and waterfowl use documented at a subset of survey points, primarily in the eastern portion of the Study Area (Figure 3). The highest use values were from waterbirds recorded at Point 23 (25.00 observations/survey) and waterfowl recorded at Point 18 (18.00 observations/survey; Appendix C). Use by diurnal raptors was more consistent across the Study Area, ranging from 0.36 to 3.08 observations/survey (Appendix C). Use by other species groups (shorebirds, gulls/terns, owls, vultures, upland gamebirds, and doves/pigeons) was comparatively low and limited to only a few survey points across the Study Area (Appendix C).

Flight Paths

Flight paths of waterbirds, waterfowl, and diurnal raptors (including eagles) were mapped in the Study Area (Figures 5a and 5b). Consistent flight patterns were not evident for waterbirds or waterfowl (Figure 5a). Waterbird flight paths were recorded in low numbers across the Study Area, while waterfowl (primarily Canada goose) flight paths were somewhat more concentrated in the eastern third of the Study Area (Figure 5a). Diurnal raptor flight paths were recorded across the Study Area; however, the eastern half of the Study Area had a somewhat greater concentration of flight paths, particularly for *buteos* (e.g., red-tailed hawk and Swainson's hawk) and northern harriers (Figure 5b).

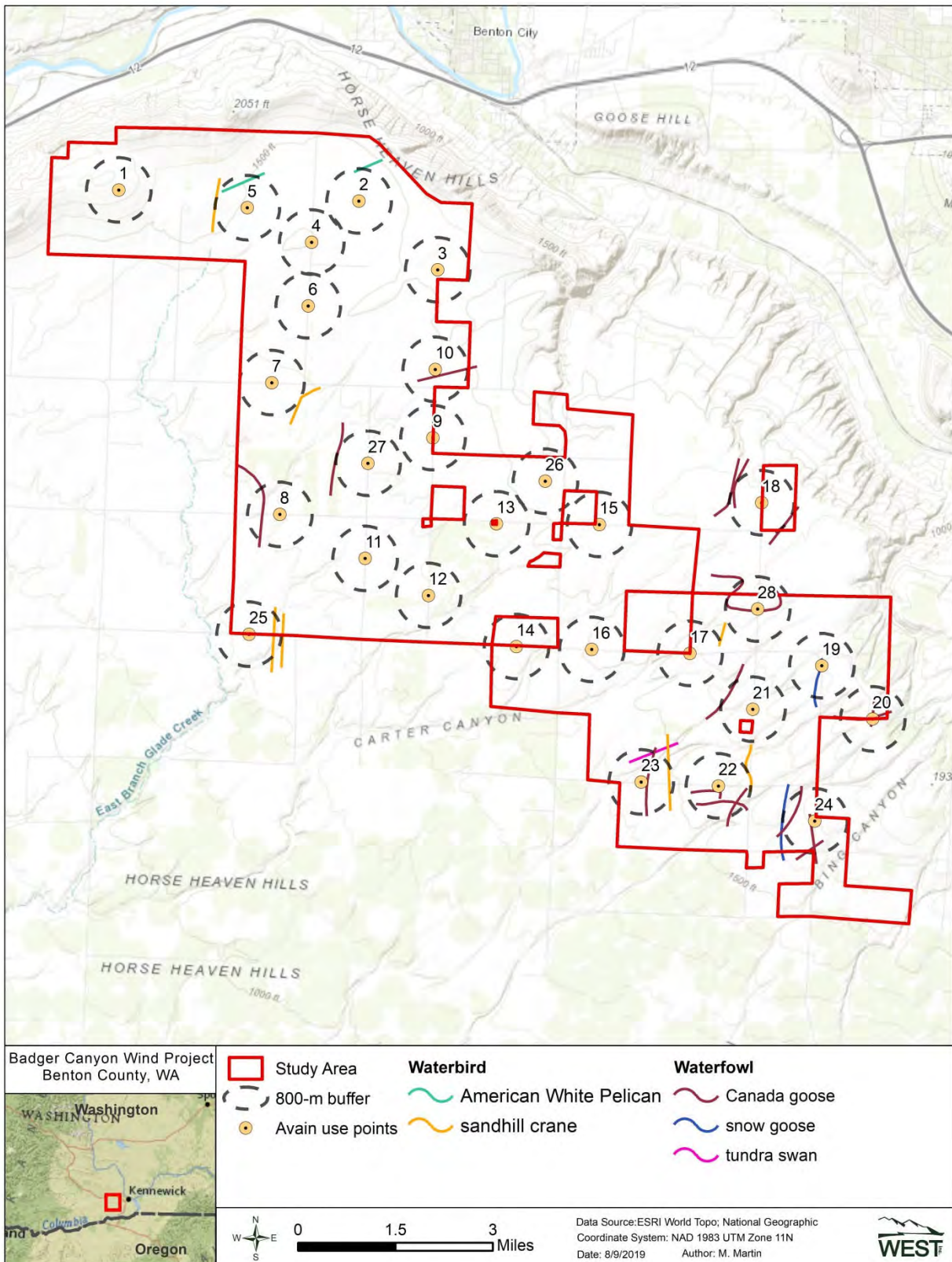


Figure 5a. Flight paths of waterbird and waterfowl species recorded during large bird surveys at the Badger Canyon Wind Project Study Area from June 7, 2018 to May 28, 2019

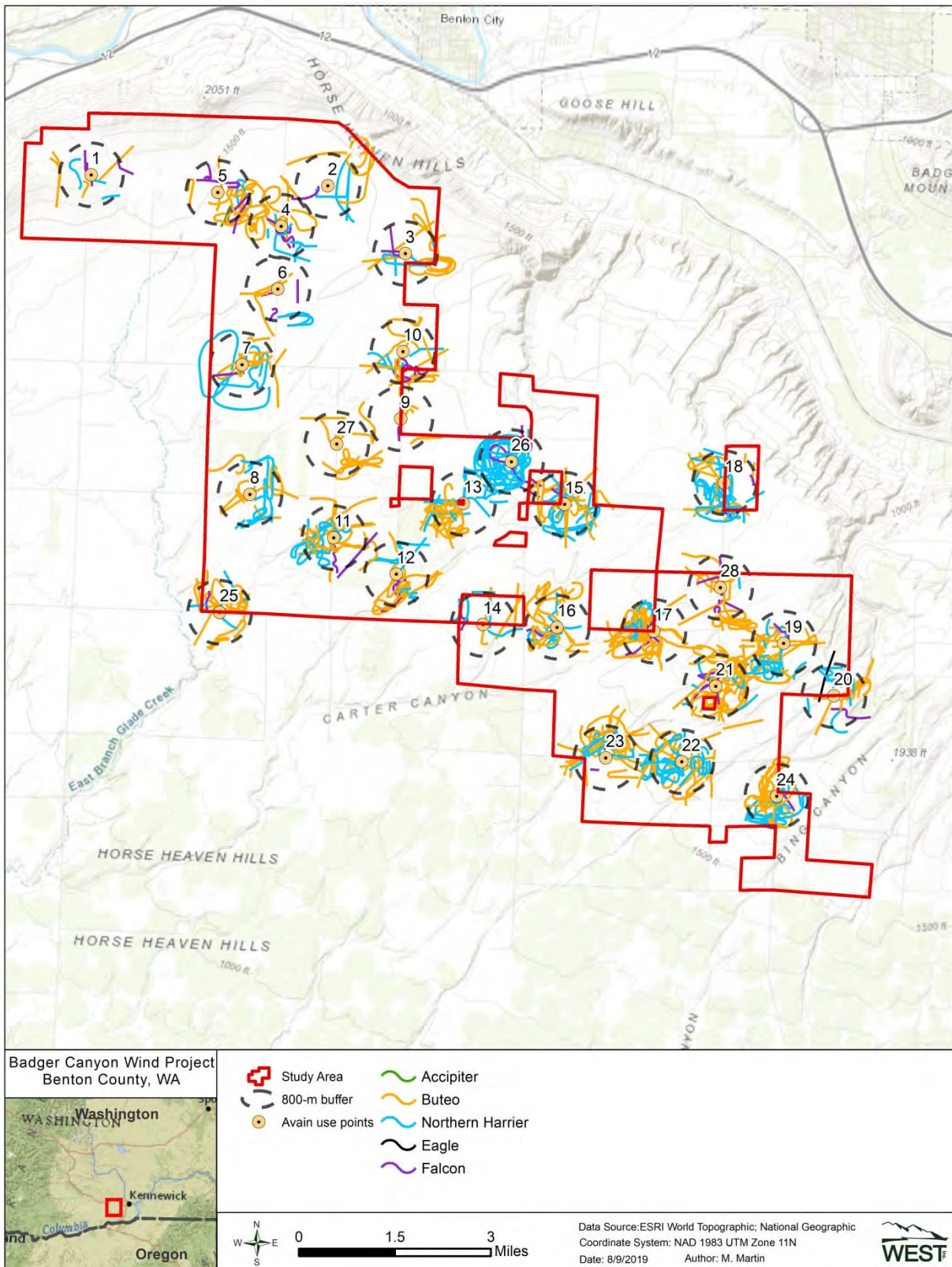


Figure 5b. Flight paths of diurnal raptor subtypes recorded during large bird surveys at the Badger Canyon Wind Project Study Area from June 7, 2018 to May 28, 2019.

Eagles

Over the course of 327 hours of surveys, only one bald eagle observation was recorded. The single bald eagle was observed in March at Point 20 (Figure 5b) for a total of three minutes in flight. This single observation resulted in one eagle exposure minute or 0.0031 exposure minutes per survey hour. No golden eagles were observed during the year-long study.

Small Birds

Fifteen species of small birds were observed or heard over the 327 hours of surveys during the year-long study. The greatest number of small bird species was recorded in spring (10), followed by summer (eight), fall (six), and winter (five; Appendix A2). The most commonly recorded species was horned lark (*Eremophila alpestris*) which composed 92.3% of all small bird observations (Appendix A2). Other species recorded in relatively high numbers included savannah sparrow (*Passerculus sandwichensis*), western meadowlark (*Sturnella neglecta*), and barn swallow (*Hirundo rustica*) which collectively composed another 5.0% of overall small bird observations (Appendix A2).

Mean Use

Small bird mean use (observations/100-m plot/10-min survey), composed entirely of use by passerines, was highest during winter (13.81), followed by spring (6.11), fall (5.93), and summer (3.35; Appendix B2). Horned lark composed between 84.8% and 98.2% of small bird use during each season (Appendix B2). After horned lark, cliff swallow (*Petrochelidon pyrrhonota*) had the highest use in summer, while western meadowlark had the highest use in fall, and savannah sparrow had the highest use in winter and spring (Appendix B2).

Spatial Variation

Small bird use ranged from 1.45 observations/100-m plot/10-min survey at Point 26 near the center of the Study Area to 22.58 at Point 22 in the southeast corner of the Study Area (Figure 1, Appendix C). Higher use at Point 22 was attributed to use by horned lark which dominated small bird use across survey points.

Incidental Observations

Nine avian species were recorded incidentally during the study (Table 3). Of these, two species were not observed during standardized surveys: loggerhead shrike (*Lanius ludovicianus*), and common nighthawk (*Chordeiles minor*; Table 3).

Table 3. Number of groups (grps) and observations (obs) for wildlife observed incidentally outside of the standardized avian use surveys at the Badger Canyon Wind Project from June 7, 2018 to May 28, 2019.

Species	Scientific Name	# grps	# obs
sandhill crane	<i>Antigone canadensis</i>	13	1,783
snow goose	<i>Chen caerulescens</i>	1	7
long-billed curlew	<i>Numenius americanus</i>	1	1
red-tailed hawk	<i>Buteo jamaicensis</i>	1	1
prairie falcon	<i>Falco mexicanus</i>	1	1
short-eared owl	<i>Asio flammeus</i>	1	1
barn swallow	<i>Hirundo rustica</i>	1	3
loggerhead shrike	<i>Lanius ludovicianus</i>	1	1
common nighthawk	<i>Chordeiles minor</i>	1	1
Total	9 species	21	1,799

Species of Concern

Six species of concern were recorded during avian use surveys or incidentally within the Study Area including one state-endangered species (sandhill crane), one state-threatened species (American white pelican [*Pelecanus erythrorhynchos*]), and one state candidate for listing (loggerhead shrike; WDFW 2019; Table 4). Each of these species, in addition to prairie falcon (*Falco mexicanus*) and tundra swan (*Cygnus columbianus*), is also considered a state Priority Species by the WDFW (2008). Bald eagle is protected under the federal BGEPA (1940).

Table 4. Groups and observations of species of concern recorded during avian use surveys or as incidental wildlife observations at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

Species	Scientific Name	Status*	Surveys		Incidental		Total	
			# of grps	# of obs	# of grps	# of obs	# of grps	# of obs
sandhill crane	<i>Antigone canadensis</i>	SE, SP	7	715	13	1,783	20	2,498
American white pelican	<i>Pelecanus erythrorhynchos</i>	ST, SP	2	13	0	0	2	13
tundra swan	<i>Cygnus columbianus</i>	SP	1	35	0	0	1	35
bald eagle	<i>Haliaeetus leucocephalus</i>	BGEPA	1	1	0	0	1	1
prairie falcon	<i>Falco mexicanus</i>	SP	3	3	1	1	4	4
loggerhead shrike	<i>Lanius ludovicianus</i>	SC, SP	0	0	1	1	1	1
Total	6 species		14	767	15	1,785	29	2,552

grps=groups, obs=observations

*BGEPA = Bald and Golden Eagle Protection Act (BGEPA 1940) SE = state-endangered species; ST = state-threatened species; SC = state candidate species; SP = state priority species. State species status from Washington Department of Fish and Wildlife (2008, 2019).

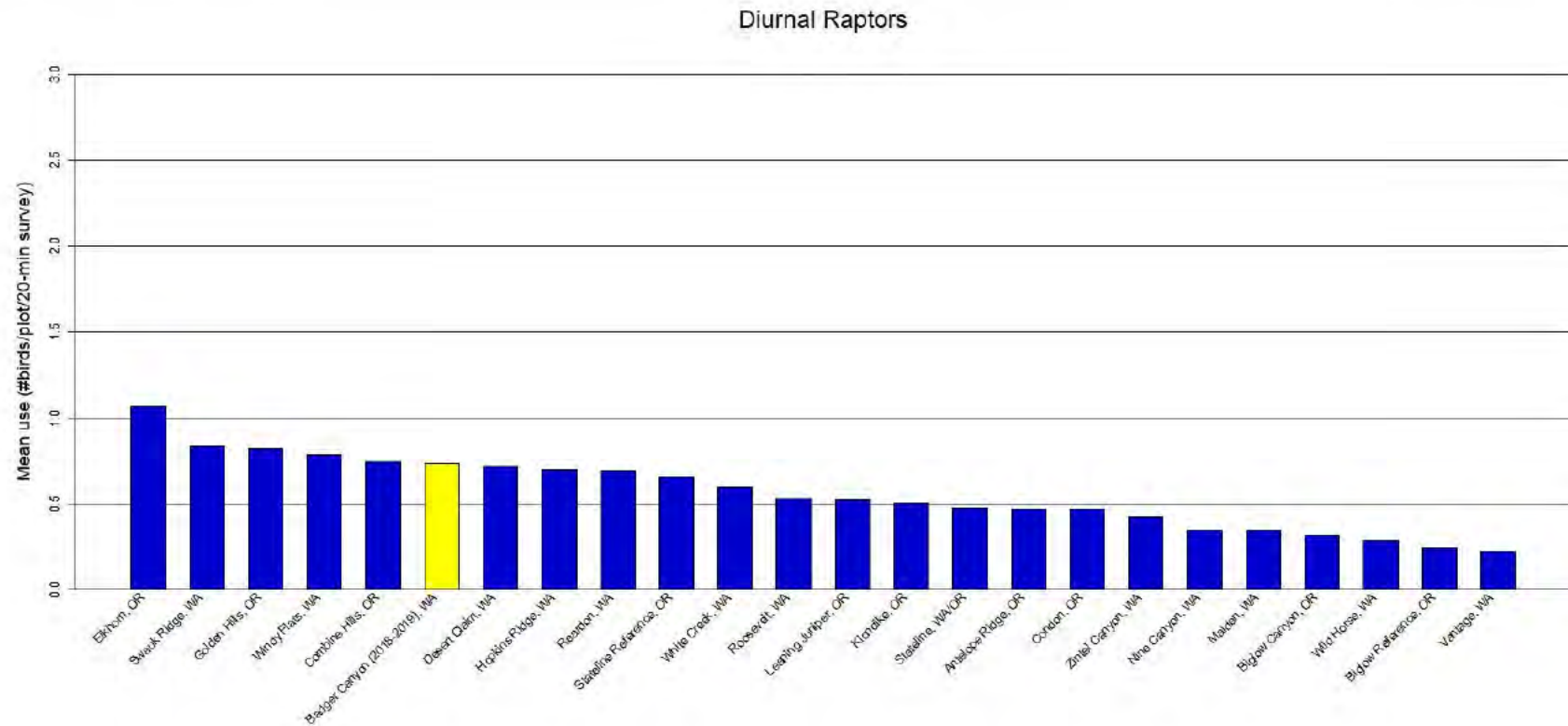
DISCUSSION

The principal objective of this avian use study was to assess the temporal and spatial use of the Study Area by large and small birds, including eagles and other species of concern. Over the course of the year-long study, approximately 382 hours of large and small bird use surveys were

completed and 5,027 bird observations comprising 39 separate species were recorded. Overall, large bird use varied substantially across seasons and across the Study Area; however, most of this variability was attributed to several relatively large groups of waterbirds and waterfowl observed primarily in the fall and in the eastern portion of the Study Area. Most of the waterbird observations (96.3%) were flying at heights well above the RSH of proposed turbines and not at risk of collision; however, the majority of waterfowl observations (66.3%) were flying within the RSH. Use by diurnal raptors was more consistent across seasons and across survey points. Seasonal use by diurnal raptors ranged from a low of 0.53 birds/800-m plot/60-min survey in winter to a high of 2.81 in fall. The most commonly recorded diurnal raptor species were northern harrier, Swainson's hawk, and rough-legged hawk.

In order to allow comparison with raptor use at other regional wind energy facilities in Washington and Oregon that implemented similar protocols and had data for three or four seasons, annual mean raptor use at the Project was recalculated for a 20-min survey period by using only the data collected during the first 20 min of the 60-min survey period. Based on this shorter survey period, diurnal raptor use at the Project (0.73 raptors/800-m plot/20-min survey) was on the higher end, but well the range of estimated raptor use at 23 regional wind energy facilities with publicly available data, ranking 19th out of 23 other sites (0.35-1.07 raptors/800-m plot/20-min survey; Figure 6).

Small bird use varied considerably across the Study Area; however, no clear spatial patterns of use were evident. Use by small birds was highest in winter (13.81 birds/100-m plot/10-min survey) and lowest in summer (3.35); however, use in all seasons was driven by horned lark which composed between 84.8% and 98.2% of overall small bird use in any given season.



Wind Energy Facility

Figure 6. Comparison of estimated annual diurnal raptor use during fixed-point large bird use surveys at the Badger Canyon Wind Project from June 7, 2018 – May 28, 2019 and diurnal raptor use at other Oregon and Washington Wind Resource Areas with similarly collected data.

Figure 6 (continued). Comparison of estimated annual diurnal raptor use during fixed-point large bird use surveys at the Badger Canyon Wind Project from June 7, 2018 – May 28, 2019 and diurnal raptor use at other Oregon and Washington Wind Resource Areas with similarly collected data.

Data from the following sources:

Wind Energy Facility/Study	Report Citation	Wind Energy Facility/Study	Report Citation
Badger Canyon, WA	This study.		
Elkhorn, OR	WEST 2005a	Klondike, OR	Johnson et al. 2002
Swauk Ridge, WA	Erickson et al. 2003a	Stateline, WA/OR	Erickson et al. 2003b
Golden Hills, OR	Jeffrey et al. 2008	Antelope Ridge, OR	WEST 2009
Windy Flats, WA	Johnson et al. 2007	Condon, OR	Erickson et al. 2002a
Combine Hills, OR	Young et al. 2003a	Zintel Canyon, WA	Erickson et al. 2002b, 2003c
Desert Claim, WA	Young et al. 2003b	Nine Canyon, WA	Erickson et al. 2001
Hopkins Ridge, WA	Young et al. 2003c	Maiden, WA	Young et al. 2002
Reardon, WA	WEST 2005b	Biglow Canyon, OR	WEST 2005c
Stateline Reference, OR	URS et al. 2001	Wild Horse, WA	Erickson et al. 2003d
White Creek, WA	NWC and WEST 2005	Biglow Reference, OR	WEST 2005c
Roosevelt, WA	NWC and WEST 2004	Vantage, WA	Jeffrey et al. 2007
Leaning Juniper, OR	Kronner et al. 2005		

Species of Concern

During the study, six bird species of concern were recorded within the Study Area, none of which are unexpected for the region. These include the state-endangered sandhill crane, the state-threatened American white pelican, and the state candidate for listing loggerhead shrike. All three of these species are also considered Priority Species by the WDFW, along with tundra swan and prairie falcon. While not a state or federally listed species, bald eagles are protected under the federal BGEPA.

Sandhill Crane

Sandhill cranes were recorded within the Study Area during fall (four groups totaling 673 individuals) and spring (three groups totaling 42 individuals). Sandhill cranes typically use large freshwater marshes, prairie ponds, and marshy tundra during summer and grain fields or prairies during migration and winter. In Washington, sandhill cranes are known to breed only in Yakima and Klickitat counties (Stinson 2017). They typically use large freshwater marshes, prairie ponds, and marshy tundra during summer and grain fields or prairies during migration and winter. Although suitable breeding and stopover habitat is generally absent from the Study Area, there is potential for the species to migrate over the Project in spring and fall, which is supported by the data collected during this study. During surveys the majority (96.3%) of sandhill crane observations were recorded flying well above the RSH.

Waterbirds, including sandhill crane, do not appear to be particularly susceptible to collision with wind turbines. According to the National Research Council (2007) cumulative effects report, waterbirds composed about 1% of documented fatalities at 14 wind energy facilities. Waterbirds made up 0.2% of all bird fatalities (n = 4,975) in an analysis of 116 standardized monitoring studies conducted at over 70 wind energy facilities throughout the US and Canada (Erickson et al. 2014). Among publicly available reports reviewed by WEST, waterbirds accounted for just 0.2% of

fatalities recorded during 41 studies at wind energy facilities in the Pacific Northwest region of North America (four of 1,942 total fatalities; see Appendix D for a list of facilities and references). The four waterbird fatalities documented at Pacific Northwest wind energy facilities were all great blue herons (*Ardea herodias*; see Appendix D). While no sandhill crane fatalities have been documented in the Pacific Northwest, several sandhill crane fatalities have been documented at facilities in other states. This includes one fatality documented at an older-generation facility at Altamont Pass in California (Smallwood and Karas 2009), and two fatalities from a facility in west Texas (Navarrete and Griffis-Kyle 2014 as cited in Gerber et al. 2014; Stehn 2011), documented as part of a wintering crane displacement study conducted by graduate student L. Navarrete of Texas Tech University.

Researchers at WEST monitored use by migrating sandhill cranes at five wind energy facilities in North and South Dakota from 2009 – 2013 for three years at each site. Concurrently, they searched underneath all turbines daily for fatalities of cranes. Cumulatively, observers spent 13,182 hours recording crane use over 1,305 days, and even though 42,727 sandhill crane observations were recorded, no fatalities of cranes were found beneath turbines (Derby et al. 2018). A crane monitoring study was conducted at the Forward Energy Center, a wind energy facility in southern Wisconsin located within 3.2 km (2.0 mi) of a large wetland used by sandhill cranes. No crane fatalities were found during the crane monitoring study in the fall of 2008, or during regular bird fatality monitoring studies conducted in the fall of 2008, spring and fall of 2009, and in the spring of 2010, even though sandhill cranes were observed in the study area (Grodsky et al. 2013).

Given the absence of suitable breeding and stopover habitat within the Project area and the available data regarding these species' interactions with wind turbines, impacts to sandhill crane resulting from Project development and operation are anticipated to be low.

American White Pelican

American white pelicans were recorded only during summer surveys (two groups totaling 13 individuals). These two groups were observed along the northwest boundary of the Study Area flying at an average of 250 m (820 ft) above mean sea level, well above the RSH. The American white pelican is known to nest on Columbia River dredge islands near the Tri-Cities (Stinson 2016), within 20 mi (32 km) of the Study Area. While suitable breeding and foraging habitat is not present within the Study Area, the species may fly over the Study Area while traveling between foraging areas.

Similar to sandhill crane and other waterbird species, American white pelicans do not appear to be particularly susceptible to collision with wind turbines. Based on publicly available data, no American white pelican fatalities have been documented at facilities in the Pacific Northwest (see Appendix D for a list of facilities and references). However, this may be the result of the siting of current wind energy facilities outside of pelican flight corridors. At least two American white pelican fatalities have been documented at wind energy facilities outside of Oregon and Washington, both of which were found at the Buffalo Ridge facility in South Dakota (Derby et al. 2010, 2012).

Given the absence of suitable breeding and stopover habitat within the Project area, the species' use of the Study Area, and the available data regarding these species' interactions with wind turbines, impacts to American white pelican resulting from Project development and operation are anticipated to be low.

Bald Eagle

Based on information compiled by the USFWS, there have been 49 documented bald eagle fatalities or injuries at wind energy facilities in the US between 2013 and 2018 (Kritz et al. 2018). The majority of bald eagle casualties occurred in the Upper Midwest, Intermountain West, and Alaska, with only single bald eagle fatalities documented in each of Oregon and Washington (Kritz et al. 2018).

The Columbia Plateau supports both breeding and wintering populations of bald eagles, generally at lower densities than areas west of the Cascades; however, bald eagle nests have increased annually across the state since 2005 (Kalasz and Buchanan 2016). While bald eagle nest sites and breeding season foraging habitat is absent from the Project area, the species is known to nest in areas adjacent to rivers and lakes. During eagle nest surveys conducted within a 16-km radius of the Study Area, two occupied bald eagle nests were documented (Chatfield et al. 2019). Both of these nests were located along the Yakima River approximately 11.9 km (7.4 mi) west of the Study Area and 13.2 km northeast of the Study Area (Chatfield et al. 2019). Based on the generally low direct impacts to bald eagles documented in the Pacific Northwest, the distance of eagle nests from the proposed Project boundary, and the very low use of the Study Area by bald eagles documented during the study, risk to bald eagles from the development and operation of the Project is anticipated to be low.

Prairie Falcon

During surveys, four prairie falcon observations were recorded within the Study Area: one during fall surveys, one incidentally in fall, and two during winter surveys. Prairie falcons are year-round residents of the region and, while nesting habitat is absent from the Study Area, the species may forage throughout the site's open grasslands and agricultural lands. No prairie falcon nests were documented in the vicinity of the Study Area during the 2019 aerial raptor nest surveys conducted for the Project (Chatfield et al. 2019).

Though prairie falcon fatalities have been documented at Pacific Northwest wind energy facilities, they have been relatively rare (three out of 154 total diurnal raptor fatalities; see Appendix D for a list of facilities and references). Given the relatively low use of the Project Area by prairie falcons and the low level of direct impacts reported for this species in the Pacific Northwest, risk to prairie falcons from development and operation of the Project is anticipated to be low.

Loggerhead Shrike

Only a single loggerhead shrike, recorded incidentally, was observed during the study, suggesting low use of the Study Area by this species. Loggerhead shrikes typically nest in mature shrub-steppe habitat; which is very limited within the Study Area (see Figure 2); however, the species

will utilize grassland, agricultural land, and other open areas for foraging. Loggerhead shrike fatalities have been documented at wind energy facilities, particularly at facilities in California (see ICF International 2016; WEST 2008); however, no loggerhead shrike fatalities (out of 1,228 total passerine fatalities) have been reported in the Pacific Northwest (see Appendix D for a list of facilities and references). Given the low documented use the Study Area by this species and the very small amount of suitable nesting habitat, risk to loggerhead shrike from the development and operation of the Project is anticipated to be low.

Tundra Swan

A single group of tundra swans, comprising 35 individuals, was recorded in the Study Area during spring surveys. This group was recorded at Point 23 near the southern boundary of the Study Area, flying about 15 m (49 ft) AGL. In western North America, tundra swans breed in Alaska and the Canadian low arctic and winter mainly on the Pacific coast from British Columbia to California (NatureServe 2019). The Study Area lies within the migratory path of the tundra swan, and the species utilizes waterways in eastern Washington, such as the Columbia River, during its spring journey to northern breeding grounds. As a result, there is potential for tundra swans to fly over the Study Area or forage within the Study Area's agricultural fields during spring migration. Among 41 post-construction monitoring studies at facilities in the Pacific Northwest, no tundra swan fatalities have been documented (see Appendix D for a list of facilities and references). In the Pacific Northwest, waterfowl fatalities have composed 0.8% of overall avian mortality at wind energy facilities with publicly available data. The most common waterfowl fatalities have been Canada goose (six fatalities) and mallard (*Anas platyrhynchos*; four fatalities; Appendix D).

Given low use of the Study Area by tundra swans, risk of collision is anticipated to be low; however, the magnitude of this risk depends greatly on interannual use of the Study Area by swans during spring migration.

Avian Mortality at Regional Wind Energy Facilities

To date, overall fatality rates for birds at wind energy facilities in the Pacific Northwest with publicly available data have been variable, ranging from 0.16 to 8.45 birds/megawatt (MW)/year, with fatality rates for diurnal raptors ranging from zero to 0.47 bird/MW/year (Appendix D). At the nearby Nine Canyon facility, post-construction fatality monitoring conducted in 2002-2003 resulted in estimated mortality rates of 2.79 birds/MW/year and 0.03 diurnal raptors/MW/year (Erickson et al. 2003c). At the Windy Flats, Combine Hills, and Hopkins Ridge wind energy facilities in Oregon and Washington, where with pre-construction diurnal raptor use estimates were similar to that recorded at the Project (see Figure 6), corresponding post-construction diurnal raptor fatality rates ranged from zero to 0.14 raptors/MW/year (Young et al. 2006, 2007, 2009; Enz et al. 2011, 2012; Appendix D).

At wind energy facilities in the Pacific Northwest with publicly available fatality data, diurnal raptors have composed 7.9% of all documented avian fatalities (154 out of 1,942 total avian fatalities; see Appendix D for a list of facilities and references). In the Pacific Northwest, 12 separate diurnal raptor species have been found as fatalities, the most common of which have been American kestrel (*Falco sparverius*; 35.7%), red-tailed hawk (31.2%), and Swainson's hawk (9.1%; see

Appendix D for a list of facilities and references). During the year-long fatality monitoring study at Nine Canyon, only one diurnal raptor fatality was documented, an American kestrel (Erickson et al. 2003c). Based on the composition of turbine-related raptor fatalities in the region, and the composition of diurnal raptors observed during this study, the diurnal raptor species most likely impacted by the Project are American kestrel and red-tailed hawk.

CONCLUSIONS

Tier 3 studies are used to address questions regarding impacts that could not be sufficiently addressed using available literature (i.e., during Tier 1 and 2 desktop analyses). These studies provide additional data that, when combined with available literature reviewed in previous tiers, allow for a better-informed assessment of the risk of significant adverse impacts to species of concern at the Project. The Study Area is dominated by agricultural cover types (i.e., cultivated cropland) of limited value to most avian species, particularly species of conservation concern. Several species of concern were documented during the study; however, these were not unexpected for the region and are believed to be at low risk from Project development and operation given their use of the Study Area, and known interactions with turbines in the region. Nothing in the data collected within the Study Area to date suggests that the Project would fall outside of the range of impacts observed at other wind energy facilities in Oregon and Washington.

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**Appendix A. All Bird Types and Species Observed at the Badger Canyon Wind Project
Study Area during Avian Use Surveys, June 7, 2018 – May 28, 2019**

Appendix A1. Numbers of groups and observations by bird type and species for 60-minute large bird use surveys at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

Type/Species	Scientific Name	Summer		Fall		Winter		Spring		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Waterbirds		2	13	4	673	0	0	3	42	9	728
sandhill crane	<i>Antigone canadensis</i>	0	0	4	673	0	0	3	42	7	715
American white pelican	<i>Pelecanus erythrorhynchos</i>	2	13	0	0	0	0	0	0	2	13
Waterfowl		0	0	8	568	9	255	3	83	20	906
Canada goose	<i>Branta canadensis</i>	0	0	8	568	7	190	2	48	17	806
snow goose	<i>Chen caerulescens</i>	0	0	0	0	2	65	0	0	2	65
tundra swan	<i>Cygnus columbianus</i>	0	0	0	0	0	0	1	35	1	35
Shorebirds		0	0	0	0	0	0	4	7	4	7
long-billed curlew	<i>Numenius americanus</i>	0	0	0	0	0	0	4	7	4	7
Gulls/Terns		0	0	0	0	0	0	5	62	5	62
California gull	<i>Larus californicus</i>	0	0	0	0	0	0	1	35	1	35
ring-billed gull	<i>Larus delawarensis</i>	0	0	0	0	0	0	4	27	4	27
Diurnal Raptors		100	102	236	236	42	42	112	116	490	496
<u>Accipiters</u>		0	0	1	1	0	0	0	0	1	1
sharp-shinned hawk	<i>Accipiter striatus</i>	0	0	1	1	0	0	0	0	1	1
<u>Buteos</u>		73	75	114	114	14	14	59	63	260	266
red-tailed hawk	<i>Buteo jamaicensis</i>	13	14	41	41	3	3	16	16	73	74
rough-legged hawk	<i>Buteo lagopus</i>	0	0	60	60	11	11	12	13	83	84
unidentified buteo	<i>Buteo spp</i>	5	6	4	4	0	0	5	5	14	15
Swainson's hawk	<i>Buteo swainsoni</i>	55	55	9	9	0	0	26	29	90	93
<u>Northern Harrier</u>		14	14	96	96	15	15	44	44	169	169
northern harrier	<i>Circus hudsonius</i>	14	14	96	96	15	15	44	44	169	169
<u>Eagles</u>		0	0	0	0	0	0	1	1	1	1
bald eagle	<i>Haliaeetus leucocephalus</i>	0	0	0	0	0	0	1	1	1	1
<u>Falcons</u>		13	13	25	25	13	13	8	8	59	59
merlin	<i>Falco columbarius</i>	0	0	0	0	0	0	1	1	1	1
prairie falcon	<i>Falco mexicanus</i>	0	0	1	1	2	2	0	0	3	3
American kestrel	<i>Falco sparverius</i>	13	13	21	21	9	9	7	7	50	50
unidentified falcon	<i>Falco spp.</i>	0	0	3	3	2	2	0	0	5	5
Owls		1	1	1	1	1	1	0	0	3	3
short-eared owl	<i>Asio flammeus</i>	1	1	0	0	0	0	0	0	1	1
great horned owl	<i>Bubo virginianus</i>	0	0	1	1	1	1	0	0	2	2
Vultures		0	0	0	0	0	0	2	2	2	2
turkey vulture	<i>Cathartes aura</i>	0	0	0	0	0	0	2	2	2	2

Appendix A1. Numbers of groups and observations by bird type and species for 60-minute large bird use surveys at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

Type/Species	Scientific Name	Summer		Fall		Winter		Spring		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Upland Game Birds		0	0	0	0	0	0	2	2	2	2
ring-necked pheasant	<i>Phasianus colchicus</i>	0	0	0	0	0	0	2	2	2	2
Doves/Pigeons		10	69	4	40	1	5	1	4	16	118
rock pigeon	<i>Columba livia</i>	4	62	4	40	1	5	1	4	10	111
mourning dove	<i>Zenaida macroura</i>	6	7	0	0	0	0	0	0	6	7
Large Corvids		45	71	66	200	68	95	66	104	245	470
common raven	<i>Corvus corax</i>	45	71	66	200	68	95	66	104	245	470
Overall		158	256	319	1,718	121	398	198	422	796	2,794

Regardless of distance from observer

obs=observations; grps=groups

Appendix A2. Numbers of groups and observations by bird type and species for 10-minute small bird use surveys at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

Type/Species	Scientific Name	Summer		Fall		Winter		Spring		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Passerines		163	278	186	498	126	944	195	513	670	2,233
<u>Blackbirds/Orioles</u>		9	9	9	10	7	8	10	14	35	41
Brewer's blackbird	<i>Euphagus cyanocephalus</i>	0	0	0	0	0	0	1	2	1	2
western meadowlark	<i>Sturnella neglecta</i>	9	9	9	10	7	8	6	7	31	34
European starling	<i>Sturnus vulgaris</i>	0	0	0	0	0	0	3	5	3	5
<u>Finches/Crossbills</u>		0	0	0	0	1	2	1	3	2	5
American goldfinch	<i>Spinus tristis</i>	0	0	0	0	1	2	1	3	2	5
<u>Flycatchers</u>		2	2	0	0	0	0	1	3	3	5
western kingbird	<i>Tyrannus verticalis</i>	2	2	0	0	0	0	1	3	3	5
<u>Grassland/Sparrows</u>		146	244	173	478	117	932	181	483	617	2,137
grasshopper sparrow	<i>Ammodramus savannarum</i>	6	6	0	0	0	0	2	3	8	9
American pipit	<i>Anthus rubescens</i>	0	0	3	4	0	0	0	0	3	4
horned lark	<i>Eremophila alpestris</i>	139	237	165	466	114	923	169	435	587	2,061
savannah sparrow	<i>Passerculus sandwichensis</i>	0	0	4	7	3	9	10	45	17	61
vesper sparrow	<i>Pooecetes gramineus</i>	1	1	0	0	0	0	0	0	1	1
chipping sparrow	<i>Spizella passerina</i>	0	0	1	1	0	0	0	0	1	1
<u>Swallows</u>		6	23	3	9	0	0	1	3	10	35
barn swallow	<i>Hirundo rustica</i>	1	4	3	9	0	0	1	3	5	16
cliff swallow	<i>Petrochelidon pyrrhonota</i>	2	12	0	0	0	0	0	0	2	12
bank swallow	<i>Riparia riparia</i>	1	3	0	0	0	0	0	0	1	3
unidentified swallow		2	4	0	0	0	0	0	0	2	4
<u>Thrushes</u>		0	0	0	0	1	2	1	7	2	9
American robin	<i>Turdus migratorius</i>	0	0	0	0	1	2	1	7	2	9
<u>Unidentified Passerine</u>		0	0	1	1	0	0	0	0	1	1
Overall		163	278	186	498	126	944	195	513	670	2,233

Regardless of distance from observe
obs=observations; grps=group.

**Appendix B. Bird Use, Percent of Use, and Frequency of Occurrence for Large Birds and
Small Birds Observed during Avian Use Surveys at the Badger Canyon Wind
Project from June 7, 2018 – to May 28, 2019**

Appendix B1. Mean use (number of birds/plot^a/60-minute survey), percent of use, and frequency of occurrence (%) for each large bird type and species by season during the avian use surveys at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

Type/Species	Mean Use				% of Use				% Frequency			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Waterbirds	0.15	8.01	0	0.50	5.0	39.2	0	10.0	2.4	3.6	0	3.6
sandhill crane	0	8.01	0	0.50	0	39.2	0	10.0	0	3.6	0	3.6
American white pelican	0.15	0	0	0	5.0	0	0	0	2.4	0	0	0
Waterfowl	0	6.76	3.15	0.99	0	33.1	63.2	19.7	0	7.1	10.0	2.4
Canada goose	0	6.76	2.26	0.57	0	33.1	45.3	11.4	0	7.1	7.1	1.2
snow goose	0	0	0.89	0	0	0	17.9	0	0	0	2.9	0
tundra swan	0	0	0	0.42	0	0	0	8.3	0	0	0	1.2
Shorebirds	0	0	0	0.08	0	0	0	1.7	0	0	0	3.6
long-billed curlew	0	0	0	0.08	0	0	0	1.7	0	0	0	3.6
Gulls/Terns	0	0	0	0.74	0	0	0	14.7	0	0	0	3.6
California gull	0	0	0	0.42	0	0	0	8.3	0	0	0	1.2
ring-billed gull	0	0	0	0.32	0	0	0	6.4	0	0	0	2.4
Diurnal Raptors	1.23	2.81	0.53	1.38	39.9	13.7	10.6	27.5	57.8	79.8	32.1	66.7
<u>Accipiters</u>	0	0.01	0	0	0	<0.1	0	0	0	1.2	0	0
sharp-shinned hawk	0	0.01	0	0	0	<0.1	0	0	0	1.2	0	0
<u>Buteos</u>	0.90	1.36	0.19	0.75	29.4	6.6	3.7	14.9	49.4	51.2	16.2	39.3
red-tailed hawk	0.17	0.49	0.04	0.19	5.6	2.4	0.8	3.8	9.8	26.2	4.0	14.3
rough-legged hawk	0	0.71	0.15	0.15	0	3.5	2.9	3.1	0	31.0	12.1	11.9
unidentified buteo	0.07	0.05	0	0.06	2.4	0.2	0	1.2	6.0	4.8	0	6.0
Swainson's hawk	0.66	0.11	0	0.35	21.4	0.5	0	6.9	38.4	7.1	0	20.2
<u>Northern Harrier</u>	0.17	1.14	0.19	0.52	5.5	5.6	3.8	10.4	10.8	52.4	16.4	38.1
northern harrier	0.17	1.14	0.19	0.52	5.5	5.6	3.8	10.4	10.8	52.4	16.4	38.1
<u>Eagles</u>	0	0	0	0.01	0	0	0	0.2	0	0	0	1.2
bald eagle	0	0	0	0.01	0	0	0	0.2	0	0	0	1.2
<u>Falcons</u>	0.16	0.30	0.15	0.10	5.0	1.5	3.1	1.9	10.8	27.4	11.9	9.5
merlin	0	0	0	0.01	0	0	0	0.2	0	0	0	1.2
prairie falcon	0	0.01	0.02	0	0	<0.1	0.5	0	0	1.2	2.4	0
American kestrel	0.16	0.25	0.11	0.08	5.0	1.2	2.1	1.7	10.8	23.8	9.5	8.3
unidentified falcon	0	0.04	0.02	0	0	0.2	0.5	0	0	3.6	2.4	0
Owls	0.01	0.01	0.01	0	0.4	<0.1	0.2	0	1.2	1.2	1.2	0
short-eared owl	0.01	0	0	0	0.4	0	0	0	1.2	0	0	0
great horned owl	0	0.01	0.01	0	0	<0.1	0.2	0	0	1.2	1.2	0
Vultures	0	0	0	0.02	0	0	0	0.5	0	0	0	2.4
turkey vulture	0	0	0	0.02	0	0	0	0.5	0	0	0	2.4
Upland Game Birds	0	0	0	0.02	0	0	0	0.5	0	0	0	2.4

Appendix B1. Mean use (number of birds/plot^a/60-minute survey), percent of use, and frequency of occurrence (%) for each large bird type and species by season during the avian use surveys at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

Type/Species	Mean Use				% of Use				% Frequency			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
ring-necked pheasant	0	0	0	0.02	0	0	0	0.5	0	0	0	2.4
Doves/Pigeons	0.82	0.48	0.06	0.05	26.8	2.3	1.2	0.9	8.4	4.8	1.2	1.2
rock pigeon	0.74	0.48	0.06	0.05	24.0	2.3	1.2	0.9	2.4	4.8	1.2	1.2
mourning dove	0.08	0	0	0	2.8	0	0	0	6.0	0	0	0
Large Corvids	0.86	2.38	1.24	1.24	27.9	11.6	24.8	24.6	36.4	48.8	52.4	57.1
common raven	0.86	2.38	1.24	1.24	27.9	11.6	24.8	24.6	36.4	48.8	52.4	57.1
Overall	3.07	20.45	4.99	5.02	100	100	100	100				

^a 800-meter radius plot for large birds

Appendix B2. Mean bird use (number of birds/plot^a/10-minute survey), percent of use, and frequency of occurrence (%) for each small bird type and species by season during the avian use surveys at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

Type/Species	Mean Use				% of Use				% Frequency			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Passerines	3.35	5.93	13.81	6.11	100	100	100	100	70.0	72.6	63.8	83.3
<u>Passerines(Subtype)</u>	0	0.01	0	0	0	0.2	0	0	0	1.2	0	0
unidentified passerine	0	0.01	0	0	0	0.2	0	0	0	1.2	0	0
<u>Blackbirds/Orioles</u>	0.11	0.12	0.10	0.17	3.3	2.0	0.7	2.7	9.8	9.5	4.0	10.7
Brewer's blackbird	0	0	0	0.02	0	0	0	0.4	0	0	0	1.2
western meadowlark	0.11	0.12	0.10	0.08	3.3	2.0	0.7	1.4	9.8	9.5	4.0	6.0
European starling	0	0	0	0.06	0	0	0	1.0	0	0	0	3.6
<u>Finches/Crossbills</u>	0	0	0.02	0.04	0	0	0.2	0.6	0	0	1.2	1.2
American goldfinch	0	0	0.02	0.04	0	0	0.2	0.6	0	0	1.2	1.2
<u>Flycatchers</u>	0.02	0	0	0.04	0.7	0	0	0.6	1.2	0	0	1.2
western kingbird	0.02	0	0	0.04	0.7	0	0	0.6	1.2	0	0	1.2
<u>Grassland/Sparrows</u>	2.94	5.69	13.66	5.75	87.7	96.0	98.9	94.2	63.9	70.2	63.8	81.0
grasshopper sparrow	0.07	0	0	0.04	2.2	0	0	0.6	3.7	0	0	1.2
American pipit	0	0.05	0	0	0	0.8	0	0	0	3.6	0	0
horned lark	2.85	5.55	13.55	5.18	85.1	93.6	98.2	84.8	63.9	69.0	63.8	77.4
savannah sparrow	0	0.08	0.11	0.54	0	1.4	0.8	8.8	0	4.8	2.4	10.7
vesper sparrow	0.01	0	0	0	0.4	0	0	0	1.2	0	0	0
chipping sparrow	0	0.01	0	0	0	0.2	0	0	0	1.2	0	0

Appendix B2. Mean bird use (number of birds/plot^a/10-minute survey), percent of use, and frequency of occurrence (%) for each small bird type and species by season during the avian use surveys at the Badger Canyon Wind Project in Benton County, Washington from June 7, 2018 to May 28, 2019.

Type/Species	Mean Use				% of Use				% Frequency			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
<i>Swallows</i>	0.28	0.11	0	0.04	8.3	1.8	0	0.6	7.2	3.6	0	1.2
barn swallow	0.05	0.11	0	0.04	1.4	1.8	0	0.6	1.2	3.6	0	1.2
cliff swallow	0.15	0	0	0	4.4	0	0	0	2.4	0	0	0
bank swallow	0.04	0	0	0	1.1	0	0	0	1.2	0	0	0
unidentified swallow	0.05	0	0	0	1.5	0	0	0	2.4	0	0	0
<i>Thrushes</i>	0	0	0.02	0.08	0	0	0.2	1.4	0	0	1.2	1.2
American robin	0	0	0.02	0.08	0	0	0.2	1.4	0	0	1.2	1.2
<i>Unidentified Passerine</i>	0	0.01	0	0	0	0.2	0	0	0	1.2	0	0
Overall	3.35	5.93	13.81	6.11	100	100	100	100				

^a. 100-meter radius plot for small birds.

**Appendix C. Mean Use by Point for All Birds, Bird Types, and Diurnal Raptor Subtypes
during Avian Use Surveys at the Badger Canyon Wind Project from
June 7, 2018 – to May 28, 2019**

Appendix C. Mean use (number of large birds/60-minute survey; number of small birds/10-minute survey) by point for large bird types, diurnal raptor subtypes, all large birds, and all small birds at the Badger Canyon Wind Project, Benton County, Washington from June 7, 2018 to May 28, 2019.

Obs. Pt.	Waterbirds	Waterfowl	Shorebirds	Gulls/Terns	Diurnal Raptors	<u>Accipiters</u>	<u>Buteos</u>	<u>Northern Harrier</u>	<u>Eagles</u>	<u>Falcons</u>	Owls	Vultures	Upland Game Birds	Doves/Pigeons	Large Corvids	All Large Birds	All Small Birds
1	0	0	0	0	0.91	0	0.36	0.27	0	0.27	0	0	0	0	1.36	2.27	13.73
2	1	0	0	0	0.67	0	0.33	0.25	0	0.08	0	0	0	0	0.83	2.50	6.33
3	0	0	0	0	1.00	0	0.67	0.17	0	0.17	0	0	0	0	0.67	1.67	9.33
4	0	0	0	0	1.08	0	0.42	0.42	0	0.25	0	0	0	0	0.42	1.50	10.50
5	17.58	0	0	0	1.17	0.08	0.67	0.08	0	0.33	0	0	0	0	1.33	20.08	3.75
6	0	0	0	0	0.67	0	0.25	0.17	0	0.25	0	0	0	0	1.42	2.08	5.08
7	1.25	0	0	0	0.92	0	0.58	0.25	0	0.08	0	0	0	0	10.08	12.25	9.33
8	0	2.18	0	0	1.36	0	0.55	0.82	0	0	0	0	0.09	0	2.00	5.64	2.18
9	0	0	0	0	0.36	0	0.27	0	0	0.09	0	0	0	0	0.18	0.55	3.18
10	0	0.83	0	0	1.50	0	0.83	0.25	0	0.42	0	0	0	0.17	0.25	2.75	2.08
11	0	0	0	0	1.42	0	0.92	0.33	0	0.17	0	0	0	0	2.25	3.67	4.50
12	0	0	0	0	1.33	0	0.5	0.67	0	0.17	0	0	0	0.08	0.42	1.83	6.42
13	0	0	0	0	1.83	0	0.92	0.92	0	0	0	0	0	0.08	1.17	3.08	12.67
14	0	0	0.09	0	0.82	0	0.27	0.45	0	0.09	0	0	0	0	1.55	2.45	2.73
15	0	0	0	1.27	2.36	0	1.27	1.00	0	0.09	0.27	0.09	0	0.36	1.00	5.36	3.55
16	0	0	0	2.92	1.58	0	1.08	0.42	0	0.08	0	0	0	0	1.42	5.92	3.58
17	2	0	0	0	2.25	0	1.58	0.5	0	0.17	0	0.08	0	0	2.58	6.92	5.67
18	0	18	0	0	2.82	0	1.09	1.55	0	0.18	0	0	0	0	1.00	21.82	5.27
19	0	2.08	0	0	2.17	0	1.17	0.83	0	0.17	0	0	0	4.75	0.58	9.58	6.67
20	0	3.50	0	0	1.75	0	1.00	0.58	0.08	0.08	0	0	0	0	1.58	6.83	8.83
21	0	12.50	0	0	3.08	0	2.08	0.42	0	0.58	0	0	0	1.58	0.33	17.50	3.08
22	0.25	4.08	0	1.08	2.58	0	1.33	1.25	0	0	0	0	0	0	0.75	8.75	22.58
23	25.00	9.17	0.42	0	1.83	0	1.25	0.42	0	0.17	0	0	0	0	0.33	36.75	11.08
24	0	17.55	0	0	1.45	0	0.73	0.64	0	0.09	0	0	0.09	3.09	1.91	24.09	10.18
25	13.58	0	0	0	1.58	0	1.17	0.33	0	0.08	0	0	0	0	1.92	17.08	4.67
26	0	0	0.09	0	2.00	0	0.09	1.55	0	0.36	0	0	0	0	0.91	3.00	1.45
27	0	7.17	0	0	0.50	0	0.50	0	0	0	0	0	0	0	0.83	8.50	7.00
28	0	1.73	0	0	1.45	0	0.73	0.09	0	0.64	0	0	0	0	1.00	4.18	4.55

Appendix D. Fatality Summary Table for the Pacific Northwest Region of North America

Appendix D. Publicly available and comparable all bird and diurnal raptor fatality estimates and habitat types from wind energy facilities in the Pacific Northwest (Oregon and Washington) region of North America.

Project Name	All Bird Fatality Rate (birds/MW/year)	Diurnal Raptor Fatality Rate (raptors/MW/year)	Predominant Habitat Type	Citation
Big Horn, WA (2006-2007)	2.54	0.11	agriculture/grassland	Kronner et al. 2008
Biglow Canyon, OR (Phase I; 2008)	1.76	0.03	agriculture/grassland	Jeffrey et al. 2009a
Biglow Canyon, OR (Phase I; 2009)	2.47	0	agriculture	Enk et al. 2010
Biglow Canyon, OR (Phase II; 2009-2010)	5.53	0.14	grassland/shrub-steppe, agriculture	Enk et al. 2011a
Biglow Canyon, OR (Phase II; 2010-2011)	2.68	0.03	grassland/shrub-steppe, agriculture	Enk et al. 2012a
Biglow Canyon, OR (Phase III; 2010-2011)	2.28	0.05	grassland/shrub-steppe, agriculture	Enk et al. 2012b
Combine Hills, OR (2011)	2.33	0.05	agriculture/grassland	Enz et al. 2012
Combine Hills, OR (Phase I; 2004-2005)	2.56	0	shrub/scrub & agriculture	Young et al. 2006
Elkhorn, OR (2008)	0.64	0.06	shrub/scrub & agriculture	Jeffrey et al. 2009b
Elkhorn, OR (2010)	1.95	0.08	agriculture	Enk et al. 2011b
Goodnoe, WA (2009-2010)	1.4	0.17	agriculture/grassland	URS Corporation (URS) 2010a
Harvest Wind, WA (2010-2012)	2.94	0.23	agriculture/grassland	Downes and Gritski 2012a
Hay Canyon, OR (2009-2010)	2.21	0	grassland/shrub-steppe and agriculture	Gritski and Kronner 2010a
Hopkins Ridge, WA (2006)	1.23	0.14	agriculture/grassland	Young et al. 2007
Hopkins Ridge, WA (2008)	2.99	0.07	agriculture	Young et al. 2009
Kittitas Valley, WA (2011-2012)	1.06	0.09	grassland	Stantec Consulting Services 2012
Klondike II, OR (2005-2006)	3.14	0.06	agriculture/grassland	Northwest Wildlife Consultants (NWC) and WEST 2007
Klondike III (Phase I), OR (2007-2009)	3.02	0.15	agriculture/grassland	Gritski et al. 2010
Klondike IIIa (Phase II), OR (2008-2010)	2.61	0.06	grassland and shrub-steppe	Gritski et al. 2011
Klondike, OR (2002-2003)	0.95	0	grassland/shrub-steppe	Johnson et al. 2003
Leaning Juniper, OR (2006-2008)	6.66	0.16	agriculture/grassland	Gritski et al. 2008
Linden Ranch, WA (2010-2011)	6.65	0.27	agriculture/grassland	Enz and Bay 2011
Marengo I, WA (2009-2010)	0.27	0	sagebrush-steppe, grassland	URS 2010b
Marengo II, WA (2009-2010)	0.16	0.05	grassland/shrub-steppe, agriculture	URS 2010c
Nine Canyon, WA (2002-2003)	2.76	0.03	agriculture	Erickson et al. 2003c

Appendix D. Publicly available and comparable all bird and diurnal raptor fatality estimates and habitat types from wind energy facilities in the Pacific Northwest (Oregon and Washington) region of North America.

Project Name	All Bird Fatality Rate (birds/MW/year)	Diurnal Raptor Fatality Rate (raptors/MW/year)	Predominant Habitat Type	Citation
Pebble Springs, OR (2009-2010)	1.93	0.04	agriculture	Gritski and Kronner 2010b
Stateline, OR/WA (2001-2002)	3.17	0.09	agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2003)	2.68	0.09	Cropland, Developed, Grassland, Shrub Steppe, Winter Wheat	Erickson et al. 2004
Stateline, OR/WA (2006)	1.23	0.11	grassland/shrub-steppe, agriculture and forest	Erickson et al. 2007
Tucannon River, WA (2015)	1.5	0.16	Shrub-steppe, grassland	Hallingstad et al. 2016
Tuolumne (Windy Point I), WA (2009-2010)	3.2	0.29	grassland/shrub-steppe, agriculture	Enz and Bay 2010
Vansycle, OR (1999)	0.95	0	grassland	Erickson et al. 2000
Vantage, WA (2010-2011)	1.27	0.29	grassland/shrub-steppe, agriculture	Ventus Environmental Solutions 2012
White Creek, WA (2007-2011)	4.05	0.47	agriculture/grassland	Downes and Gritski 2012b
Wild Horse, WA (2007)	1.55	0.09	agriculture/grassland	Erickson et al. 2008
Windy Flats, WA (2010-2011)	8.45	0.04	agriculture/grassland	Enz et al. 2011

MW = megawatt

Avian Use Surveys at the Four Mile Wind Project, Benton County, Washington

**Final Report
June 2018 – May 2019**



Prepared for:
Four Mile MW LLC
205 SE Spokane Street, Suite 300
Portland, Oregon 97202

Prepared by:
Andrea Chatfield, Joel Thompson, Julie Bushey, and Diem Pham
Western EcoSystems Technology, Inc.
2725 NW Walnut Boulevard
Corvallis, Oregon 97330

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Public Draft - For Distribution

EXECUTIVE SUMMARY

Four Mile MW LLC (Four Mile) is proposing to develop the Four Mile Wind Project (Project) in Benton County, Washington. To support the development of the Project, Four Mile contracted Western EcoSystems Technology, Inc. to conduct a pre-construction avian use study in the area where the Project is proposed (Study Area). The principle objective of the study was to assess the temporal and spatial use of the Study Area by large and small birds, including eagles and other species of regulatory or conservation concern.

Fixed-point avian surveys were conducted at 27 points (26 points located throughout the Study Area and one point southwest of the Study Area) from June 5, 2018 to May 29, 2019. Two separate surveys were conducted at each point every month: a 10-minute (min) small bird survey followed immediately by a 60-min large bird survey. Over the course of the study, 309 large bird surveys were completed and a total of 16,281 large bird observations representing 26 separate species were recorded. Large bird use was highest in winter, largely due to higher use by waterfowl which composed 94.1% of large bird use during that season. Flight paths for several species of waterfowl (Canada goose and snow goose) and waterbirds (American white pelican) were concentrated in the eastern third of the Study Area, likely due to its proximity to the Columbia River.

Diurnal raptor use was highest in fall (3.69 birds/plot/60-min survey) and lowest in summer (1.06). Eleven separate diurnal raptor species were recorded during surveys, the most abundant of which were northern harrier, red-tailed hawk, and rough-legged hawk which collectively composed 79.5% of all diurnal raptor observations. A total of five bald eagle observations were recorded during surveys, including four observations in winter and one in spring. Bald eagle observations recorded during the study resulted in a total of 10 eagle exposure minutes. Diurnal raptors were observed at all 27 survey points; however, relatively higher raptor use was recorded in the eastern portion of the Study Area with the highest use was recorded at Point 17. Annual mean raptor use at the Project was scaled to 20-min to compare with other wind energy sites in Washington and Oregon that implemented similar protocols and had data for three or four seasons. Diurnal raptor use at the Project (0.90 raptors/plot/20-min) fell within the range of the 23 other wind energy sites evaluated in the Pacific Northwest, ranking second from the highest.

Over the course of the 309 small bird surveys conducted during the study, a total of 1,632 small bird observations, representing 21 separate species, were recorded. The most abundant small bird species recorded was horned lark (1,125 observations) which composed 68.9% of all small bird observations. Three species, western meadowlark, European startling, and bank swallow composed an additional 18.0% of small bird observations. The highest small bird use was recorded in fall (6.49 birds/plot/10-min survey), followed by winter (5.81), spring (5.56), and summer (3.60). Small bird use varied widely across the 27 survey points, ranging from 0.58 to 17.58 birds/10-min survey; however, no obvious spatial patterns in use were evident.

During surveys or incidentally, six bird species of concern were recorded within the Study Area including one state-endangered species (sandhill crane), one state-threatened species (American white pelican), and two state candidates for listing (loggerhead shrike and sage thrasher). Each of these species, in addition to prairie falcon, is also considered a state Priority Species. Bald eagle is protected under the federal Bald and Golden Eagle Protection Act.

To date, overall fatality rates for birds at wind energy facilities in the Pacific Northwest with publicly available data have been variable, ranging from 0.16 to 8.45 birds/megawatt (MW)/year, with fatality rates for diurnal raptors ranging from zero to 0.47 bird/MW/year. The Study Area is dominated by agricultural cover types (i.e., cultivated cropland) of limited value to most avian species, particularly species of conservation concern. While several species of concern were documented during the study, these observations were not unexpected for the region and most of these species are believed to be at relatively low risk from Project development and operation given their use of the Study Area, and known interactions with wind turbines in the region. One species of particular concern at the Project is American white pelican. Relatively large numbers of the species were documented flying at rotor-swept height through the eastern third of the Study Area suggesting this species may be at risk of collision with turbine blades.

STUDY PARTICIPANTS

Andrea Chatfield	Project Manager
Joel Thompson	Senior Reviewer
Carmen Boyd	Project Tracking and Data Manager
Diem Pham	Lead Client Analyst
Julie Bushey	Data Analyst
Mysti Martin	GIS Technician
Katie Wynne	Technical Editor
Kori Hutchison	Field Supervisor
Joshua Parrott	Field Technician

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INTRODUCTION

Four Mile MW LLC (Four Mile) is proposing the development of the Four Mile Wind Project (Project) in Benton County, Washington. To support the development of the Project, Four Mile contracted Western EcoSystems Technology, Inc. (WEST) to conduct a pre-construction avian use study in the area where the Project is proposed (Study Area). Study methodology was based upon the recommendations in the US Fish and Wildlife Service (USFWS) 2012 *Final Land-Based Wind Energy Guidelines* (WEG; USFWS 2012), Appendix C(1)(a) of the 2013 USFWS *Eagle Conservation Plan Guidelines* (ECPG; USFWS 2013), the USFWS *Revisions to Regulations for Eagle Incidental Take and Take of Eagle Nests* (Final Eagle Rule; 81 FR 91494 [December 16, 2016]), and the Washington Department of Fish and Wildlife (WDFW) Wind Power Guidelines (WDFW 2009). The principle objective of the study was to assess the temporal and spatial use of the Study Area by large and small birds, including eagles and other species of concern (USFWS 2012). This report summarizes methods and results from the year-long avian use study conducted at the proposed Project.

STUDY AREA

The Study Area encompasses 14,563 hectares (35,987 acres) of privately owned and state-owned land within Benton County in southeastern Washington, approximately 11.3 kilometers (km; 7.0 miles [mi]) south of the city of Kennewick (Figure 1). Topography within the Study Area generally consists of rolling hills bisected by meandering canyons that drain primarily to the south and east into the Columbia River. Elevations range from approximately 192 meters (m; 630 feet [ft]) along the northeastern boundary of the Study Area to 613 m (2,010 ft) in the northwest. The eastern boundary of the Study Area lies adjacent to the Columbia River as it bends around the Study Area from the north to the southwest. The 96-megawatt (MW) Nine Canyon wind energy facility (Nine Canyon) is located immediately to the north of the Study Area and the 300-MW Stateline wind energy facility (Stateline) is located approximately 6.4 km (4.0 mi) to the southeast.

Historically, the native vegetation of the Study Area consisted of a bluebunch wheatgrass (*Pseudoroegneria spicata*)-Idaho fescue (*Festuca idahoensis*) zonal association, which was predominately grassland and shrub-steppe with deciduous riparian forest and scrub along drainages (Franklin and Dyrness 1973). Today, native grassland and shrub-steppe habitats have been replaced by tilled dry-land agriculture (primarily wheat) with a smaller amount of uncultivated grassland, the majority of which is managed as part of the US Department of Agriculture Farm Service Agency's Conservation Reserve Program. Based on vegetation and land cover mapping conducted within the Study Area, four vegetation/land cover types were identified within the Study Area (Chatfield and Brown 2018). The predominant land cover type was agriculture, encompassing 53.2% of the total Study Area. Agricultural areas within the Study Area were primarily cultivated croplands consisting of dryland wheat, and were more extensive in the central portions of the Study Area. This was followed by grasslands which encompassed a further 29.5% of the Study Area (Figure 2). Smaller areas of remnant shrub-steppe (16.5% of the Study Area) were located primarily in the northeastern and western portions of the Study Area (Figure 2).

Developed areas, including Highway 82 and individual structures, residences, and farms, were scattered throughout the area and composed the remaining 0.9% of the Study Area (Figure 2). Although the areas containing shrub-steppe are relatively small, shrub-steppe is considered an important habitat type for avian species, providing critical nesting and foraging opportunities (WDFW 2009). Trees primarily associated with farms and residences are scattered throughout the Study Area.

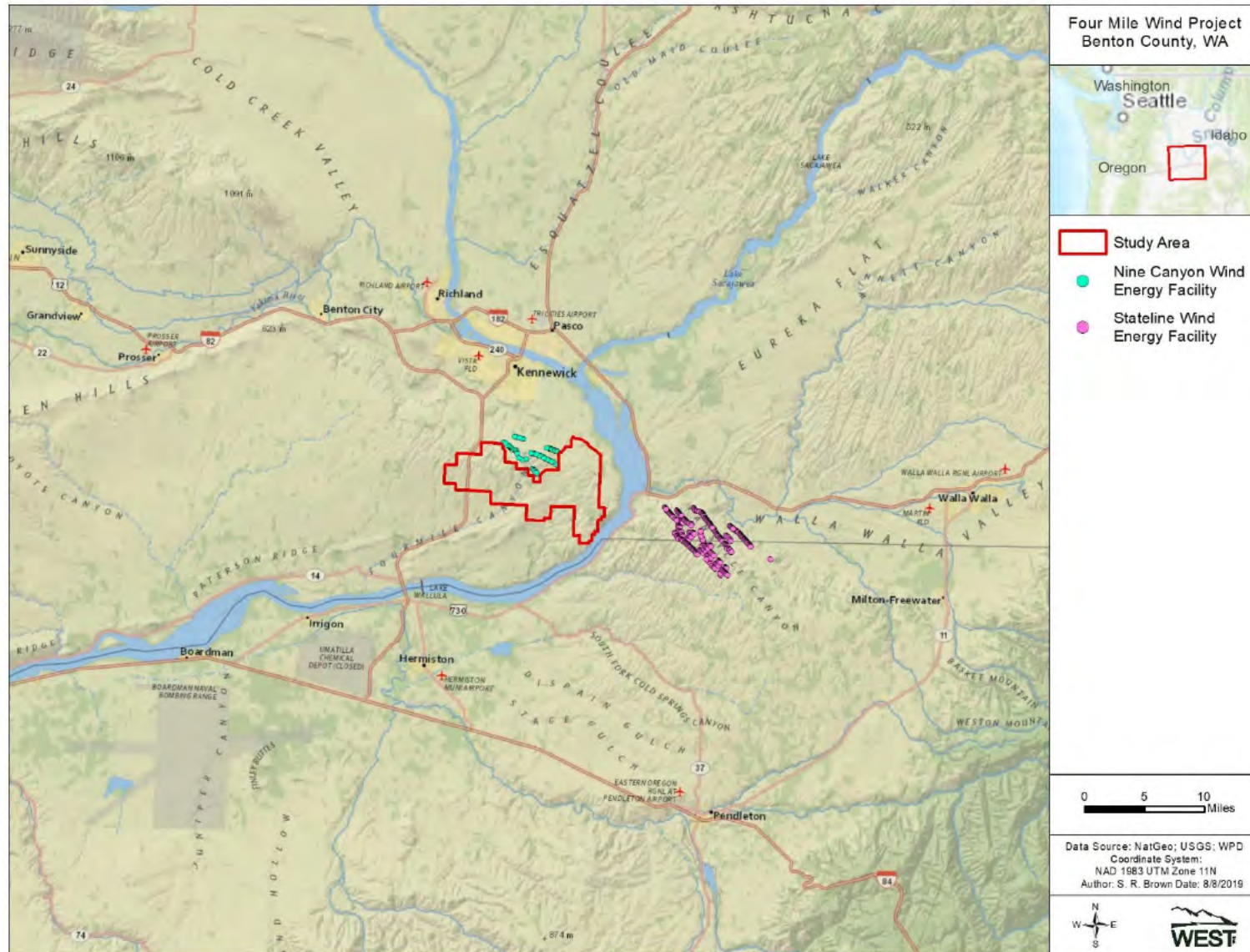


Figure 1. Location of the proposed Four Mile Wind Project, Benton County, Washington.

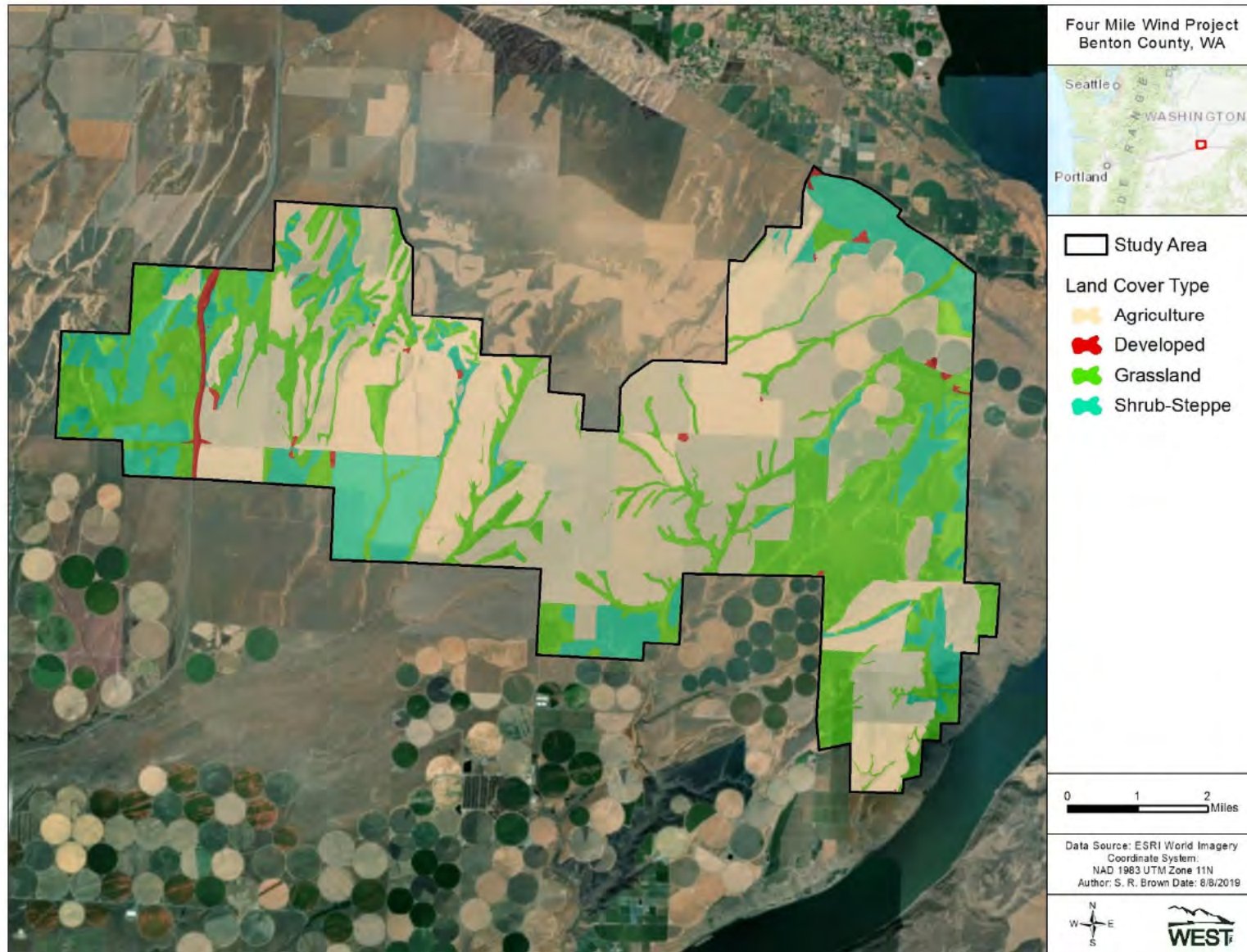


Figure 2. Land cover types and coverage within the Four Mile Wind Project Study Area, Benton County, Washington.

METHODS

Because of the need to collect information recommended by the USFWS specifically for eagles, the study design and survey methods primarily followed guidance from the ECPG and the Final Eagle Rule; however, this guidance is also appropriate for collecting data on other large bird species (e.g., other diurnal raptors, waterfowl, waterbirds). Because of the additional need to collect information on small bird species, small bird surveys were incorporated into the study design using guidance from the WEG and WDFW Wind Power Guidelines. Methods described below, therefore, are common for all birds (i.e., large and small birds, eagles, and other species of concern) except as noted.

Species of concern are defined per the WEG as any species that 1) is either a) listed as an endangered, threatened or candidate species under the Endangered Species Act, subject to the Migratory Bird Treaty Act (1918) or Bald and Golden Eagle Protection Act (BGEPA; 1940); b) is designated by law, regulation, or other formal process for protection and/or management by the relevant agency or other authority; or c) has been shown to be significantly adversely affected by wind energy development, and 2) is determined to be possibly affected by the Project (USFWS 2012).

Large birds are defined as waterbirds, waterfowl, shorebirds, gulls/terns, diurnal raptors (i.e., kites, accipiters, buteos, eagles, falcons, northern harrier, and osprey), owls, vultures, upland game birds, doves/pigeons, goatsuckers, large corvids (e.g., magpies, crows, and ravens). Small birds are defined as cuckoos, swifts/hummingbirds, woodpeckers, kingfishers, and passerines.

Study Design

Twenty-six survey points were established in the Study Area to achieve a minimum of 30% coverage as recommended in the Final Eagle Rule (81 FR 91494 [December 16, 2016]; Figure 3). An additional point (Point 27; Figure 3) was established approximately 7.1 km (4.4 mi) to the southwest of the Study Area in another area under evaluation by Four Mile. Each point was centered on a circular survey plot with an 800-m (2,625-ft) radius for large birds (including eagles) and 100-m (328-ft) radius for small birds (Reynolds et al. 1980, USFWS 2013, 81 FR 91494 [December 16, 2016]).

Surveys at all 27 points were conducted once per month during all seasons, as specified in the ECPG (USFWS 2013) and Final Eagle Rule (81 FR 91494 [December 16, 2016]), from June 5, 2018 to May 29, 2019. Seasons were defined: summer (June 1 – August 31), fall (September 1 – November 30), winter (December 1 – February 28), and spring (March 1 – May 31). Surveys were conducted during daylight hours and survey times at survey points were randomized to cover all daylight hours during a season. Surveys were conducted under all weather conditions except when visibility was less than 800 m horizontally and 200 m (656 ft) vertically.

Survey Methods

All Birds

Surveys at each point were conducted for a period of 70 minutes (min), with only small birds recorded during the first 10 min of the survey period, and only large birds (including eagles) recorded for the remaining 60 min of the survey period. Biologists recorded the following information for each survey: date, start and end time, and weather (i.e., temperature, wind speed, wind direction, precipitation, and percent cloud cover). Additionally, the following data were recorded for each group of birds observed:

- Observation number
- Species (or best possible identification)
- Number of individuals
- Sex and age class (if identifiable)
- Distance from survey plot center to the nearest 5-m (16-ft) interval (first and closest)
- Flight height above ground level (AGL) to the nearest 5-m interval (first, lowest, and highest)
- Flight direction (first observed)
- Habitat
- Activity (e.g., flying, perched)
- Observation type (visual or aural)
- Flight paths and perch locations of eagles, other diurnal raptors, waterbirds and waterfowl

Eagles

Data were collected based on the recommendations in the ECPG (USFWS 2013) and the Final Eagle Rule (81 FR 91494 [December 16, 2016]) if a bald eagle (*Haliaeetus leucocephalus*) or golden eagle (*Aquila chrysaetos*) was observed during the survey period. Biologists recorded eagle behavior (i.e., flight height, distance from observer, activity) each minute, at the top of the minute, to provide an instantaneous count for every eagle observed, and age class (juvenile [1st year], immature or sub-adult [2nd to 4th year], adult [\geq 5th year]).

Incidental Observations

Incidental wildlife observations are wildlife seen outside of the standardized survey periods but within the Study Area and are focused on federal- or state-protected species, unusually large congregations of individuals, species not yet recorded during surveys, or eagle attractants (e.g., ground squirrel [*Urocitellus* spp.] colonies, areas with concentration of carrion). Data recorded for incidentally observed species were similar to that recorded during scheduled surveys, with the exception that minute by minute data were not recorded for eagles observed incidentally.

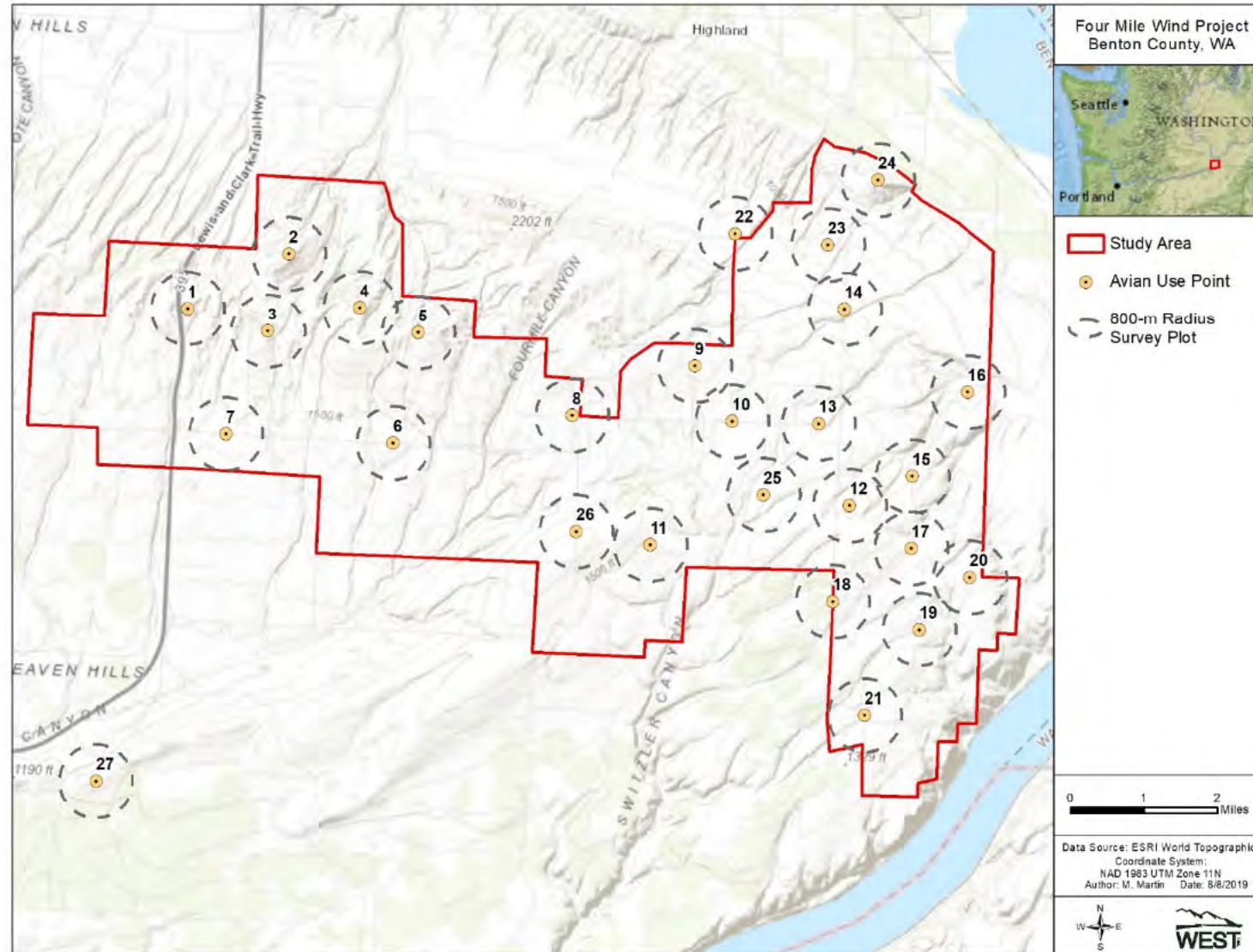


Figure 3. Location of survey points and plots used during fixed-point avian use surveys at the Four Mile Wind Project from June 5, 2018 to May 29, 2019.

Data Management

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following surveys, biologists were responsible for inspecting data forms for completeness, accuracy, and legibility. If errors or anomalies were found within the data, follow-up measures were implemented including discussions and review of field data with field technicians and/or project managers. Any errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms where appropriate changes and measures were implemented. Multiple reviews were conducted as part of the QA/QC process.

Data Compilation and Storage

A Microsoft® SQL database was specifically developed to store, organize, and retrieve survey data. Project data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis and all data forms and electronic data files were retained for reference.

Statistical Analysis

A visit was defined as surveying all of the survey plots once and could occur across multiple dates but had to be completed in a single season (e.g., spring). If extreme weather conditions prevented all plots from being surveyed during a visit, then a visit might not have constituted a complete survey of all plots. A survey was defined as a single 10-min or 60-min count of birds. In some cases, a count of bird observations may represent repeated observations of the same individual. Only observations within the survey plot were included for data analysis.

Mean Use, Percent of Use, and Frequency of Occurrence

Mean use is the average number of birds observed per plot per survey for small or large birds. Small bird use (per 100-m plot per 10-min survey) and large bird use (per 800-m plot per 60-min survey) is calculated by: 1) summing birds per plot per visit, 2) averaging number of birds over plots within a visit, and 3) averaging number of birds across visits within a season. Overall mean use was calculated as a weighted average of seasonal values by the number of days in each season. Percent of use was calculated as the percentage of small or large bird use that was attributable to a particular bird type or species. Frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed.

Mean use and frequency of occurrence describe different aspects of relative abundance, in that mean use is based on the number of birds (i.e., large groups can produce high estimates), whereas frequency of occurrence is based on the number of groups (i.e., it is not influenced by group size). Qualitative comparisons were made with these metrics among bird types, seasons, and survey points to help understand how birds are using the Project area over time and space.

Flight Height

Bird flight heights are important metrics to assess relative potential exposure to turbine blades and were used to calculate the percentage of eagles and other large birds observed flying within the rotor-swept height (RSH) of proposed turbines. A RSH of 25 to 150 m (82 to 492 ft) AGL was assumed for the purpose of the analysis. Flight height recorded during the initial observation was used to calculate mean flight height and the percentage of birds flying within the RSH.

Spatial Use

Mean use was calculated by survey point for large birds, small birds, and eagles to make spatial comparisons among the survey points. Additionally, flight paths of eagles, other diurnal raptors, waterbirds, and waterfowl were mapped during large bird use surveys to qualitatively show flight path location compared to Project area characteristics (e.g., topographic features) to identify if there were areas of concentration or consistent flight patterns within the Study Area.

Eagles

Eagle observations during surveys were summarized to provide flight heights (see Flight Height) and flight path maps (see Spatial Use). Minute data were examined to count eagle exposure minutes, defined as the number of minutes an eagle was observed in flight within the risk cylinder (defined as the area within 800 m of the survey point and up to 200 m AGL during the 60-min survey periods). The eagle exposure minutes per survey hour were reported by survey plot and month to enable spatial and temporal assessments of eagle exposure minutes recorded in the Study Area. Observations of perched eagles and those outside of survey plots were not considered eagle exposure minutes; however, the perch locations and flight paths of all eagles were mapped to qualitatively assess areas of eagle use within the Study Area.

RESULTS

Overall, 309 avian use surveys were conducted for large birds and 309 surveys were conducted for small birds (Table 1). Survey results are summarized below, supplemented by the appendices, which present species-level detail on numbers of groups and observations within the survey plot by season (Appendices A1 and A2), avian use, percent of use, and frequency of occurrence by season (Appendices B1 and B2), and mean use by survey point (Appendix C).

Table 1. Summary of survey effort at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Season ¹	Large Birds		Small Birds	
	# Visits ²	# Surveys ³	# Visits ²	# Surveys ³
Summer	3	79	3	79
Fall	3	81	3	81
Winter	3	69	3	69
Spring	3	80	3	80
Overall	12	309	12	309

¹ Season dates: Summer (June 1 – August 31), Fall (September 1 – November 30), Winter (December 1 – February 28), Spring (March 1 – May 31).

² A visit was defined as surveying all of the survey plots once within the Study Area and could occur across multiple dates but had to be completed in a single season.

³ A survey was defined as a single 10-min or 60-min count of birds.

Large Birds

Twenty-six large bird species were observed or heard over the 309 hours of surveys during the year-long study. The greatest number of species was recorded in spring (18) followed by fall (17), winter (16), and summer (13; Appendix A1). The most abundant large bird species was snow goose (*Chen caerulescens*; 11,805 observations in 53 separate groups), followed by Canada goose (*Branta canadensis*; 1,315 observations in 28 separate groups; Appendix A1). Together, these two waterfowl species composed 80.6% of all large bird observations and 94.0% of large bird observations in winter (Appendix A1). Waterbirds, represented by two species, composed another 7.3% of overall large bird observations: sandhill crane (*Antigone canadensis*; 383 observations in three groups) and American white pelican (*Pelecanus erythrorhynchos*; 808 observations in 68 groups; Appendix A1). Diurnal raptors represented 3.9% of large bird observations and the most abundant raptor species were northern harrier (*Circus hudsonius*; 225 observations), red-tailed hawk (*Buteo jamaicensis*; 177 observations), and rough-legged hawk (*B. lagopus*; 99 observations; Appendix A1).

Mean Use, Percent of Use, and Frequency of Occurrence

Mean use, percent of use, and frequency of occurrence were calculated by season for large bird types (Figures 4a, 4b, 4c) and species (Appendices B1). Large bird mean use (observations/800-m plot/60-min survey) was highest during winter (160.00), followed by fall (23.10), spring (22.38), and summer (11.71; Figure 4a, Appendix B1). Among large bird types, waterfowl composed the greatest percentage of use in fall, winter, and spring (44.2%, 94.1%, and 74.0%, respectively), while waterbirds composed the greatest percentage of use in summer (77.0%; Figure 4b, Appendix B1). Diurnal raptors composed between 1.2% and 16.0% of total large bird use during each season (Figure 4b, Appendix B1). Diurnal raptors and large corvids were the most frequently observed large bird types during all seasons, with diurnal raptors recorded during 55.7% to 91.4% of surveys seasonally and large corvids observed during 31.6% to 80.8% of surveys seasonally (Figure 4c, Appendix B1). Alternatively, waterbirds were recorded during less than 30.0% of surveys each season and waterfowl were recorded during less than 34.0% of surveys each season (Figure 4c, Appendix B1).

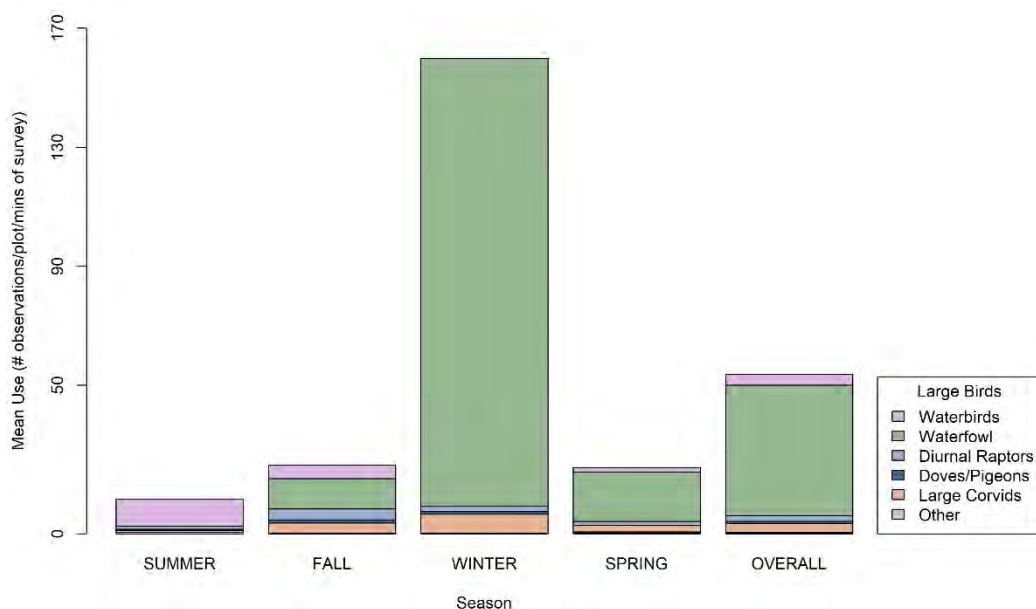


Figure 4a. Large bird mean use by season and bird type at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

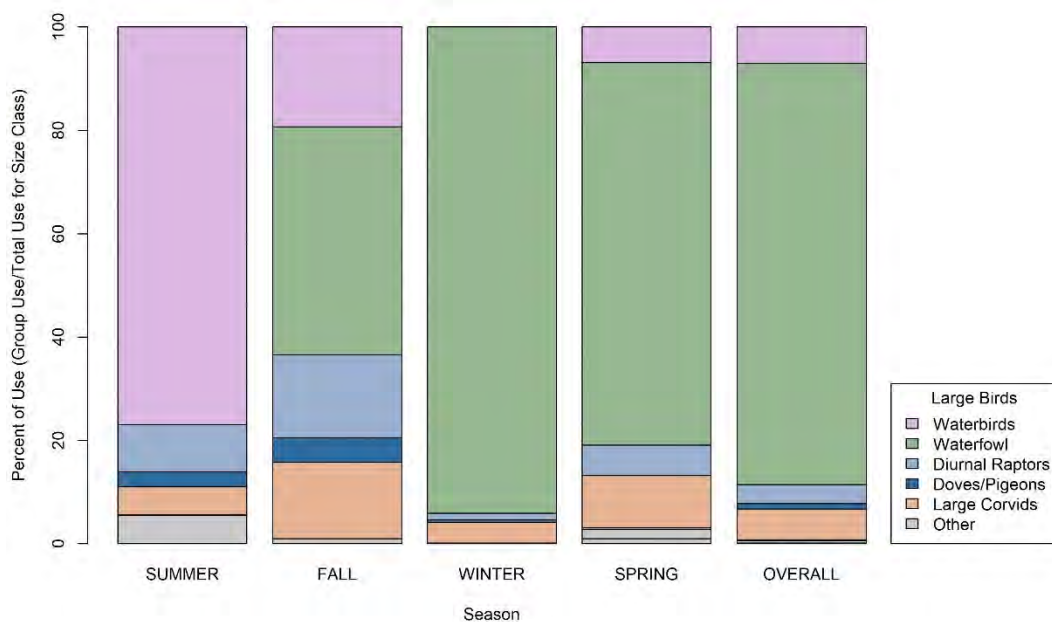


Figure 4b. Large bird percent of use by season and bird type at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

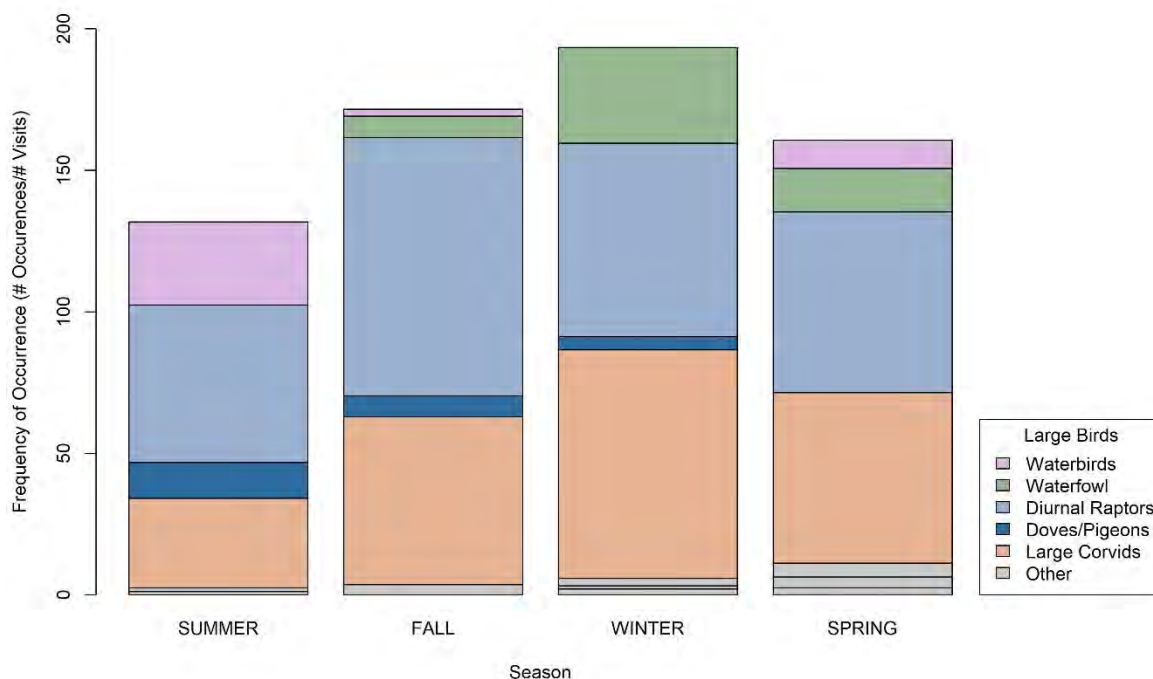


Figure 4c. Large bird frequency of occurrence by season and bird type at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Bird Flight Height

Mean large bird flight heights ranged from two m (seven ft) for upland game birds to 196 m (643 ft) for gulls/terns (Table 2). Bird types recorded most frequently within the RSH included waterfowl (71.0%), large corvids (67.4%), gulls/terns (65.9%), and waterbirds (60.5%; Table 2). Overall, diurnal raptors were recorded flying within the RSH during 48.5% of observations, with 50.5% recorded below the RSH, and 1.0% recorded above (Table 2). Among diurnal raptor subtypes the majority of accipiters, buteos, and eagles were recorded flying within the RSH, while northern harrier and falcons were more often recorded flying below the RSH (Table 2).

Table 2. Flight height characteristics by bird type and raptor subtype during 60-minute large bird use surveys at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Bird Type	# Groups	# Obs	Mean Flight	% Obs	% within Flight Height Categories		
	Flying	Flying	Height (m)	Flying	<25 m	25-150 m ^a	>150 m
Waterbirds	71	1,191	123	100	0.3	60.5	39.3
Waterfowl	77	12,495	123	95.0	<0.1	71.0	28.9
Shorebirds	4	20	12	95.2	100	0	0
Gulls/Terns	5	82	196	100	0	65.9	34.1
Diurnal Raptors	494	511	35	81.1	50.5	48.5	1.0
<i>Accipiters</i>	5	5	111	100	0	80.0	20.0
<i>Buteos</i>	237	243	54	77.4	19.8	78.6	1.6
<i>Northern Harrier</i>	210	220	13	97.8	83.6	16.4	0
<i>Eagles</i>	5	5	66	100	40.0	60.0	0
<i>Falcons</i>	37	38	22	46.9	63.2	36.8	0
Owls	1	1	5	100	100	0	0
Upland Game Birds	2	4	2	11.4	100	0	0
Doves/Pigeons	22	112	23	65.1	48.2	51.8	0
Large Corvids	292	946	35	95.2	32.2	67.4	0.3
Large Birds Overall	968	15,362	49	94.4	4.3	68.9	26.8

^a. The likely "rotor-swept height" for potential collision with a turbine blade, or 25 to 150 m (85 to 492 feet) above ground level.

Obs=observations

Spatial Variation

Mean Use by Point

Large bird use varied widely across survey plots, ranging from 2.36 observations/survey at Point 2 to 363.33 at Point 16 (Appendix C). High variability in large bird use across the Study Area was largely driven by waterfowl, and to a lesser extent, waterbirds, documented at a subset of survey points, primarily in the eastern third of the Study Area. At the two survey points with the highest overall large bird use (points 16 and 12), waterfowl composed 92.9% and 98.7% of that use. The highest use by waterbirds was recorded at points 1 and 16 (27.27 and 16.50 observations/survey, respectively; Appendix C). Use by diurnal raptors was more consistent across the Study Area, ranging from 0.75 to 5.00 observations/survey (Appendix C). Use by other species groups (shorebirds, gulls/terns, owls, upland gamebirds, and doves/pigeons) was comparatively low and limited to only a few survey points across the Study Area (Appendix C).

Flight Paths

Flight paths of waterbirds, waterfowl, and diurnal raptors (including eagles) were mapped in the Study Area (Figures 5a and 5b). Flight paths for several species of waterbirds and waterfowl, namely American white pelican, Canada goose, and snow goose, were concentrated in the eastern third of the Study Area, likely due to the proximity to the Columbia River (Figure 5a). Flight paths for diurnal raptors were more evenly distributed throughout the Study Area, with a somewhat higher concentration of flight paths in the eastern portion of the Study Area, and another concentration of flight paths, particularly for *Buteos* (e.g., red-tailed hawk and Swainson's hawk [*Buteo swainsoni*]), surrounding Point 1 in the northwest corner of the Study Area (Figure 5b).

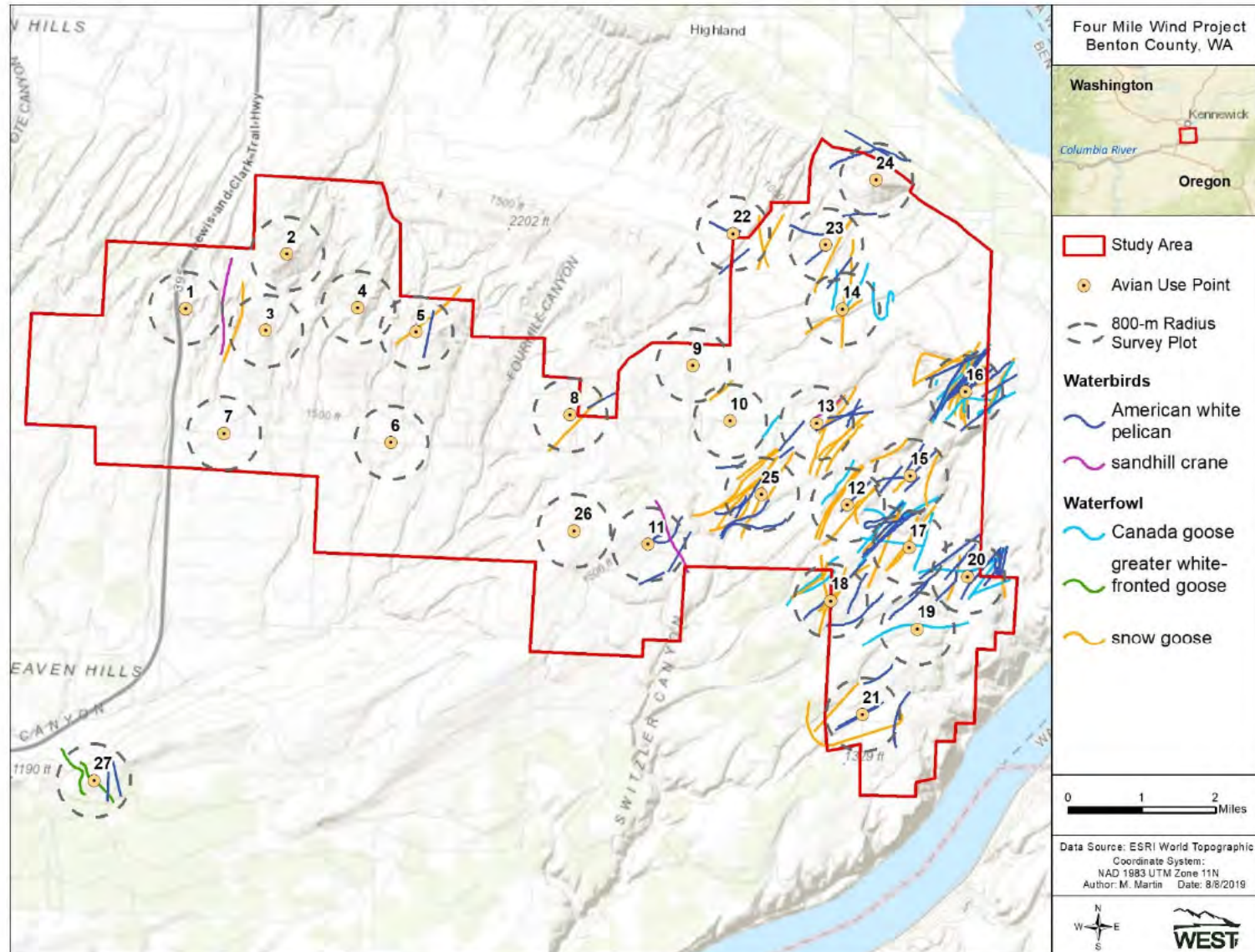


Figure 5a. Flight paths of waterbird and waterfowl species recorded during large bird surveys at the Four Mile Wind Project Study Area from June 5, 2018 to May 29, 2019.

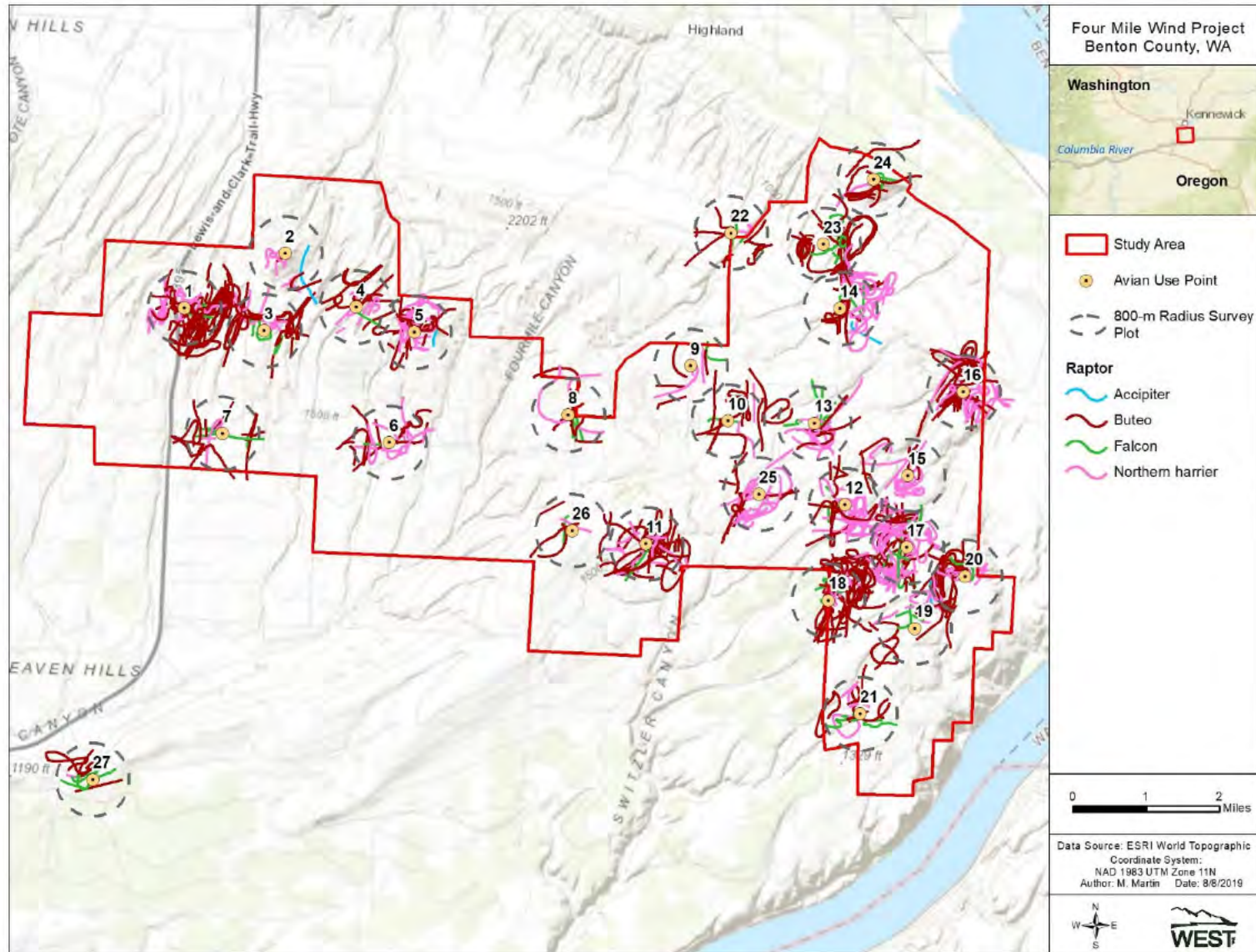


Figure 5b. Flight paths of diurnal raptor subtypes recorded during large bird surveys at the Four Mile Wind Project Study Area from June 5, 2018 to May 29, 2019.

Eagles

Over the course of 309 hours of survey, five bald eagle observations were recorded, including four observations in winter and one observation in spring (Table 3). These five bald eagle observations resulted in 32 minutes of flight and 10 bald eagle exposure minutes, or an exposure rate of 0.0324 exposure minutes per survey hour (Table 3). Bald eagles were observed at four survey points including two observations at Point 1, and single observations at points 12, 14, and 23 (Figure 5b, Appendix C). No golden eagles were observed during the year-long study.

Table 3. Bald eagle observations and exposure minutes* (min.) recorded during 60-minute large bird surveys conducted at the Four Mile Wind Project from June 5, 2018 to May 29, 2019.

Season	Survey Effort (Hours)	Observations	Flight Min.	Exposure Min.	Exposure Min./Survey Hour
Summer	79	0	0	0	-
Fall	81	0	0	0	-
Winter	69	4	28	8	0.1159
Spring	80	1	4	2	0.0250
Total	309	5	32	10	0.0324

* Exposure minutes are defined as flying behavior at or below 200 meters (m; 656 feet [ft]) and within 800 m (2,625 ft) of the survey location.

Small Birds

Twenty-one species of small birds were observed or heard over 51.5 hours of survey during the year-long study. The greatest number of small bird species was recorded in fall (12), followed by summer (11), spring (nine), and winter (five; Appendix A2). The most abundant species was horned lark (*Eremophila alpestris*), which composed 68.9% of all small bird observations (Appendix A2). Other abundant species included western meadowlark (*Sturnella neglecta*), European starling (*Sturnus vulgaris*), and bank swallow (*Riparia riparia*) which collectively composed another 18.0% of all small bird observations (Appendix A2).

Mean Use

Small bird mean use (observations/100-m plot/10-min survey) was highest during fall (6.49), followed by winter (5.81), spring (5.56), and summer (3.60; Appendix B2). Horned lark had the highest use of any small bird species during each season, composing between 43.4% and 81.7% of seasonal small bird use (Appendix B2). After horned lark, bank swallow had the highest use in summer, savannah sparrow (*Passerculus sandwichensis*) had the highest use in fall, American goldfinch (*Spinus tristis*) had the highest use in winter, and European starling had the highest use in spring (Appendix B2).

Spatial Variation

Small bird use ranged from 0.58 observations/100-m plot/10-min survey at Point 12 to 17.58 at Point 9 (Figure 3, Appendix C). Relatively high use at Point 9 was attributed entirely to use by horned lark.

Incidental Observations

Twelve species were recorded incidentally during the study (Table 4). Of these, six species were not observed during standardized surveys: American crow (*Corvus brachyrhynchos*), gray flycatcher (*Empidonax wrightii*), spotted towhee (*Pipilo maculatus*), lazuli bunting (*Passerina amoena*), loggerhead shrike (*Lanius ludovicianus*), and American robin (*Turdus migratorius*; Table 4).

Table 4. Number of groups (grps) and observations (obs) for wildlife observed incidentally outside of the standardized avian use surveys at the Four Mile Wind Project from June 5, 2018 to May 29, 2019.

Species	Scientific Name	# grps	# obs
sandhill crane	<i>Antigone canadensis</i>	3	155
snow goose	<i>Chen caerulescens</i>	1	200
killdeer	<i>Charadrius vociferus</i>	1	1
American crow	<i>Corvus brachyrhynchos</i>	1	85
western meadowlark	<i>Sturnella neglecta</i>	1	60
gray flycatcher	<i>Empidonax wrightii</i>	1	1
spotted towhee	<i>Pipilo maculatus</i>	2	2
sage thrasher	<i>Oreoscoptes montanus</i>	1	1
lazuli bunting	<i>Passerina amoena</i>	1	2
loggerhead shrike	<i>Lanius ludovicianus</i>	1	1
hermit thrush	<i>Catharus guttatus</i>	1	1
American robin	<i>Turdus migratorius</i>	1	65
Total	12 species	15	574

Species of Concern

Six species of concern were recorded during avian use surveys or incidentally within the Study Area including one state-endangered species (sandhill crane), one state-threatened species (American white pelican), and two state candidates for listing (loggerhead shrike and sage thrasher [*Oreoscoptes montanus*]; WDFW 2019; Table 5). Each of these species, in addition to prairie falcon (*Falco mexicanus*), is also considered a state Priority Species by the WDFW (2008). Bald eagle is protected under the federal BGEPA (1940).

Table 5. Groups and observations of species of concern recorded during avian use surveys or as incidental wildlife observations at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Species	Scientific Name	Status*	Surveys		Incidental		Total	
			# of grps	# of obs	# of grps	# of obs	# of grps	# of obs
sandhill crane	<i>Antigone canadensis</i>	SE, SP	3	383	3	155	6	538
American white pelican	<i>Pelecanus erythrorhynchos</i>	ST, SP	68	808	0	0	68	808
bald eagle	<i>Haliaeetus leucocephalus</i>	BGEPA	5	5	0	0	5	5
prairie falcon	<i>Falco mexicanus</i>	SP	19	19	0	0	19	19
loggerhead shrike	<i>Lanius ludovicianus</i>	SC, SP	0	0	1	1	1	1
sage thrasher	<i>Oreoscoptes montanus</i>	SC, SP	2	2	1	1	3	3
Total	6 species		97	1,217	5	157	102	1,374

grps=groups, obs=observations

*BGEPA = Bald and Golden Eagle Protection Act (BGEPA 1940) SE = state endangered; ST = state threatened species; SC = state candidate species; SP = state priority species. State species status from Washington Department of Fish and Wildlife (2008, 2019).

DISCUSSION

The principal objective of this avian use study was to assess the temporal and spatial use of the Study Area by large and small birds, including eagles and other species of concern. Over the course of the year-long study, approximately 361 hours of large and small bird use surveys were completed and 17,913 bird observations comprising 47 separate species were recorded. Overall, large bird use varied substantially across seasons and across the Study Area; however, most of this variability was attributed to relatively large groups of waterfowl observed primarily in the winter and in the eastern portion of the Study Area. Although recorded in lower numbers than waterfowl, waterbirds composed the majority (77.0%) of large bird use in summer. The majority of waterfowl and waterbird observations (71.0% and 60.5%, respectively) were recorded flying at heights within the RSH of proposed turbines which may put these species at risk of collision with Project turbines. Use by diurnal raptors was more consistent across seasons and across survey points. Seasonal use by diurnal raptors ranged from a low of 1.06 birds/800-m plot/60-min survey in summer to a high of 3.69 in fall. The most commonly recorded diurnal raptor species included northern harrier, red-tailed hawk, and rough-legged hawk.

In order to allow comparison with raptor use at other regional wind energy facilities in Washington and Oregon that implemented similar protocols and had data for three or four seasons, annual mean raptor use at the Project was recalculated for a 20-min survey period by using only the data collected during the first 20 min of the 60-min survey period. Based on this shorter survey period, diurnal raptor use at the Project (0.90 raptors/800-m/20-min) was on the high end, but within the range of raptor use at 23 regional wind energy facilities with publicly available data, ranking second highest of 23 other sites (0.35-1.07 raptors/800-m/20-min; Figure 6). Diurnal raptor use at adjacent Nine Canyon was 0.35 raptors/800-m/20-min, while use at nearby Stateline was 0.47 (Figure 6).

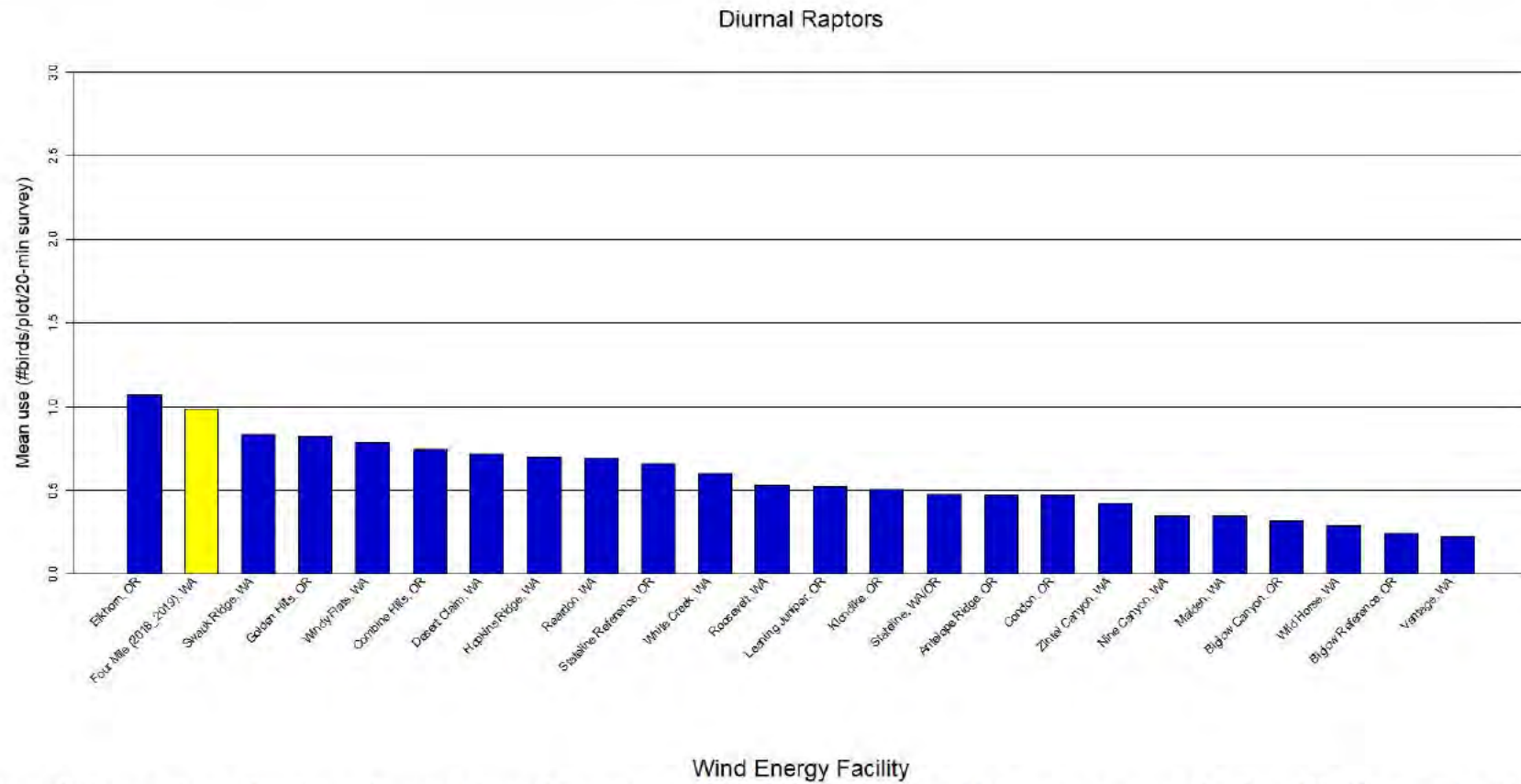


Figure 6. Comparison of estimated annual diurnal raptor use during fixed-point large bird use surveys at the Four Mile Wind Project from June 5, 2018 – May 29, 2019 and diurnal raptor use at other Oregon and Washington Wind Resource Areas with similarly collected data.

Figure 6 (continued). Comparison of estimated annual diurnal raptor use during fixed-point large bird use surveys at the Four Mile Wind Project from June 5, 2018 – May 29, 2019 and diurnal raptor use at other Oregon and Washington Wind Resource Areas with similarly collected data.

Data from the following sources:

Wind Energy Facility/Study	Report Citation	Wind Energy Facility/Study	Report Citation
Four Mile Wind Project, WA	This study.		
Elkhorn, OR	WEST 2005a	Klondike, OR	Johnson et al. 2002
Swauk Ridge, WA	Erickson et al. 2003a	Stateline, WA/OR	Erickson et al. 2003b
Golden Hills, OR	Jeffrey et al. 2008	Antelope Ridge, OR	WEST 2009
Windy Flats, WA	Johnson et al. 2007	Condon, OR	Erickson et al. 2002a
Combine Hills, OR	Young et al. 2003a	Zintel Canyon, WA	Erickson et al. 2002b, 2003c
Desert Claim, WA	Young et al. 2003b	Nine Canyon, WA	Erickson et al. 2001
Hopkins Ridge, WA	Young et al. 2003c	Maiden, WA	Young et al. 2002
Reardon, WA	WEST 2005b	Biglow Canyon, OR	WEST 2005c
Stateline Reference, OR	URS et al. 2001	Wild Horse, WA	Erickson et al. 2003d
White Creek, WA	NWC and WEST 2005	Biglow Reference, OR	WEST 2005c
Roosevelt, WA	NWC and WEST 2004	Vantage, WA	Jeffrey et al. 2007
Leaning Juniper, OR	Kronner et al. 2005		

Small bird use varied considerably across the Study Area; however, no clear spatial patterns of use were evident. Use by small birds was highest in fall (6.49 birds/100-m plot/10-min survey) and lowest in summer (3.60); however, use in all seasons was driven by horned lark which composed between 43.4% and 81.7% of all small bird use in any given season.

Species of Concern

During the study, six bird species of concern were recorded within the Study Area, none of which are unexpected for the region. These include the state-endangered sandhill crane, the state-threatened American white pelican, and the state candidates for listing loggerhead shrike and sage thrasher. All four of these species are also considered Priority Species by the WDFW, along with prairie falcon. While not a state or federally listed species, bald eagles are protected under the BGEPA.

Sandhill Crane

Sandhill cranes were recorded within the Study Area during fall (one group totaling 300 individuals) and spring (two groups totaling 83 individuals). Sandhill cranes typically use large freshwater marshes, prairie ponds, and marshy tundra during summer and grain fields or prairies during migration and winter. In Washington, sandhill cranes are known to breed only in Yakima and Klickitat counties (Stinson 2017). They typically use large freshwater marshes, prairie ponds, and marshy tundra during summer and grain fields or prairies during migration and winter. Although suitable breeding and stopover habitat is generally absent from the Study Area, there is potential for the species to migrate over the Project in spring and fall, which is supported by the data collected during this study. During surveys the majority (99.2%) of sandhill crane observations were recorded flying well above the RSH.

Waterbirds, including sandhill crane, do not appear to be particularly susceptible to collision with wind turbines. According to the National Research Council (2007) cumulative effects report, waterbirds composed about 1% of documented fatalities at 14 wind energy facilities. Waterbirds made up 0.2% of all bird fatalities ($n = 4,975$) in an analysis of 116 standardized monitoring studies conducted at over 70 wind energy facilities throughout the US and Canada (Erickson et al. 2014). Among publicly available reports reviewed by WEST, waterbirds accounted for just 0.2% of fatalities recorded during 41 studies at wind energy facilities in the Pacific Northwest region of North America (four of 1,942 total fatalities; see Appendix D for a list of facilities and references). The four waterbird fatalities documented at Pacific Northwest wind energy facilities were all great blue herons (*Ardea herodias*; see Appendix D). While no sandhill crane fatalities have been documented in the Pacific Northwest, several sandhill crane fatalities have been documented at facilities in other states. This includes one fatality documented at an older-generation facility at Altamont Pass in California (Smallwood and Karas 2009), and two fatalities from a facility in west Texas (Navarrete and Griffis-Kyle 2014 as cited in Gerber et al. 2014; Stehn 2011), documented as part of a wintering crane displacement study conducted by graduate student L. Navarrete of Texas Tech University.

Researchers at WEST monitored use by migrating sandhill cranes at five wind energy facilities in North and South Dakota from 2009 – 2013 for three years at each site. Concurrently, they searched underneath all turbines daily for fatalities of cranes. Cumulatively, observers spent 13,182 hours recording crane use over 1,305 days, and even though 42,727 sandhill crane observations were recorded, no fatalities of cranes were found beneath turbines (Derby et al. 2018). A crane monitoring study was conducted at the Forward Energy Center, a wind energy facility in southern Wisconsin located within 3.2 km (2.0 mi) of a large wetland used by sandhill cranes. No crane fatalities were found during the crane monitoring study in the fall of 2008, or during regular bird fatality monitoring studies conducted in the fall of 2008, spring and fall of 2009, and in the spring of 2010, even though sandhill cranes were observed in the study area (Grodsky et al. 2013).

Given the absence of suitable breeding and stopover habitat within the Project area, average flight heights well above the RSH, and the available data regarding these species' interactions with wind turbines, impacts to sandhill crane resulting from Project development and operation are anticipated to be low.

American White Pelican

American white pelicans were recorded in summer (58 groups totaling 705 individuals), fall (two groups totaling 61 individuals), and spring (eight groups totaling 42 individuals). American white pelicans are known to nest on Badger Island in the Columbia River, approximately 6.4 km (4.0 mi) east of the Study Area (Stinson 2016). While suitable breeding and foraging habitat for pelicans is not present within the Study Area, the species may fly over the Study Area during migration or while traveling between foraging areas, as evidenced by the survey data. The majority of pelicans observed during surveys were flying either in a southwest or northeast direction, suggesting movement between breeding areas on Columbia River dredge islands and foraging areas to the southwest of the Study Area. These groups of pelicans were recorded primarily at survey points

within the eastern third of the Study Area and flying at an average height of 118 m (387 ft) above mean sea level, with the majority (88.7%) of groups flying within the RSH.

Similar to sandhill crane and other waterbird species, American white pelicans do not appear to be particularly susceptible to collision with wind turbines. Based on publicly available data, no American white pelican fatalities have been documented at facilities in the Pacific Northwest (see Appendix D for a list of facilities and references). However, this may be the result of the siting of current wind energy facilities outside of pelican flight corridors. At least two American white pelican fatalities have been documented at wind energy facilities outside of Oregon and Washington, both of which were found at the Buffalo Ridge facility in South Dakota (Derby et al. 2010, 2012). The flight behavior of pelicans recorded flying over the eastern portion of the Study Area suggests that these birds may be at risk of collision. While data on the ability of waterbirds and other avian species to avoid wind turbines on the landscape is scarce, at nearby Nine Canyon, located immediately to the north of the Project, no American white pelicans were found during a 15-month post-construction fatality monitoring study (Erickson et al. 2005). However, Nine Canyon is located to the west of the majority of pelican observations for the Project and the facility appears to lie just beyond the flight corridor used by pelicans traveling between sections of the Columbia River. During pre-construction avian use survey conducted at Nine Canyon, no American white pelican observations were recorded (Erickson et al. 2001, 2003c). At the proposed Project, it is likely that collision risk for pelicans would be limited to turbines constructed in the eastern half of the Study Area, and concentrated during the summer months; however, the magnitude of this risk is unclear.

Bald Eagle

Based on information compiled by the USFWS, there have been 49 documented bald eagle fatalities or injuries at wind energy facilities in the US between 2013 and 2018 (Kritz et al. 2018). The majority of bald eagle casualties occurred in the Upper Midwest, Intermountain West, and Alaska, with only single bald eagle fatalities documented in each of Oregon and Washington (Kritz et al. 2018).

The Columbia Plateau supports both breeding and wintering populations of bald eagles, generally at lower densities than areas west of the Cascades; however, bald eagle nests have increased annually across the state since 2005 (Kalasz and Buchanan 2016). While bald eagle nest sites and breeding season foraging habitat is absent from the Project area, the species is known to nest in areas adjacent to rivers and lakes. During eagle nest surveys conducted within a 16-km (10-mi) radius of the Study Area, five occupied bald eagle breeding territories were documented, with four of those territories containing an active bald eagle nest in 2019 (Chatfield et al. 2019). Bald eagle nests documented during the survey were located along the Columbia River and its tributaries and ranged from 4.0-16.0 km (2.5-10.0 mi) from the proposed Project boundary (Chatfield et al. 2019). Despite several occupied bald eagle nests in the vicinity of the Study Area, only a single bald eagle was recorded (March) during the spring and summer nesting season, suggesting even lower use of the Study Area by breeding eagles than migrating or wintering eagles. The remaining four bald eagle observations were recorded in December and January. Based on the generally low direct impacts to bald eagles documented in the Pacific Northwest

and the low use of the Study Area by bald eagles documented during the study, risk to bald eagles from the development and operation of the Project is anticipated to be low.

Prairie Falcon

During surveys, 19 prairie falcon observations were recorded within the Study Area, with the majority of those observations recorded in fall and winter (each with seven observations). Prairie falcons are year-round residents of the region and, while nesting habitat is absent from the Study Area, the species may forage throughout the site's open grasslands and agricultural lands. No prairie falcon nests were documented in the vicinity of the Study Area during the 2019 aerial raptor nest surveys conducted for the Project (Chatfield et al. 2019).

Though prairie falcon fatalities have been documented at Pacific Northwest wind energy facilities, they have been relatively rare (three out of 154 total diurnal raptor fatalities; see Appendix D for a list of facilities and references). Given the relatively low use of the Study Area by prairie falcons and the low level of direct impacts reports for this species in the Pacific Northwest, risk to prairie falcons from development and operation of the Project is anticipated to be low.

Loggerhead Shrike

Only a single loggerhead shrike, recorded incidentally, was observed during the study, suggesting low use of the Study Area by this species. Loggerhead shrikes typically nest in mature shrub-steppe habitat; which is very limited within the Study Area (see Figure 2); however, the species will utilize grassland, agricultural land, and other open areas for foraging. Loggerhead shrike fatalities have been documented at wind energy facilities, particularly at facilities in California (see ICF International 2016; WEST 2008); however, no loggerhead shrike fatalities (out of 1,228 total passerine fatalities) have been reported in the Pacific Northwest (see Appendix D for a list of facilities and references). Given the low documented use the Study Area by this species and the very small amount of suitable nesting habitat, direct and indirect impacts to loggerhead shrike from the development and operation of the Project are anticipated to be low.

Sage Thrasher

Three sage thrasher observations were recorded during the study, including two recorded during surveys in September and one recorded incidentally in March. Given the timing of these observations, they were more likely migrating individuals passing through the Study Area than resident breeders. Sage thrashers require open shrub-steppe habitat for breeding which is limited in the Study Area (see Figure 2). Among 1,228 passerine fatalities recorded at wind energy facilities in the Pacific Northwest, only two sage thrasher fatalities have been documented (see Appendix D for a list of facilities and references). Given the low documented use the Study Area by this species and the very small amount of suitable shrub-steppe nesting habitat, direct and indirect impacts to sage thrashers from the development and operation of the Project are anticipated to be low.

Avian Mortality at Regional Wind Energy Facilities

To date, overall fatality rates for birds at wind energy facilities in the Pacific Northwest with publicly available data have been variable, ranging from 0.16 to 8.45 birds/MW/year, with fatality rates for

diurnal raptors ranging from zero to 0.47 birds/MW/year (Appendix D). At adjacent Nine Canyon, post-construction fatality monitoring conducted in 2002-2003 resulted in estimated mortality rates of 2.79 birds/MW/year and 0.03 diurnal raptors/MW/year (Erickson et al. 2003c). During three years of fatality monitoring at nearby Stateline, annual overall bird mortality estimates ranged from 1.23 to 3.17 birds/MW/year, while annual diurnal raptor mortality estimates ranged from 0.09 to 0.11 raptors/MW/year (Erickson et al. 2005, 2007). At the Elkhorn and Windy Flats wind energy facilities in Oregon and Washington, where pre-construction diurnal raptor use estimates were similar to that recorded at the Project (see Figure 6), corresponding post-construction diurnal raptor fatality rates ranged from 0.04 to 0.08 raptors/MW/year (Jeffrey et al. 2009a, Enk et al. 2011a, Enz et al. 2011; Appendix D), which was only slightly higher than that reported at Nine Canyon (0.03 raptors/MW/year; Erickson et al. 2003c) immediately adjacent the Study Area (Appendix D).

At wind energy facilities in the Pacific Northwest with publicly available fatality data, diurnal raptors have composed 7.9% of all documented avian fatalities (154 out of 1,942 total avian fatalities; see Appendix D for a list of facilities and references). In the Pacific Northwest, 12 separate diurnal raptor species have been found as fatalities, the most common of which have been American kestrel (*Falco sparverius*; 35.7%), red-tailed hawk (31.2%), and Swainson's hawk (9.1%; see Appendix D for a list of facilities and references). During the year-long fatality monitoring study at Nine Canyon, only one diurnal raptor fatality was documented, an American kestrel (Erickson et al. 2003c). Based on the composition of turbine-related raptor fatalities in the region, and the composition of diurnal raptors observed during this study, the diurnal raptor species most likely to be directly impacted by the Project are American kestrel and red-tailed hawk.

CONCLUSIONS

Tier 3 studies are used to address questions regarding impacts that could not be sufficiently addressed using available literature (i.e., during Tier 1 and 2 desktop analyses). These studies provide additional data that, when combined with available literature reviewed in previous tiers, allow for a better-informed assessment of the risk of significant adverse impacts to species of concern at the Project. The Study Area is dominated by agricultural cover types (i.e., cultivated cropland) of limited value to most avian species, particularly species of conservation concern. Several species of concern were documented during the study; however, these were not unexpected for the region and most are believed to be at low risk from Project development and operation given their use of the Study Area, and known interactions with turbines in the region. One species of particular concern at the Project is American white pelican. Relatively large numbers of the species were documented flying at RSH through the eastern third of the Study Area suggesting this species may be at risk of collision with turbine blades. However, it is unclear whether this flight behavior will translate to high levels of mortality, or if the birds would be able to successfully avoid turbines by flying above the RSH or diverting their flight paths around the entire facility. With the exception of potential direct impacts to pelicans, there is nothing in the data collected within the Study Area to date that would suggest the Project would fall outside of the range of impacts observed at other wind energy facilities in Oregon and Washington.

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**Appendix A. All Bird Types and Species Observed at the Four Mile Wind Project Study
Area during Avian Use Surveys, June 5, 2018 – May 29, 2019**

Appendix A1. Numbers of groups and observations by bird type and species for 60-minute large bird use surveys at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Type/Species	Scientific Name	Summer		Fall		Winter		Spring		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Waterbirds		58	705	3	361	0	0	10	125	71	1,191
sandhill crane	<i>Antigone canadensis</i>	0	0	1	300	0	0	2	83	3	383
American white pelican	<i>Pelecanus erythrorhynchos</i>	58	705	2	61	0	0	8	42	68	808
Waterfowl		0	0	10	827	51	11,036	22	1,292	83	13,155
greater white-fronted goose	<i>Anser albifrons</i>	0	0	0	0	0	0	2	35	2	35
Canada goose	<i>Branta canadensis</i>	0	0	1	12	16	846	11	457	28	1,315
snow goose	<i>Chen caerulescens</i>	0	0	9	815	35	10,190	9	800	53	11,805
Shorebirds		0	0	0	0	1	4	4	17	5	21
killdeer	<i>Charadrius vociferus</i>	0	0	0	0	1	4	4	17	5	21
Gulls/Terns		1	50	0	0	0	0	4	32	5	82
ring-billed gull	<i>Larus delawarensis</i>	0	0	0	0	0	0	1	25	1	25
unidentified gull		1	50	0	0	0	0	3	7	4	57
Diurnal Raptors		84	84	284	299	140	141	105	106	613	630
<u>Accipiters</u>		1	1	4	4	0	0	0	0	5	5
Cooper's hawk	<i>Accipiter cooperii</i>	1	1	0	0	0	0	0	0	1	1
unidentified accipiter	<i>Accipiter</i> spp.	0	0	2	2	0	0	0	0	2	2
sharp-shinned hawk	<i>Accipiter striatus</i>	0	0	2	2	0	0	0	0	2	2
<u>Buteos</u>		39	39	134	139	73	73	62	63	308	314
red-tailed hawk	<i>Buteo jamaicensis</i>	21	21	89	94	35	35	27	27	172	177
rough-legged hawk	<i>Buteo lagopus</i>	0	0	37	37	37	37	25	25	99	99
unidentified buteo	<i>Buteo</i> spp.	4	4	1	1	1	1	2	2	8	8
Swainson's hawk	<i>Buteo swainsoni</i>	14	14	7	7	0	0	8	9	29	30
<u>Northern Harrier</u>		21	21	116	125	44	45	34	34	215	225
northern harrier	<i>Circus hudsonius</i>	21	21	116	125	44	45	34	34	215	225
<u>Eagles</u>		0	0	0	0	4	4	1	1	5	5
bald eagle	<i>Haliaeetus leucocephalus</i>	0	0	0	0	4	4	1	1	5	5
<u>Falcons</u>		23	23	30	31	19	19	8	8	80	81
merlin	<i>Falco columbarius</i>	0	0	0	0	1	1	0	0	1	1
prairie falcon	<i>Falco mexicanus</i>	2	2	7	7	7	7	3	3	19	19
peregrine falcon	<i>Falco peregrinus</i>	0	0	2	2	1	1	0	0	3	3
American kestrel	<i>Falco sparverius</i>	21	21	20	21	9	9	5	5	55	56
unidentified falcon	<i>Falco</i> spp.	0	0	1	1	1	1	0	0	2	2
Owls		0	0	0	0	1	1	0	0	1	1

Appendix A1. Numbers of groups and observations by bird type and species for 60-minute large bird use surveys at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Type/Species	Scientific Name	Summer		Fall		Winter		Spring		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
short-eared owl	<i>Asio flammeus</i>	0	0	0	0	1	1	0	0	1	1
Upland Game Birds		1	1	4	19	2	10	5	5	12	35
California quail	<i>Callipepla californica</i>	0	0	3	11	0	0	3	3	6	14
gray partridge	<i>Perdix perdix</i>	0	0	1	8	2	10	0	0	3	18
ring-necked pheasant	<i>Phasianus colchicus</i>	1	1	0	0	0	0	2	2	3	3
Doves/Pigeons		14	27	6	89	4	56	0	0	24	172
rock pigeon	<i>Columba livia</i>	7	20	6	89	4	56	0	0	17	165
mourning dove	<i>Zenaida macroura</i>	7	7	0	0	0	0	0	0	7	7
Large Corvids		30	50	96	276	106	489	87	179	319	994
common raven	<i>Corvus corax</i>	29	49	92	256	105	488	85	177	311	970
black-billed magpie	<i>Pica hudsonia</i>	1	1	4	20	1	1	2	2	8	24
Overall		188	917	403	1,871	305	11,737	237	1,756	1,133	16,281

Regardless of distance from observer

obs=observations; grps=groups

Appendix A2. Numbers of groups and observations by bird type and species for 10-minute small bird use surveys at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Type/Species	Scientific Name	Summer		Fall		Winter		Spring		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Passerines		143	282	149	526	97	377	170	445	559	1,630
<u>Blackbirds/Orioles</u>		36	41	12	20	7	34	33	129	88	224
red-winged blackbird	<i>Agelaius phoeniceus</i>	0	0	0	0	0	0	2	3	2	3
western meadowlark	<i>Sturnella neglecta</i>	35	40	11	18	6	27	26	27	78	112
European starling	<i>Sturnus vulgaris</i>	1	1	1	2	1	7	5	99	8	109
<u>Finches/Crossbills</u>		1	2	1	25	1	40	0	0	3	67
house finch	<i>Haemorhous mexicanus</i>	0	0	1	25	0	0	0	0	1	25
American goldfinch	<i>Spinus tristis</i>	1	2	0	0	1	40	0	0	2	42
<u>Flycatchers</u>		5	6	0	0	0	0	0	0	5	6
western kingbird	<i>Tyrannus verticalis</i>	5	6	0	0	0	0	0	0	5	6
<u>Grassland/Sparrows</u>		85	143	132	477	89	303	133	298	439	1,221
grasshopper sparrow	<i>Ammodramus savannarum</i>	8	8	0	0	0	0	6	6	14	14

Appendix A2. Numbers of groups and observations by bird type and species for 10-minute small bird use surveys at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Type/Species	Scientific Name	Summer		Fall		Winter		Spring		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
American pipit	<i>Anthus rubescens</i>	0	0	2	4	0	0	0	0	2	4
lark sparrow	<i>Chondestes grammacus</i>	8	12	0	0	0	0	0	0	8	12
horned lark	<i>Eremophila alpestris</i>	69	123	102	430	87	292	122	280	380	1,125
dark-eyed junco	<i>Junco hyemalis</i>	0	0	1	2	0	0	0	0	1	2
savannah sparrow	<i>Passerculus sandwichensis</i>	0	0	19	28	2	11	3	4	24	43
vesper sparrow	<i>Pooecetes gramineus</i>	0	0	3	6	0	0	0	0	3	6
white-crowned sparrow	<i>Zonotrichia leucophrys</i>	0	0	4	6	0	0	2	8	6	14
unidentified sparrow		0	0	1	1	0	0	0	0	1	1
<u>Mimids</u>		0	0	2	2	0	0	0	0	2	2
sage thrasher	<i>Oreoscoptes montanus</i>	0	0	2	2	0	0	0	0	2	2
<u>Swallows</u>		16	90	0	0	0	0	4	18	20	108
barn swallow	<i>Hirundo rustica</i>	1	1	0	0	0	0	0	0	1	1
cliff swallow	<i>Petrochelidon pyrrhonota</i>	7	17	0	0	0	0	2	13	9	30
bank swallow	<i>Riparia riparia</i>	6	70	0	0	0	0	1	3	7	73
unidentified swallow		2	2	0	0	0	0	1	2	3	4
<u>Thrushes</u>		0	0	1	1	0	0	0	0	1	1
hermit thrush	<i>Catharus guttatus</i>	0	0	1	1	0	0	0	0	1	1
<u>Wrens</u>		0	0	1	1	0	0	0	0	1	1
Bewick's wren	<i>Thryomanes bewickii</i>	0	0	1	1	0	0	0	0	1	1
Woodpeckers		1	1	0	0	0	0	0	0	1	1
northern flicker	<i>Colaptes auratus</i>	1	1	0	0	0	0	0	0	1	1
Unidentified Birds		0	0	0	0	0	0	1	1	1	1
unidentified small bird		0	0	0	0	0	0	1	1	1	1
Overall		144	283	149	526	97	377	171	446	561	1,632

Regardless of distance from observe

obs=observations; grps=group.

**Appendix B. Bird Use, Percent of Use, and Frequency of Occurrence for Large Birds and
Small Birds Observed during Avian Use Surveys at the Four Mile Wind Project from
June 5, 2018 – to May 29, 2019**

Appendix B1. Mean use (number of birds/plot^a/60-minute survey), percent of use, and frequency of occurrence (%) for each large bird type and species by season during the avian use surveys at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Type/Species	Mean Use				% of Use				% Frequency			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Waterbirds	9.01	4.46	0	1.55	77.0	19.3	0	6.9	29.3	2.5	0	10.0
sandhill crane	0	3.70	0	1.03	0	16.0	0	4.6	0	1.2	0	2.5
American white pelican	9.01	0.75	0	0.52	77.0	3.3	0	2.3	29.3	1.2	0	7.5
Waterfowl	0	10.21	150.58	16.56	0	44.2	94.1	74.0	0	7.4	33.9	15.3
greater white-fronted goose	0	0	0	0.45	0	0	0	2.0	0	0	0	1.3
Canada goose	0	0.15	14.58	5.86	0	0.6	9.1	26.2	0	1.2	18.0	7.6
snow goose	0	10.06	136.00	10.26	0	43.6	85.0	45.8	0	7.4	21.8	9.0
Shorebirds	0	0	0.08	0.22	0	0	<0.1	1.0	0	0	2.1	2.6
killdeer	0	0	0.08	0.22	0	0	<0.1	1.0	0	0	2.1	2.6
Gulls/Terns	0.64	0	0	0.41	5.5	0	0	1.8	1.3	0	0	3.8
ring-billed gull	0	0	0	0.32	0	0	0	1.4	0	0	0	1.3
unidentified gull	0.64	0	0	0.09	5.5	0	0	0.4	1.3	0	0	2.5
Diurnal Raptors	1.06	3.69	1.89	1.32	9.1	16.0	1.2	5.9	55.7	91.4	68.3	63.8
<u>Accipiters</u>	<u>0.01</u>	<u>0.05</u>	<u>0</u>	<u>0</u>	<u>0.1</u>	<u>0.2</u>	<u>0</u>	<u>0</u>	<u>1.2</u>	<u>4.9</u>	<u>0</u>	<u>0</u>
Cooper's hawk	0.01	0	0	0	0.1	0	0	0	1.2	0	0	0
unidentified accipiter	0	0.02	0	0	0	0.1	0	0	0	2.5	0	0
sharp-shinned hawk	0	0.02	0	0	0	0.1	0	0	0	2.5	0	0
<u>Buteos</u>	<u>0.50</u>	<u>1.72</u>	<u>0.99</u>	<u>0.79</u>	<u>4.2</u>	<u>7.4</u>	<u>0.6</u>	<u>3.5</u>	<u>33.0</u>	<u>67.9</u>	<u>57.4</u>	<u>47.5</u>
red-tailed hawk	0.27	1.16	0.47	0.34	2.3	5.0	0.3	1.5	24.1	53.1	30.2	27.5
rough-legged hawk	0	0.46	0.51	0.31	0	2.0	0.3	1.4	0	22.2	40.6	21.4
unidentified buteo	0.05	0.01	0.01	0.02	0.4	<0.1	<0.1	0.1	5.1	1.2	1.2	2.5
Swainson's hawk	0.18	0.09	0	0.11	1.5	0.4	0	0.5	12.7	6.2	0	7.4
<u>Northern Harrier</u>	<u>0.26</u>	<u>1.54</u>	<u>0.59</u>	<u>0.42</u>	<u>2.3</u>	<u>6.7</u>	<u>0.4</u>	<u>1.9</u>	<u>15.2</u>	<u>58.0</u>	<u>38.9</u>	<u>27.4</u>
northern harrier	0.26	1.54	0.59	0.42	2.3	6.7	0.4	1.9	15.2	58.0	38.9	27.4
<u>Eagles</u>	<u>0</u>	<u>0</u>	<u>0.05</u>	<u>0.01</u>	<u>0</u>	<u>0</u>	<u><0.1</u>	<u><0.1</u>	<u>0</u>	<u>0</u>	<u>3.8</u>	<u>1.3</u>
bald eagle	0	0	0.05	0.01	0	0	<0.1	<0.1	0	0	3.8	1.3
<u>Falcons</u>	<u>0.29</u>	<u>0.38</u>	<u>0.25</u>	<u>0.10</u>	<u>2.5</u>	<u>1.7</u>	<u>0.2</u>	<u>0.4</u>	<u>18.9</u>	<u>29.6</u>	<u>17.4</u>	<u>8.7</u>
merlin	0	0	0.01	0	0	0	<0.1	0	0	0	1.3	0
prairie falcon	0.03	0.09	0.10	0.04	0.2	0.4	<0.1	0.2	2.6	8.6	9.7	2.5
peregrine falcon	0	0.02	0.01	0	0	0.1	<0.1	0	0	2.5	1.3	0
American kestrel	0.27	0.26	0.12	0.06	2.3	1.1	<0.1	0.3	17.7	19.8	9.0	6.2
unidentified falcon	0	0.01	0.01	0	0	<0.1	<0.1	0	0	1.2	1.3	0
Owls	0	0	0.01	0	0	0	<0.1	0	0	0	1.2	0
short-eared owl	0	0	0.01	0	0	0	<0.1	0	0	0	1.2	0
Upland Game Birds	0.01	0.23	0.12	0.06	0.1	1.0	<0.1	0.3	1.3	3.7	2.5	5.0

Appendix B1. Mean use (number of birds/plot^a/60-minute survey), percent of use, and frequency of occurrence (%) for each large bird type and species by season during the avian use surveys at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Type/Species	Mean Use				% of Use				% Frequency			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
California quail	0	0.14	0	0.04	0	0.6	0	0.2	0	2.5	0	3.8
gray partridge	0	0.10	0.12	0	0	0.4	<0.1	0	0	1.2	2.5	0
ring-necked pheasant	0.01	0	0	0.02	0.1	0	0	0.1	1.3	0	0	2.5
Doves/Pigeons	0.34	1.10	0.86	0	2.9	4.8	0.5	0	12.6	7.4	4.6	0
rock pigeon	0.26	1.10	0.86	0	2.2	4.8	0.5	0	5.1	7.4	4.6	0
mourning dove	0.09	0	0	0	0.8	0	0	0	8.8	0	0	0
Large Corvids	0.63	3.41	6.45	2.26	5.4	14.8	4.0	10.1	31.6	59.3	80.8	60.2
common raven	0.62	3.16	6.44	2.24	5.3	13.7	4.0	10.0	30.3	55.6	80.8	60.2
black-billed magpie	0.01	0.25	0.01	0.03	0.1	1.1	<0.1	0.1	1.3	4.9	1.3	2.5
Overall	11.71	23.10	160.00	22.38	100	100	100	100				

^a 800-meter radius plot for large birds

Appendix B2. Mean bird use (number of birds/plot^a/10-minute survey), percent of use, and frequency of occurrence (%) for each small bird type and species by season during the avian use surveys at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Type/Species	Mean Use				% of Use				% Frequency			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Passerines	3.59	6.49	5.81	5.55	99.6	100	100	99.8	66.1	60.5	52.5	78.7
<u>Blackbirds/Orioles</u>	<u>0.52</u>	<u>0.25</u>	<u>0.42</u>	<u>1.60</u>	<u>14.5</u>	<u>3.8</u>	<u>7.3</u>	<u>28.7</u>	<u>29.3</u>	<u>13.6</u>	<u>8.8</u>	<u>29.8</u>
red-winged blackbird	0	0	0	0.04	0	0	0	0.7	0	0	0	2.5
western meadowlark	0.51	0.22	0.33	0.34	14.2	3.4	5.8	6.0	29.3	12.3	7.5	24.9
European starling	0.01	0.02	0.09	1.22	0.4	0.4	1.5	22.0	1.3	1.2	1.2	5.0
<u>Finches/Crossbills</u>	<u>0.02</u>	<u>0.31</u>	<u>0.49</u>	<u>0</u>	<u>0.7</u>	<u>4.8</u>	<u>8.5</u>	<u>0</u>	<u>1.2</u>	<u>1.2</u>	<u>1.2</u>	<u>0</u>
house finch	0	0.31	0	0	0	4.8	0	0	0	1.2	0	0
American goldfinch	0.02	0	0.49	0	0.7	0	8.5	0	1.2	0	1.2	0
<u>Flycatchers</u>	<u>0.08</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2.1</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>5.1</u>	<u>0</u>	<u>0</u>	<u>0</u>
western kingbird	0.08	0	0	0	2.1	0	0	0	5.1	0	0	0
<u>Grassland/Sparrows</u>	<u>1.82</u>	<u>5.89</u>	<u>4.89</u>	<u>3.73</u>	<u>50.5</u>	<u>90.7</u>	<u>84.2</u>	<u>67.0</u>	<u>52.1</u>	<u>54.3</u>	<u>46.2</u>	<u>66.3</u>
grasshopper sparrow	0.10	0	0	0.07	2.8	0	0	1.3	6.4	0	0	6.2
American pipit	0	0.05	0	0	0	0.8	0	0	0	2.5	0	0
lark sparrow	0.15	0	0	0	4.3	0	0	0	3.8	0	0	0
horned lark	1.56	5.31	4.74	3.50	43.4	81.7	81.6	63.0	44.4	44.4	46.2	62.6

Appendix B2. Mean bird use (number of birds/plot^a/10-minute survey), percent of use, and frequency of occurrence (%) for each small bird type and species by season during the avian use surveys at the Four Mile Wind Project in Benton County, Washington from June 5, 2018 to May 29, 2019.

Type/Species	Mean Use				% of Use				% Frequency			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
dark-eyed junco	0	0.02	0	0	0	0.4	0	0	0	1.2	0	0
savannah sparrow	0	0.35	0.15	0.05	0	5.3	2.6	0.9	0	9.9	3.3	3.7
vesper sparrow	0	0.07	0	0	0	1.1	0	0	0	2.5	0	0
white-crowned sparrow	0	0.07	0	0.10	0	1.1	0	1.8	0	3.7	0	2.5
unidentified sparrow	0	0.01	0	0	0	0.2	0	0	0	1.2	0	0
<u>Mimids</u>	0	0.02	0	0	0	0.4	0	0	0	1.2	0	0
sage thrasher	0	0.02	0	0	0	0.4	0	0	0	1.2	0	0
<u>Swallows</u>	1.15	0	0	0.22	31.8	0	0	4.0	16.5	0	0	4.9
barn swallow	0.01	0	0	0	0.4	0	0	0	1.3	0	0	0
cliff swallow	0.22	0	0	0.16	6.0	0	0	2.9	7.7	0	0	2.5
bank swallow	0.89	0	0	0.04	24.7	0	0	0.7	5.0	0	0	1.2
unidentified swallow	0.03	0	0	0.02	0.7	0	0	0.4	2.5	0	0	1.2
<u>Thrushes</u>	0	0.01	0	0	0	0.2	0	0	0	1.2	0	0
hermit thrush	0	0.01	0	0	0	0.2	0	0	0	1.2	0	0
<u>Wrens</u>	0	0.01	0	0	0	0.2	0	0	0	1.2	0	0
Bewick's wren	0	0.01	0	0	0	0.2	0	0	0	1.2	0	0
Woodpeckers	0.01	0	0	0	0.4	0	0	0	1.3	0	0	0
northern flicker	0.01	0	0	0	0.4	0	0	0	1.3	0	0	0
Unidentified Birds	0	0	0	0.01	0	0	0	0.2	0	0	0	1.2
unidentified small bird	0	0	0	0.01	0	0	0	0.2	0	0	0	1.2
Overall	3.60	6.49	5.81	5.56	100	100	100	100				

^a. 100-meter radius plot for small birds.

**Appendix C. Mean Use by Point for All Birds, Bird Types, and Diurnal Raptor Subtypes
during Avian Use Surveys at the Four Mile Wind Project from
June 5, 2018 to May 29, 2019**

Appendix C. Mean use (number of large birds/60-minute survey; number of small birds/10-minute survey) by point for large bird types, diurnal raptor subtypes, all large birds, and all small birds at the Four Mile Wind Project, Benton County, Washington from June 5, 2018 to May 29, 2019.

Obs. Pt.	Waterbirds	Waterfowl	Shorebirds	Gulls/Terns	Diurnal Raptors	<u>Accipiters</u>	<u>Buteos</u>	<u>Northern Harrier</u>	<u>Eagles</u>	<u>Falcons</u>	Owls	Upland Game Birds	Doves/Pigeons	Large Corvids	All Large Birds	All Small Birds
1	27.27	0	0	0	4.64	0	2.91	1.27	0.18	0.27	0	0	0	1.64	33.55	7.45
2	0	0	0	0	0.82	0.09	0.18	0.55	0	0	0	1	0	0.55	2.36	4.27
3	0	3	0	0	2.64	0	1.45	0.55	0	0.64	0	0	1.73	0.91	8.27	4.45
4	0	0	0	0	1.42	0	0.75	0.58	0	0.08	0.08	0.67	1.58	2.00	5.75	5.00
5	0.09	11.36	0	0	2.55	0.09	1.27	1.18	0	0	0	0	0.36	1.82	16.18	1.73
6	0	0	0	0	2.00	0	0.92	1.00	0	0.08	0	0	4.42	6.58	13.00	6.33
7	0	0	0	0	2.00	0	1.33	0.17	0	0.50	0	0	0.08	1.75	3.83	2.67
8	0.17	2.83	0	0	0.92	0	0.42	0.25	0	0.25	0	0	0	2.83	6.75	7.67
9	0	0	0	0	0.75	0	0.33	0.33	0	0.08	0	0.08	0	7.25	8.08	17.58
10	0	0.73	0	0.36	1.27	0	0.91	0.18	0	0.18	0	0	0	5.73	8.09	6.64
11	9.73	0	0	0	2.55	0	1.64	0.82	0	0.09	0	0	0	4.73	17.00	7.09
12	0.08	281.33	0	0	2.58	0	1.00	1.25	0.08	0.25	0	0	0	0.92	284.92	0.58
13	7.33	82.92	0.08	2.33	1.75	0	0.58	0.75	0	0.42	0	0	0	0.92	95.33	4.83
14	0	39.50	0	0	2.83	0.08	0.92	1.50	0.08	0.25	0	0	0.17	5.67	48.17	3.08
15	6.50	25.58	0	0	1.50	0	0.58	0.92	0	0	0	0.08	0	2.00	35.67	3.08
16	16.50	337.42	0	0	3.08	0	2.00	1.00	0	0.08	0	0.17	0	6.17	363.33	6.08
17	6.67	80.83	0	0	5.00	0	1.33	3.25	0	0.42	0	0	0	1.33	93.83	3.67
18	0.83	78.17	0	0	3.33	0.08	2.25	0.42	0	0.58	0	0	5.92	2.58	90.83	10.33
19	0.18	2.64	0	0	1.27	0	0.55	0.45	0	0.27	0	0	0	2.91	7.00	8.36
20	9.45	9.45	0	0	1.73	0.09	0.45	1.09	0	0.09	0	0.09	0	3.18	23.91	3.55
21	2.92	4.25	0	0	1.58	0	0.50	0.42	0	0.67	0	0	0.08	1.08	9.92	5.08
22	2.42	23.17	0	0	1.17	0	0.75	0.17	0	0.25	0	0	0.08	3.42	30.25	2.33
23	4.08	67.92	1.67	4.17	2.67	0	1.67	0.25	0.08	0.67	0	0.75	0	9.08	90.33	4.50
24	0.82	0	0	0	1.09	0	0.64	0.09	0	0.36	0	0.18	0	3.36	5.45	1.64
25	3.70	53.40	0	0	1.70	0	0.90	0.80	0	0	0	0	0	0.80	59.6	2.40
26	0	0	0	0	0.90	0	0.70	0.10	0	0.10	0	0	0	4.00	4.90	7.80
27	6.10	3.50	0	0	0.90	0	0.40	0.10	0	0.40	0	0	0.10	3.00	13.60	3.90

Appendix D. Fatality Summary Table for the Pacific Northwest Region of North America

Appendix D. Publicly available and comparable all bird and diurnal raptor fatality estimates and habitat types from wind energy facilities in the Pacific Northwest (Oregon and Washington) region of North America.

Project Name	All Bird Fatality Rate (birds/MW/year)	Diurnal Raptor Fatality Rate (raptors/MW/year)	Predominant Habitat Type	Citation
Big Horn, WA (2006-2007)	2.54	0.11	agriculture/grassland	Kronner et al. 2008
Biglow Canyon, OR (Phase I; 2008)	1.76	0.03	agriculture/grassland	Jeffrey et al. 2009b
Biglow Canyon, OR (Phase I; 2009)	2.47	0	agriculture	Enk et al. 2010
Biglow Canyon, OR (Phase II; 2009-2010)	5.53	0.14	grassland/shrub-steppe, agriculture	Enk et al. 2011b
Biglow Canyon, OR (Phase II; 2010-2011)	2.68	0.03	grassland/shrub-steppe, agriculture	Enk et al. 2012a
Biglow Canyon, OR (Phase III; 2010-2011)	2.28	0.05	grassland/shrub-steppe, agriculture	Enk et al. 2012b
Combine Hills, OR (2011)	2.33	0.05	agriculture/grassland	Enz et al. 2012
Combine Hills, OR (Phase I; 2004-2005)	2.56	0	shrub/scrub & agriculture	Young et al. 2006
Elkhorn, OR (2008)	0.64	0.06	shrub/scrub & agriculture	Jeffrey et al. 2009a
Elkhorn, OR (2010)	1.95	0.08	agriculture	Enk et al. 2011a
Goodnoe, WA (2009-2010)	1.4	0.17	agriculture/grassland	URS Corporation (URS) 2010a
Harvest Wind, WA (2010-2012)	2.94	0.23	agriculture/grassland	Downes and Gritski 2012a
Hay Canyon, OR (2009-2010)	2.21	0	grassland/shrub-steppe and agriculture	Gritski and Kronner 2010a
Hopkins Ridge, WA (2006)	1.23	0.14	agriculture/grassland	Young et al. 2007
Hopkins Ridge, WA (2008)	2.99	0.07	agriculture	Young et al. 2009
Kittitas Valley, WA (2011-2012)	1.06	0.09	grassland	Stantec Consulting Services 2012
Klondike II, OR (2005-2006)	3.14	0.06	agriculture/grassland	Northwest Wildlife Consultants (NWC) and WEST 2007
Klondike III (Phase I), OR (2007-2009)	3.02	0.15	agriculture/grassland	Gritski et al. 2010
Klondike IIIa (Phase II), OR (2008-2010)	2.61	0.06	grassland and shrub-steppe	Gritski et al. 2011
Klondike, OR (2002-2003)	0.95	0	grassland/shrub-steppe	Johnson et al. 2003
Leaning Juniper, OR (2006-2008)	6.66	0.16	agriculture/grassland	Gritski et al. 2008
Linden Ranch, WA (2010-2011)	6.65	0.27	agriculture/grassland	Enz and Bay 2011
Marengo I, WA (2009-2010)	0.27	0	sagebrush-steppe, grassland	URS 2010b
Marengo II, WA (2009-2010)	0.16	0.05	grassland/shrub-steppe, agriculture	URS 2010c
Nine Canyon, WA (2002-2003)	2.76	0.03	agriculture	Erickson et al. 2003c
Pebble Springs, OR (2009-2010)	1.93	0.04	agriculture	Gritski and Kronner 2010b
Stateline, OR/WA (2001-2002)	3.17	0.09	agriculture/grassland	Erickson et al. 2004

Appendix D. Publicly available and comparable all bird and diurnal raptor fatality estimates and habitat types from wind energy facilities in the Pacific Northwest (Oregon and Washington) region of North America.

Project Name	All Bird Fatality Rate (birds/MW/year)	Diurnal Raptor Fatality Rate (raptors/MW/year)	Predominant Habitat Type	Citation
Stateline, OR/WA (2003)	2.68	0.09	Cropland, Developed, Grassland, Shrub Steppe, Winter Wheat	Erickson et al. 2004
Stateline, OR/WA (2006)	1.23	0.11	grassland/shrub-steppe, agriculture and forest	Erickson et al. 2007
Tucannon River, WA (2015)	1.5	0.16	Shrub-steppe, grassland	Hallingstad et al. 2016
Tuolumne (Windy Point I), WA (2009- 2010)	3.2	0.29	grassland/shrub-steppe, agriculture	Enz and Bay 2010
Vansycle, OR (1999)	0.95	0	grassland	Erickson et al. 2000
Vantage, WA (2010-2011)	1.27	0.29	grassland/shrub-steppe, agriculture	Ventus Environmental Solutions 2012
White Creek, WA (2007-2011)	4.05	0.47	agriculture/grassland	Downes and Gritski 2012b
Wild Horse, WA (2007)	1.55	0.09	agriculture/grassland	Erickson et al. 2008
Windy Flats, WA (2010-2011)	8.45	0.04	agriculture/grassland	Enz et al. 2011

MW = megawatt

Avian Use and Raptor Nest Survey Report for the Horse Heaven Wind Project Benton County, Washington

**Year 2 Final Report
July 2018 – June 2019**



Prepared for:

Horse Heaven Wind Farm, LLC
4865 Sterling Drive, Suite 200
Boulder, Colorado 80301

Prepared by:

Erik W. Jansen, Samantha R. Brown, and Kori B. Hutchison

Western EcoSystems Technology, Inc.
2725 NW Walnut Blvd.
Corvallis, Oregon 97330

August 23, 2019
Revised



EXECUTIVE SUMMARY

Horse Heaven Wind Farm, LLC is developing the proposed Horse Heaven Wind Energy Project (Horse Heaven and/or Project) in Benton County, Washington. Western EcoSystems Technology, Inc. (WEST) was contracted to conduct a two-year avian use study at the proposed Project to evaluate the potential impacts of Project operation on birds. Consistent with survey methods used during the first study year (2017–2018), the second year (2018–2019) focused on large-bodied birds and was designed to comply with recommendations described by the Washington Department of Fish and Wildlife (WDFW) Wind Power Guidelines (WDFW 2009), Tier 3 of the US Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (USFWS 2012), Stage 2 of the Eagle Conservation Plan Guidance (USFWS 2013) and associated Final Eagle Rule (USFWS 2016). This report presents results from surveys conducted 2018–2019 (Year 2) and briefly compares results from 2017–2018 (Year 1; Jansen and Brown 2018) to Year 2.

The principal objective of the Year 2 survey was to provide site-specific species occurrence and the spatial and temporal patterns of avian use with a particular focus on eagles, other raptors, and non-raptors such as sandhill crane or species of regulatory or management concern (i.e., federal or state-sensitive species). Additionally, surveyors documented observations of rare and sensitive species observed incidental to standardized surveys throughout the course of the study.

The Project is located in the Columbia Plateau Ecoregion located within the Horse Heaven Hills which is an anticline ridge of the Yakima Folds. The Project area is located within 4 miles of Kennewick and the larger tri-cities urban area. Fixed-point bird surveys estimated the seasonal, spatial, and temporal use patterns of birds within the Project. All large birds were recorded within an 800-meter radius plot at 18 fixed-point count stations that were randomly located within the Project area. Surveys for large birds were conducted for 60-minutes at each station once per month (i.e., one visit) for 12 months.

Fourteen visits of large-bird use surveys for a total of 178 surveys were conducted at the Project from July 24, 2018–June 22, 2019. A total of 25 unique bird species were observed during the survey year. Overall large bird mean use ranged from 2.58 observations/plot/survey to 61.40 observations/plot/survey among seasons with the highest use during fall (61.40 observations/plot/survey), followed by spring (6.38 observations/plot/survey), winter (5.68 observations/plot/survey), and summer (2.58 observations/plot/survey).

Five species of federal- or state-protected status were recorded during avian use surveys within the Project area. Of the five species, one state-endangered species, sandhill crane and two state-threatened species, ferruginous hawk and American white pelican were observed during the study. Three bald eagles and three golden eagles were also observed during the study both of which are listed under the Bald and Golden Eagle Protection Act of 1940 and golden eagles are also considered a state species of concern.

Bald eagles were observed during fall, winter, and spring with the highest mean use occurring during winter and spring (0.03 observations/plot/survey), followed by fall (0.02 observations/plot/survey). Golden eagles were observed during fall and had a mean use of 0.06 observations/plot/survey. Collectively, eagles were observed for a total of 30 minutes during the Year 2 study. Of the 30 minutes, 13 minutes were attributed to bald eagles, of which six minutes were flying within the 800 m plot below 200 m above ground level (AGL; eagle exposure minutes). The remaining 17 minutes were from golden eagles, of which eight minutes were considered exposure minutes.

A total of 36 raptor nests were located during aerial surveys that were conducted within 10-mi of the Project boundary. Of the 36 nests documented, 24 nests (66%) were occupied; of the 24 occupied nests, 22 nests had adults incubating or young observed in the nest. Five raptor species were recorded within and 2-miles of the Project and included red-tailed hawk (8 nests) Swainson's hawk (7 nests), great-horned owl (3 nests) and ferruginous hawk (1 nest). Three bald eagle nests were located beyond the 2-mi survey area but within 10 mi of the Project. Territories of two of the three bald eagle nests were occupied and contained nestlings (Nest 37) or eggs (Nest 55). No bald or golden eagle nests were found within the Project area or in the 2-mi Survey Area.

The bird species observed in the Project during the study were typical to those commonly found in agricultural, shrub-steppe and grasslands within the Columbia Plateau. Overall large bird use was significantly higher during spring and fall, likely due to the Project's location in the Pacific Flyway and the stopover habitat available in the surrounding area. Overall, the Project area does not support areas of high concentration or use during the avian breeding season. However, special-status avian species such as eagles, sandhill crane, and American white pelican occur at the Project and pose varying levels of collision risk.

To date, overall fatality rates for birds at wind energy facilities have been consistently low, and the most recent, comprehensive, and robust studies of overall bird fatality rates at wind facilities in the Pacific Northwest have produced fatality rate estimates ranging from 0.03–0.47 birds per MW per year; no Project data suggests the Project would fall outside this range.

STUDY PARTICIPANTS

Erik Jansen	Project Manager, GIS
Samantha Brown	Report Writer
Kori Hutchison	Report Writer, Field Coordinator
Guy DiDonato	Statistician
Julie Bushey	Data Analyst
Carmen Boyd	Project Tracking and Data Manager
Joshua Parrott	Field Biologist

REPORT REFERENCE

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INTRODUCTION

Horse Heaven Wind Farm, LLC is proposing the development of the Horse Heaven Wind Farm project (Horse Heaven and/or Project) in Benton County, Washington (Figure 1). Western EcoSystems Technology, Inc. (WEST) was contracted to conduct a two-year avian use study along with raptor nest surveys for the Project to evaluate the potential impacts of Project wind turbine generator (WTG) construction and operation on birds. Additionally, observations of rare and species of concern¹ were documented incidentally to protocol wildlife surveys. The avian use study was designed to comply with recommendations described by the Washington Department of Fish and Wildlife (WDFW) *Wind Power Guidelines* (WPG; WDFW 2009), the US Fish and Wildlife Service's (USFWS) 2012 *Final Land-Based Wind Energy Guidelines* (WEG), Appendix C(1)(a) of the 2013 USFWS *Eagle Conservation Plan Guidelines* (ECPG), and the USFWS *Revisions to Regulations for Eagle Incidental Take and Take of Eagle Nests* (Final Eagle Rule; 81 FR 91494). This study was initiated August 11, 2017 through July 16, 2018 (Year 1), and continued for the second year from July 24, 2018 through June 22, 2019 (Year 2).

The principal objectives of the study were to 1) provide site-specific species occurrence and the spatial and temporal patterns of avian use with a particular focus on eagles, other raptors, and non-raptors such as sandhill crane or species of regulatory or management concern (i.e., federal or state-sensitive species), and 2) to document raptor nests within the Project and surrounding area.

This report summarizes the methodology and results of the Year 2 avian use surveys and raptor nest surveys at the Project, along with a brief comparison between Years 1 and 2. A comprehensive report of Year 1 results can be found in Jansen and Brown 2018.

PROJECT AREA

The Project encompasses 51,262 acres (80.1 mi²) in Benton County, Washington located within the Horse Heaven Hills which is an anticline ridge of the Yakima Folds within the larger Columbia Plateau Ecoregion (Clarke and Bryce 1997). The Project area is located within 4 miles of Kennewick and the larger tri-cities urban area. Topography within the Project is composed primarily of rolling to incised hills with a broad northeast-facing rampart along the northern perimeter of the Project boundary (Figure 1). The highly-eroded drainages along the rampart

¹ As defined here, "species of concern" includes any species which 1) is either a) listed as an endangered, threatened or candidate species under the Endangered Species Act, subject to the Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, or Washington State Environmental Protection Act; b) is designated by federal or state law, regulation, or other formal process for protection and/or management by the relevant agency or other authority; or c) has been shown to be significantly adversely affected by wind energy development, and 2) is determined to be possibly affected by the project (WDFW 2009, USFWS 2012).

create numerous canyons that bisect the Project (Badger Canyon, Coyote Canyon, Taylor Canyon) and expose basalt cliffs and ledges. On the southern side of the rampart, the landscape transitions to relatively rolling topography with shallow, meandering canyons that drain south into the Columbia River.

Land cover within the Project area is a mosaic of dryland and irrigated agriculture, shrub-steppe grasslands, and rural/urban development (Jansen and Brown 2018). Agriculture crop is the dominate land cover throughout the Project and surrounding area. Shrub-steppe are found in topographically steep areas where agriculture was not possible. Lands enrolled in the US Department of Agriculture's Conservation Reserve Program are found in areas throughout the Project. Much of the Project area is privately owned and actively managed for dryland agriculture and livestock grazing. The 63 WTG Nine Canyon Wind Project is located directly to the east of the proposed Project (Figure 1).

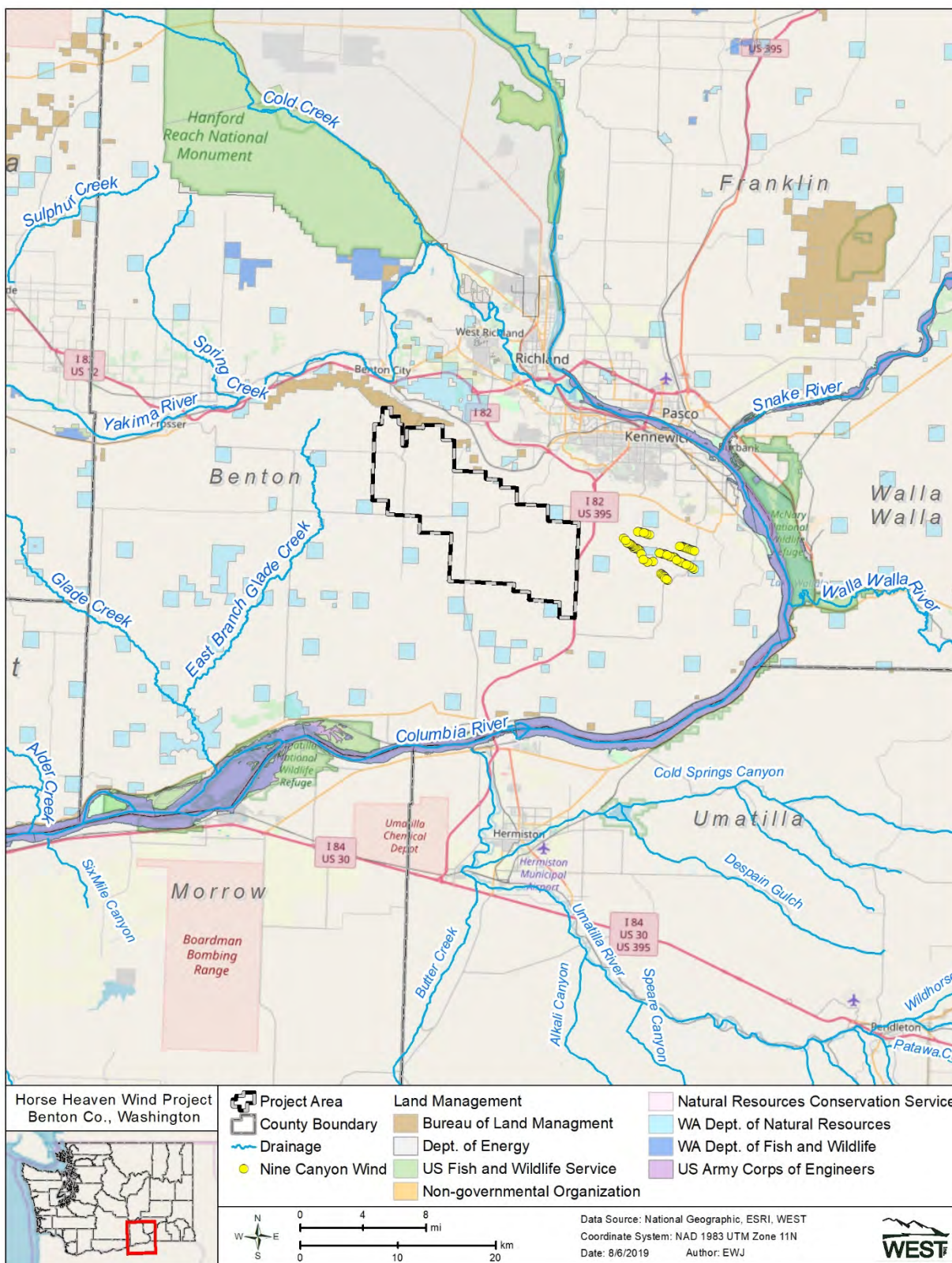


Figure 1. Location of the Horse Heaven Wind Project, Benton County, Washington.

METHODS

The study at the Project consisted of the following: 1) fixed-point avian use surveys, 2) aerial raptor nest surveys, and 3) incidental wildlife observations. The study design and survey methods for birds recorded at the Project primarily follow guidance in the ECPG and the Final Eagle Rule because of the need to collect information on eagles, while also following guidance from the WEG to collect information on other birds, and exceeding standards described in WDFW Wind Power Guidelines (WDFW 2009). Methods described below, therefore, are common for all birds (i.e., large birds, eagles, and other species of concern) except as noted.

Study Design

Fixed-point count stations were established by placing a point nearest to the farthest western proposed WTG location, then picking from a list of randomly-generated numbers that corresponded to a proposed WTG location. Numbers were discarded and redrawn if 800-m radius survey plots substantially overlapped (e.g., >50%). Point placement was micro-sited (e.g., minor shifts of approximately 100 m) in the field to maximize the surrounding viewshed and were placed on publicly accessible roads.

A total of 13 survey points were established within the proposed Project area to comply with ECPG recommended survey coverage of 30% of the area within one kilometer (km) of WTG's to be covered by 800-m radius observation plot (Figure 2). Surveys were conducted approximately once per month from July 24, 2018 through June 22, 2019 and the order at which points were surveyed was rotated each round to achieve different times of day a point was visited. Due to Project expansion, five additional points (PC15–PC18) were added in April 2019 and were surveyed for 5 visits. These additional points were established and surveyed using the same methodology as the original 13 point counts (Figure 2). Surveys were conducted by one observer; points were not surveyed concurrently to minimize the potential for double counting individuals and are considered independent samples.

Seasons were defined as summer (June 1 to August 12), fall (August 13 to November 30), winter (December 1 to February 28), and spring (March 1 to May 31). Surveys were conducted during daylight hours and survey times at points were randomized to cover all daylight hours during a season. Surveys were conducted under all weather conditions except when visibility was less than 800 m from the observer and 200 m above ground level (AGL).

Survey Methods

Large Birds

At each point, surveys were conducted for 60 minutes (min); all large birds² (including eagles) observed or heard within an 800-meter radius from the surveyor were recorded. Biologists recorded the following information for each survey: date, start and end time, and weather (i.e., temperature, wind speed, wind direction, precipitation, and percent cloud cover). Additionally, the following data were recorded for each group of birds observed:

- Observation number
- Species (or best possible identification)
- Number of individuals
- Sex and age class (if possible)
- Distance from survey plot center to the nearest five m interval (first & closest)
- Flight height AGL to the nearest five m interval (first, lowest, and highest)
- Flight direction (first observed)
- Habitat
- Activity (e.g., flying, perched)
- Observation type (visual or aural)
- Flight paths and perch locations of eagles and other species of concern

Eagles

Data were collected if a golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), or unidentified eagle were observed during the survey period. Biologists recorded eagle behavior (i.e., flight height, distance from observer, activity) each minute, at the top of the minute, to provide an instantaneous count for every eagle observed, whether or not the eagle was flying below 200 m AGL and within 800 m of the survey location at any time during the minute; and classified the eagle into age class (juvenile [1st year], immature or sub-adult [2nd to 4th year], adult [\geq 5th year]).

² Large birds were defined as waterbirds, waterfowl, shorebirds, gulls/terns, diurnal raptors (i.e., kites, accipiters, *Buteos*, eagles, falcons, northern harrier, and osprey), owls, vultures, upland game birds, doves/pigeons, goatsuckers, and large corvids (e.g., magpies, crows, and ravens).

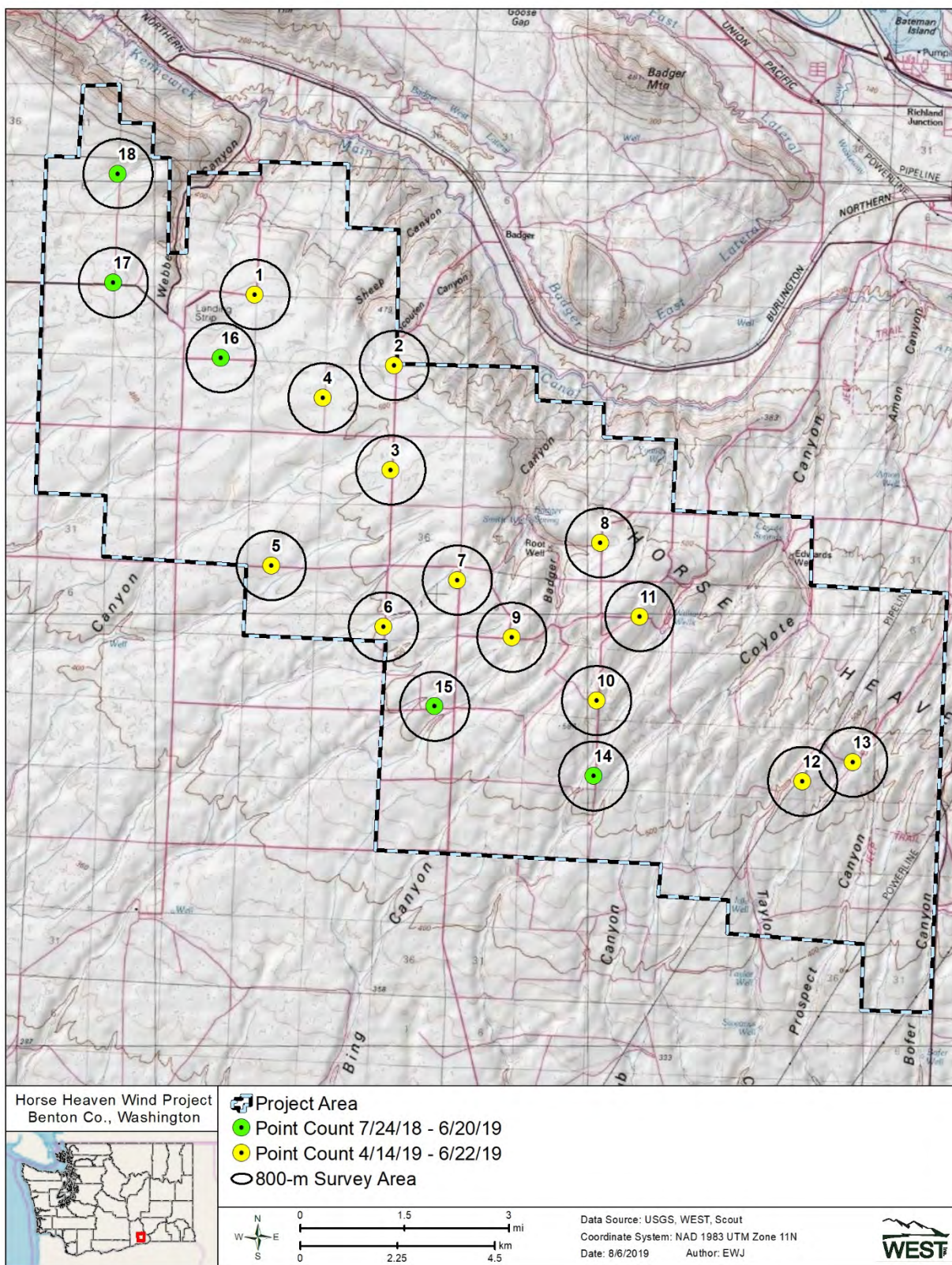


Figure 2. Avian use survey points and plots at the Horse Heaven Wind Project area in Benton County, Washington from July 24, 2018 to June 22, 2019.

Data Management

Quality Assurance and Quality Control

WEST implemented quality assurance and quality control (QA/QC) measures at all stages of the study, including in the field, during data entry and analysis, and report writing. Following surveys, biologists were responsible for inspecting data forms for completeness, accuracy, and legibility. If errors or anomalies were found within the data, follow-up measures were implemented including discussions and review of field data with field technicians and/or Project Managers. WEST traced back any errors, omissions, or problems identified in later stages of analysis to the raw data forms where appropriate changes and measures were implemented, no matter what stage of analysis. Multiple reviews were conducted as QA/QC measures.

Data Compilation and Storage

A Microsoft® SQL database was specifically developed to store, organize, and retrieve survey data. Project data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. WEST retained all data forms and electronic data files for reference.

Statistical Analysis

A *visit* was defined as surveying all of the survey plots once within the Project area and could occur across multiple dates but had to be completed in a single season (e.g., spring). If extreme weather conditions prevented all plots from being surveyed during a visit, then a visit might not have constituted a complete survey of all plots. A *survey* was defined as a single 60 min count of birds. In some cases, a count of bird observations may represent repeated observations of the same individual. Only observations within the 800-m survey plot were included for data analysis.

Mean Use, Percent of Use, and Frequency of Occurrence

Mean use is the average number of birds observed per plot per survey for large birds. Large bird use (per 800-m plot per 60-min survey) is calculated by: 1) summing birds per plot per visit, 2) averaging number of birds over plots within a visit, and 3) averaging number of birds across visits within a season. Overall mean use was calculated as a weighted average of seasonal values by the number of days in each season. *Percent of use* was calculated as the percentage of large bird use that was attributable to a particular bird type or species. *Frequency of occurrence* was calculated as the percent of surveys in which a particular bird type or species was observed.

Mean use and frequency of occurrence describe different aspects of relative abundance, in that mean use is based on the number of birds (i.e., large groups can produce high estimates), whereas frequency of occurrence is based on the number of groups (i.e., it is not influenced by group size). Qualitative comparisons were made with these metrics among bird types, seasons, and survey points to help one understand how birds are using the Project area over time and space.

Flight Height

Bird flight heights are important metrics to assess relative potential exposure to WTG blades and were used to calculate the percentage of large birds and eagles observed flying within the rotor-swept height (RSH) of proposed WTG's. A RSH of 25 to 150 m (82 to 492 ft) AGL was assumed for the purpose of the analysis. Flight height recorded during the initial observation was used to calculate the percentage of birds flying within the RSH and mean flight height.

Spatial Use

Mean use was calculated by survey point for large birds and eagles to make spatial comparisons among the survey points. Additionally, flight paths of eagles were mapped during large bird use surveys to qualitatively show flight path location compared to Project area characteristics (e.g., topographic features) to identify if there were areas of concentration or consistent flight patterns within the Project area.

Eagles

Eagle observations during surveys were summarized to provide flight heights (see *Flight Height*) and flight path maps (see *Spatial Use*). Data collected during each minute eagles were observed, were examined to count eagle exposure minutes, defined as the number of minutes an eagle was observed in flight within the risk cylinder (defined as the area within 800 m of the survey point and below 200 m AGL during the 60-min survey periods) and total minutes defined as the amount of time eagles were observed inside and outside the risk cylinder, but still within 800 m of the survey point. The eagle exposure minutes per observation hour were reported by survey plot and month to enable spatial and temporal assessments of eagle exposure minutes recorded in the Project area. Data collected on perched eagles and those outside of survey plots were not considered eagle exposure minutes; however, they were considered in the total eagle minutes. The perch locations and flight paths of all eagles were mapped to qualitatively assess areas of eagle use within the Project area.

Raptor Nest Surveys

Survey Preparation and Consultation

Prior to aerial surveys in 2019, WEST conducted a literature search (Kalasz and Buchanan 2016) and coordinated with Washington Department of Fish and Wildlife (WDFW) biologists to identify previously documented raptor nests in the Survey Area and to review survey protocol. During each survey year, the Project boundary was buffered by 2-miles and 10-miles to create the Survey Area. Compared to 2018, the Project boundary expanded from 25,815 acres to 51,262 acres in 2019. WEST developed a survey plan by plotting previously-identified eagle and non-eagle nests on maps and digital tablets (LG, Seoul, South Korea) with navigational software (Gaia GPS) that was used during aerial surveys.

Aerial Survey Methods

Raptor nest surveys were conducted during two rounds of double-observer (i.e., a primary and secondary observer) aerial surveys. Each survey round were at least 30 days apart and were preformed using a Robinson R-44 Raven II helicopter with bubble windows that provided excellent

visibility (Pagel et al. 2010, USFWS 2013). The first survey was conducted during a time period that overlapped the primary early nesting period of eagles in the Pacific Northwest, when breeding pairs are exhibiting courtship, nest-building, and/or egg-laying and incubation behaviors (Isaacs 2018). The second survey was conducted when eagles are actively engaged in mid- to late breeding season reproductive activities (e.g., incubating, brooding, feeding nestlings), and when eagles engaged in ongoing nesting activities would be reliably on or around nests (Watson 2010, Isaacs 2018).

All stick nests that could be constructed by any raptor species were documented within the 2-mi Survey Area, whereas only stick nests constructed by golden eagle or bald eagles were documented within 10 miles of the Project. Surveys utilized an intuitive controlled survey method which focused on areas with the highest potential to support raptor nests including cliffs, rock outcrops, incised drainages and canyons, and large trees. Nests located during the first survey round were revisited during the second survey to evaluate reproductive nesting status. All high-quality nesting habitat was also revisited to search for new nests and later nesting raptor species (e.g., Swainson's hawk [*Buteo swainsoni*]) that may not have been occupied during the first survey round.

During aerial surveys, the helicopter was positioned to allow thorough visual inspection of all appropriate habitat features. In general, the helicopter maintained a distance of no closer than 66 feet (20 m) from cliff faces and nests. When a nest was located, the helicopter reduced speed and adjusted the flight track to allow for a clear view of the nest for documentation and photographing. The amount of time spent circling/searching a particular area or the distance to which a nest was approached was adjusted when raptors, particularly eagles, were present on/near the nest to minimize survey-related disturbance (e.g., flushing). In the event of nestlings, deference was provided and survey of nests directly adjacent to the nestlings (e.g., within 200 m) were aborted.

For each nest or group of nests (e.g., nest site), a Global Positioning System (GPS) location was recorded, a photograph was taken, and nest attribute data were collected. A nest site was defined as two or more nests that occurred on the same shelf, cliff face or tree within close proximity to one another (e.g., approximately 80 ft [25 m]).

WEST categorized basic nesting territories and nest status using definitions originally proposed by Postupalsky (1974) and largely followed today (USFWS 2013). Nests were classified as occupied if any of the following were observed at the nest structure: (1) an adult in an incubating position; (2) eggs; (3) nestlings or fledglings; (4) presence of an adult (sometimes sub-adults); (5) a newly constructed or refurbished stick nest in the area where territorial behavior of a raptor had been observed earlier in the breeding season; or (6) a recently repaired nest with fresh sticks (clean breaks) or fresh boughs on top, and/or droppings and/or molted feathers on its rim or underneath. Occupied nests were further classified as active if an egg or eggs were laid. Nests were classified as inactive if no eggs or chicks were present. Nests not meeting the above criteria for "Occupied" during at least two consecutive surveys were classified as "Unoccupied."

Incidental Observations

Incidental observations were wildlife observed outside of the standardized survey plots but within the Project area and were focused on federal- or state-protected species, unusually large congregations of individuals, species not yet recorded during surveys, unusual or unique birds, mammals, reptiles, amphibians, or eagle attractants (e.g., ground squirrel burrows, areas with concentration of carrion). Data recorded for incidentally observed species were similar to that recorded during scheduled surveys.

RESULTS

Fixed-Point Large Bird Use Surveys

Fourteen visits of large-bird use surveys for a total of 178 surveys were conducted at the Project from July 24, 2018–June 22, 2019. Survey effort varied slightly among seasons with greater survey effort in spring and summer (4 visits), followed by fall and winter (3 visits each) due to weather and accessibility to the Project (Table 1).

Twenty-five species of large birds were observed or heard during the study. Survey results are summarized below, supplemented by the appendices, which present species-level detail on the following: scientific names, number of groups and observations within the survey plot by season (Appendices A), avian use, percent of use, and frequency of occurrence by season (Appendices B), and mean use by survey point (Appendix C).

Table 1. Summary of species richness (species/plot^a/60-min survey), and sample size by season and overall during the fixed-point bird use surveys at the Horse Heaven Wind Project in Benton County, WA during fixed-point bird use surveys from July 24, 2018 to June 22, 2019.

Season	# Visits	# Surveys Conducted	# Species	Species Richness
				Large Birds
Summer	4	41	10	1.41
Fall	4	52	21	2.38
Winter	3	36	12	1.65
Spring	3	49	15	1.99
Overall	14	178	25	1.91

Species: Count of bird species observed in the survey plots within and across seasons. Unidentified birds are included in this count ignoring their meta groups.

Species Richness: Average number of species observed within the observer viewshed/plot/visit within seasons.

^a 800-meter (m) radius plot.

Species of Concern

Eagles

Mean Use

A total of three bald eagles were observed during fall, winter, and spring. Bald eagle mean use relatively consistent among seasons and was highest during winter and spring (0.03 observations/plot/survey), followed by fall (0.02 observations/plot/survey). Overall bald eagle

mean use was 0.08 observations/plot/survey. A total of three golden eagles were observed during fall and had a mean use of 0.06 observations/800-m plot/60-min survey.

Eagle Exposure Minutes

A total of 30 eagle minutes were recorded from three bald eagles and three golden eagles during the 178 survey hours. Of the 30 eagle minutes, bald eagles were observed for 13 minutes, of which six minutes were considered exposure minutes where the eagle was observed flying within the risk cylinder (Table 2). Bald eagles occurred during fall, winter, and spring seasons and ranged from 0.02 in spring to 0.058 eagle exposure min/hr in fall (Table 2). Bald eagle exposure minutes per survey hour was highest at survey Point 11 (0.25 eagle exposure min/hr). The remaining 17 eagle minutes were attributed to golden eagles, of which eight minutes were considered exposure minutes (Table 3). Averaged across all seasons, golden eagle exposure minutes per survey hour was 0.045 eagle exposure min/hr with the highest exposure at Point 12 (Table 3).

Eagle Flight Paths

Golden and bald eagle flight paths were mapped at the Project (Figure 3). Eagles were observed flying predominantly south at an average flight height of 66.67 m which is within the 25–150 m likely RSH of a WTG blade. Because of the small number of individuals observed, no discernable patterns emerged from the flight path data; however, three eagles (two golden eagles and one bald eagle) were observed in the southeastern corner of the Project at Point 12 and Point 13. Topography in the area of Points 12 and 13 consists of dissected to rolling hills.

Table 2. The bald eagle minutes and observations recorded during avian use surveys in the Horse Heaven Wind Energy Project area in Benton County, Washington from July 24, 2018 to June 22, 2019.

Season	Eagle Minutes		Eagle Observations		Survey Hours	Eagle Exposure Mins/Survey Hr
	Within Risk Cylinder ¹	Total ²	Within Risk Cylinder ¹	Total ²		
Summer	0	0	0	0	41	0.0000
Fall	3	7	1	1	52	0.0577
Winter	2	3	1	1	36	0.0556
Spring	1	3	1	1	49	0.0204
Total	6	13	3	3	178	0.0337³

¹ Minutes or observations inside the risk cylinder (within 800 m of observer, below 200 m AGL); minutes inside risk cylinder = eagle exposure minutes.

² Total = minutes or observations inside and outside the risk cylinder, but still within 800 m of the survey point.

³ Seasonal average

Table 3. The golden eagle minutes and observations recorded during avian use surveys in the Horse Heaven Wind Energy Project area in Benton County, Washington from July 24, 2018 to June 22, 2019.

Season	Eagle Minutes		Eagle Observations		Survey Hours	Eagle Exposure Mins/Survey Hr
	Within Risk Cylinder ¹	Total ²	Within Risk Cylinder ¹	Total ²		
Summer	0	0	0	0	41	0.0000
Fall	8	17	3	3	52	0.1538
Winter	0	0	0	0	36	0.0000
Spring	0	0	0	0	49	0.0000
Total	8	17	3	3	178	0.0449

¹ In = minutes or observations inside the risk cylinder (within 800 m of observer, below 200 m AGL); minutes inside risk cylinder = eagle exposure minutes.

² Total = minutes or observations inside and outside the risk cylinder, but still within 800 m of the survey point.

³ Seasonal average

Federal- and state-protected species

Five species of federal- or state-protected status were recorded during avian use surveys within the Project area (Table 4). One state-endangered species, sandhill crane, was observed during the study. Sixteen groups comprising 2,924 individuals were observed with nearly half (52%) of the observations occurring outside of point count surveys. Two state-threatened species, one ferruginous hawk and five groups of 65 American white pelicans were observed during avian use surveys. Three bald eagles and three golden eagles were observed during the year-long study. Both species are listed under the Bald and Golden Eagle Protection Act of 1940 and golden eagles are also considered a state species of concern. A permitting process is available that authorizes the incidental take of an eagle that result from but is not the purpose of an otherwise lawful activity (USFWS 2016).

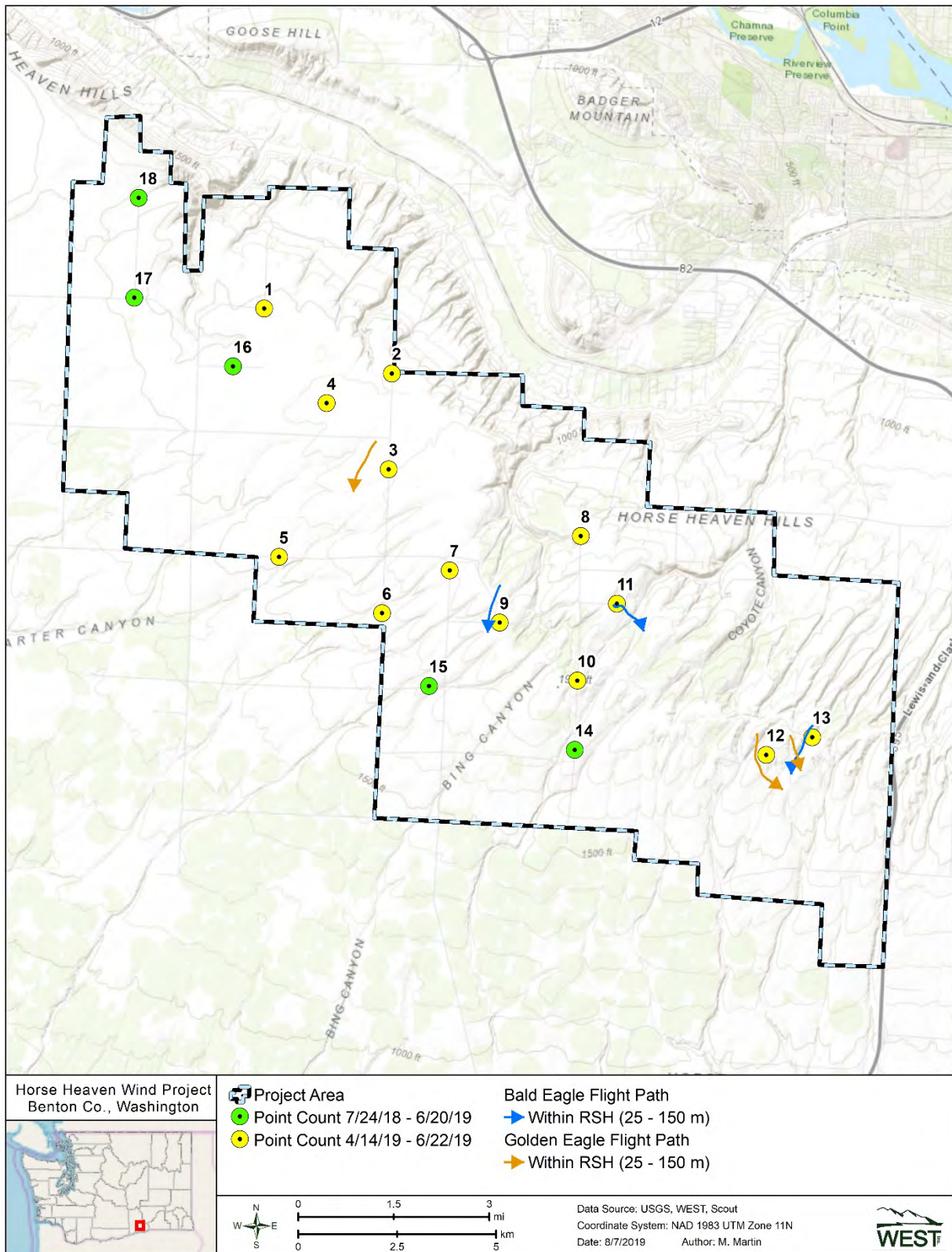


Figure 3. Bald and golden eagle flight path at the Horse Heaven Project area in Benton County, Washington.

Table 4. Groups and observations of federal- and state-protected species recorded during avian use surveys or as incidental wildlife observations at the Horse Heaven Wind Project area in Benton County, Washington from July 24, 2018 to June 22, 2019.

Species	Scientific Name	Status	Point Count		Incidental		Total	
			# grps	# obs	# grps	# obs	# grps	# obs
sandhill crane	<i>Antigone canadensis</i>	WA-E	9	1,400	7	1,524	16	2,924
golden eagle	<i>Aquila chrysaetos</i>	BGEPA; SCS	3	3	0	0	3	3
ferruginous hawk	<i>Buteo regalis</i>	WA-T	1	1	0	0	1	1
bald eagle	<i>Haliaeetus leucocephalus</i>	BGEPA	3	3	0	0	3	3
American white pelican	<i>Pelecanus erythrorhynchos</i>	WA-T	5	65	0	0	5	65
Total	5 species		21	1,472	7	1524	28	2,996

WA-E = State Endangered

WA-T = State Threatened

SCS = State Candidate Species

BGEPA = Bald and Golden Eagle Protection Act

Large Birds

Twenty-four species of large birds were observed or heard over the 178 hours of surveys during Year 2. Four unidentified bird groups (individuals that could not be identified to species) were observed during surveys. Each unidentified bird group represented a small proportion of the species observed within the group. Unidentified geese represented approximately 9% of all waterfowl observed. Within the raptor group, unidentified *Buteo* (1.2%), unidentified accipiter (<1%), and unidentified falcon (<1%) rarely occurred.

Mean Use, Percent of Use, and Frequency of Occurrence

Mean use, percent of use, and frequency of occurrence were calculated by season for large bird types (Figures 4a, 4b, 4c) and species (Appendix B). Large bird mean use ranged from 2.58 observations/plot/survey to 61.40 observations/plot/survey among seasons and was highest during fall (61.40 observations/plot/survey), followed by spring (6.38 observations/plot/survey), winter (5.68 observations/plot/survey), and summer (2.58 observations/plot/survey; Figure 4a). Species composition of avian use varied by season. Waterbirds and waterfowl comprised the majority of use during fall (27.88 observations/plot/survey and 25.65 observations/plot/survey, respectively), whereas diurnal raptors had the highest use during summer (1.28 observations/plot/survey) and doves/pigeons had the highest use in winter (2.23 observations/plot/survey) and spring (1.95 observations/plot/survey; Figure 4a).

Similarly, waterbirds and waterfowl comprised the majority of observations during fall (87.2% total), while diurnal raptors did so during summer (49.8%) and doves/pigeons during spring (30.5%; Figure 4b). Diurnal raptor frequency of occurrence was highest among seasons, ranging from 55.1 to 80.8%, followed by large corvids (26.6 to 61.3%; Figure 4c).

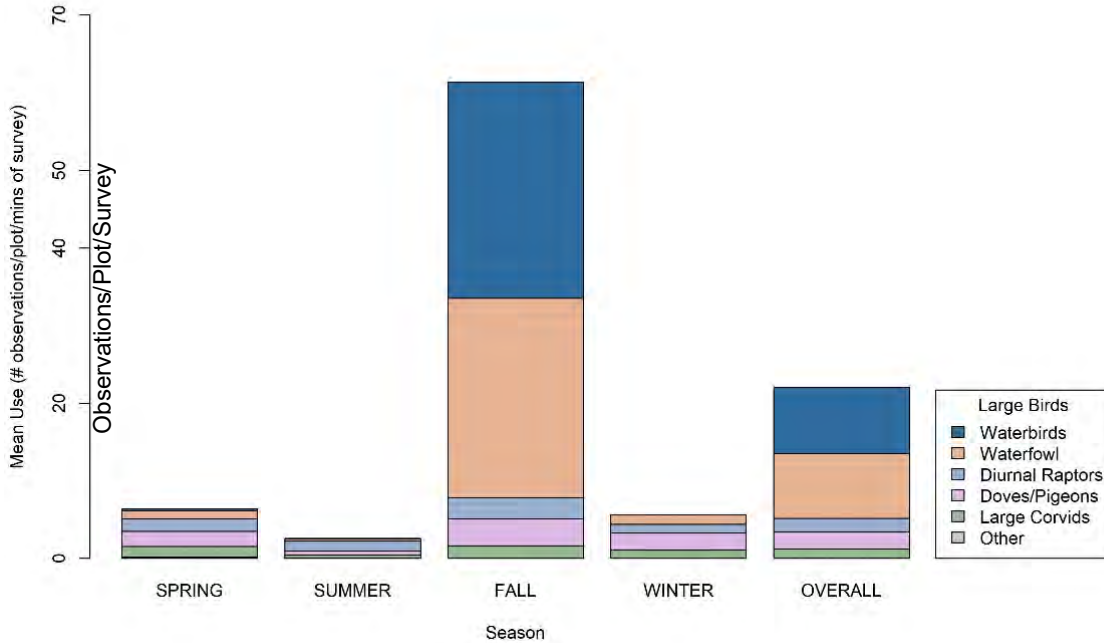


Figure 4a. Large bird mean use by season and bird type at the Horse Heaven Wind Project area in Benton County, Washington from July 24, 2018 to June 22, 2019.

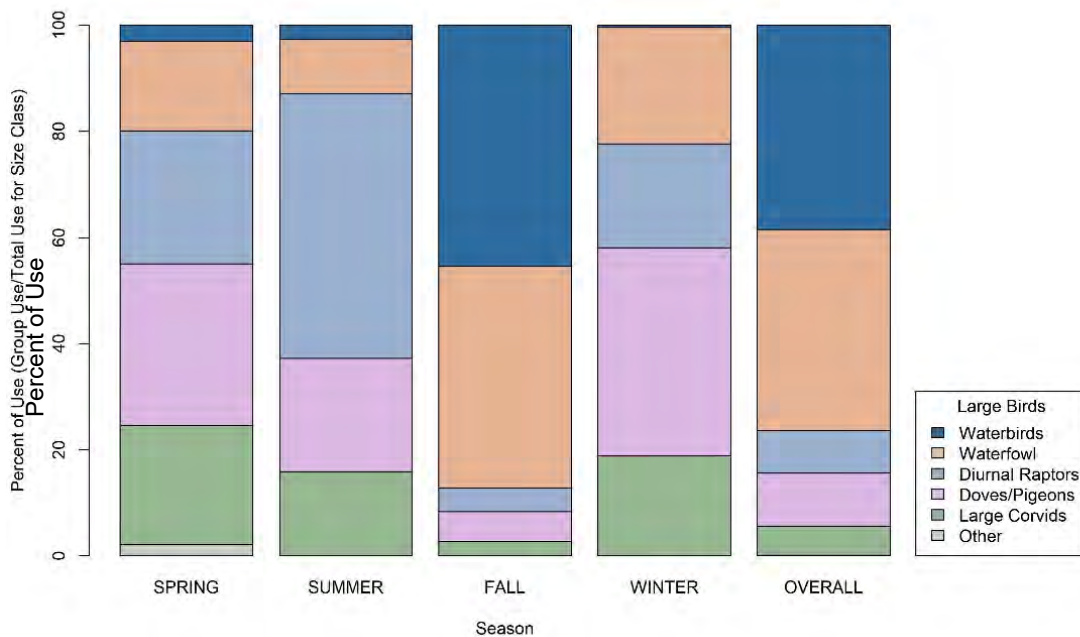


Figure 4b. Large bird percent of use by season and bird type at the Horse Heaven Wind Project area in Benton County, Washington from July 24, 2018 to June 22, 2019.

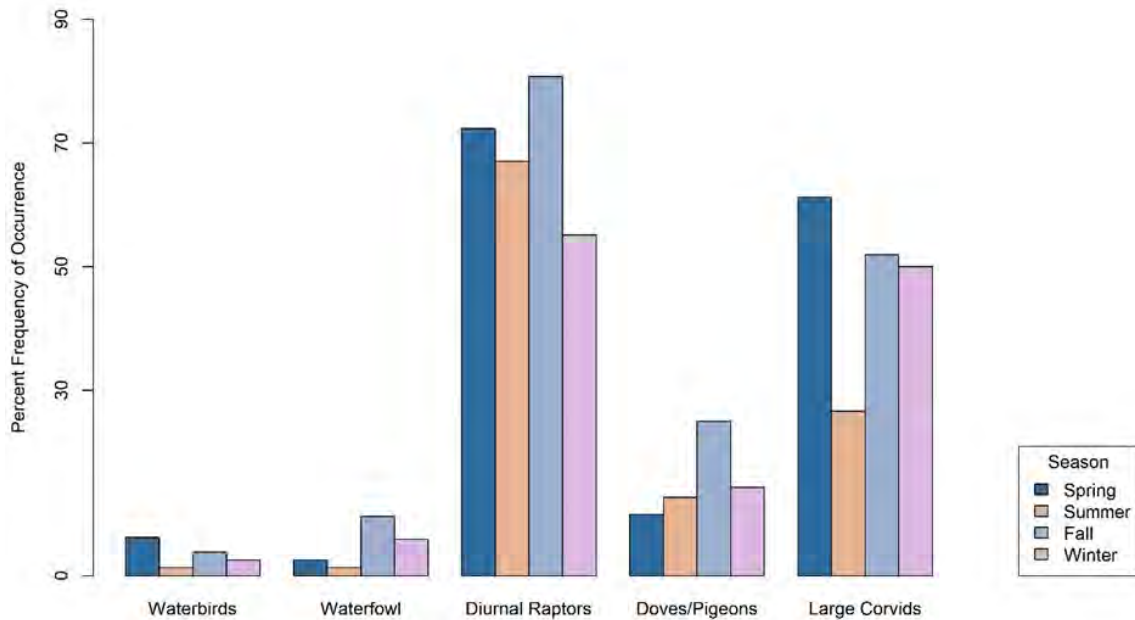


Figure 4c. Large bird frequency of occurrence by season and bird type at the Horse Heaven Wind Project area in Benton County, Washington from July 24, 2018 to June 22, 2019.

Bird Flight Height

Mean large bird flight heights ranged from 3.00 m (9.84 ft) for owls to 309.67 m (1,015.98 ft) for waterbirds. Shorebirds (100%) and waterfowl (90.8%) were recorded most frequently within RSH (25 to 150 m AGL; Table 5). Owl flight heights were within 0 to 25 m (85 ft) 100% of the time, and waterbirds flew >150 m most (99.6%) of the time (Table 5). Within the diurnal raptor group, the species with the highest mean use (*Buteos*) were observed within the RSH the majority (83%) of the time. As discussed, all six eagle observations were within the RSH. Frequently observed during surveys, northern harrier was rarely observed within the RSH and flew below 25 m AGL 92.5%.

Table 5. Flight height characteristics by large bird type and raptor subtype during 60-minute use surveys at the Horse Heaven Wind Project in Benton County, Washington from July 24, 2018 to June 22, 2019.

Bird Type	# Groups Flying	# Obs Flying	Mean Flight Height (m)	% Obs Flying	% within Flight height Categories		
					0 - <25 m	25 - 150 m ^b	> 150 m
Waterbirds	15	1,466	309.67	100	0	0.4	99.6
Waterfowl	15	1,436	100.87	100	9.2	90.8	0
Shorebirds	1	4	25.00	80.0	0	100	0
Diurnal Raptors	273	278	38.19	87.7	49.6	49.3	1.1
<u>Accipiters</u>	2	2	25.00	100	50.0	50.0	0
<u>Buteos</u>	137	141	62.42	83.9	14.9	83.0	2.1
<u>Northern Harrier</u>	106	106	9.34	100	92.5	7.5	0
<u>Eagles</u>	6	6	66.67	100	0	100	0
<u>Falcons</u>	22	23	19.73	65.7	78.3	21.7	0
Owls	1	1	3.00	100	100	0	0
Doves/Pigeons	31	363	21.35	93.8	56.7	43.3	0
Large Corvids	125	205	32.26	96.2	48.8	42.9	8.3
Large Birds Overall	461	3,753	46.22	98.1	15.4	45.2	39.4

^a 800-meter (m) radius plot for large birds.^b The likely RSH for potential collision with a WTG blade, or 25 to 150 m (85 to 492 ft) above ground level.^c Zeroes and NA values indicate that the species was observed but was not flying.

Spatial Variation

Mean Use by Point

Large bird use ranged from 1.60 observations/plot/survey to 120.33 observations/plot/survey across points and was concentrated on Points 11 and 1 (Figure 6a). High avian use at these points was influenced by large groups of waterbirds at Point 11 and waterfowl at Point 1 (Figures 6a, 6b, 6c; Appendix C).

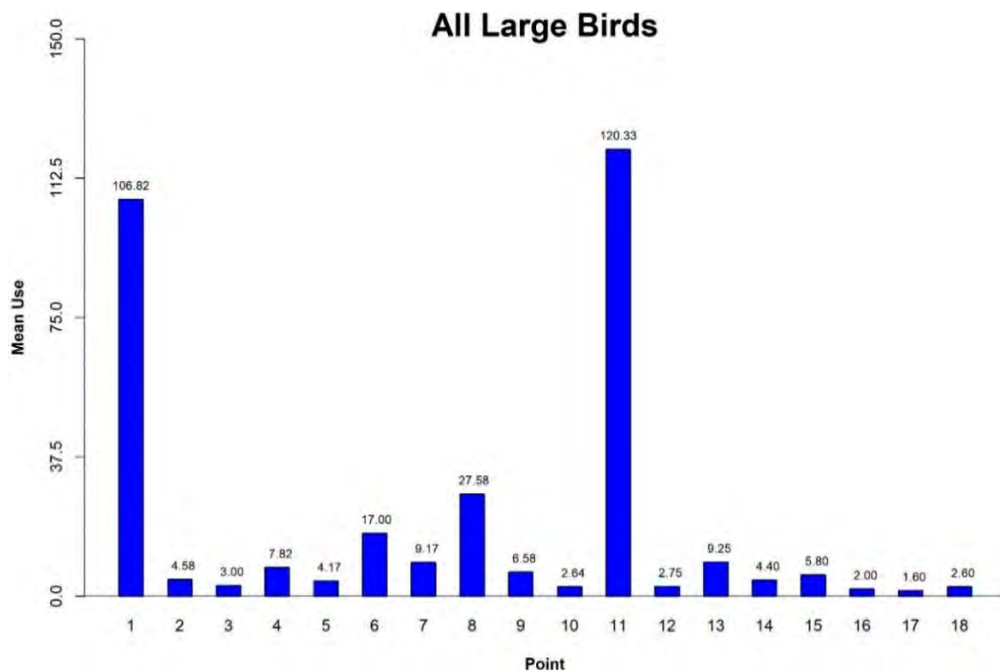


Figure 5a. Large Bird Mean Use by Point by bird type at the Horse Heaven Wind Project area in Benton County, Washington from July 24, 2018 to June 22, 2019.

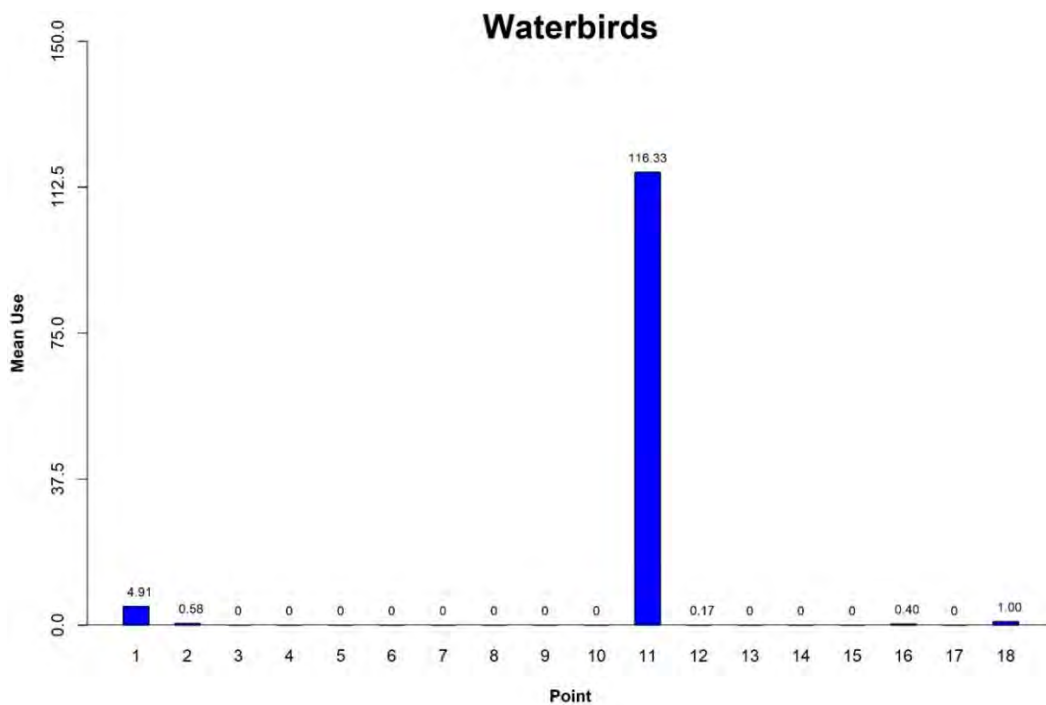


Figure 5b. Waterbird Mean Use by Point at the Horse Heaven Wind Project area in Benton County, Washington from July 24, 2018 to June 22, 2019.

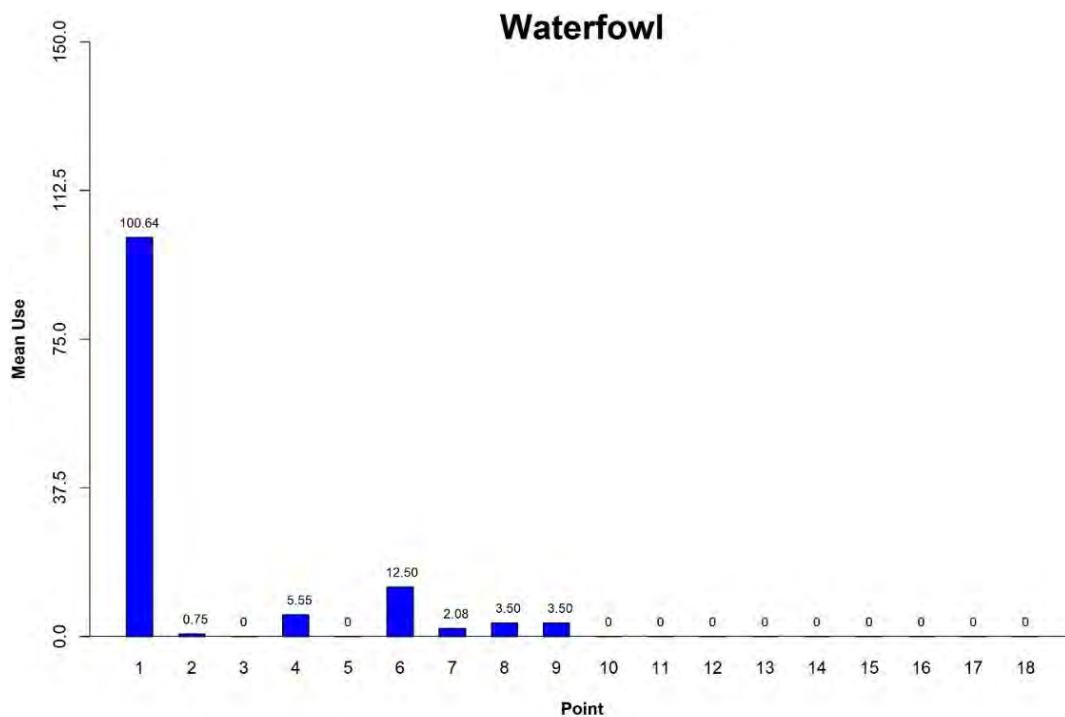


Figure 5c. Waterfowl Mean Use by Point at the Horse Heaven Wind Project area in Benton County, Washington from July 24, 2018 to June 22, 2019.

Flight Paths

Flight paths of sandhill crane were mapped at the Project. Nine groups of 1,400 individuals were observed flying over the Project area during fall. Groups were observed flying in a predominant southerly flight direction. All groups observed were flying above RSH. The average flight height was 364 m AGL (range 200–500 m AGL).

Flight paths of five groups of 65 American white pelican were mapped at the Project. Groups were observed during summer, fall and spring. Groups occurred throughout the Project area and did not appear to follow a particular flight pattern. Of the five groups observed, one group of five individuals were observed during summer flying in the RSH at approximately 125 m AGL. The average flight height was 260 m AGL (range 125–400 m AGL).

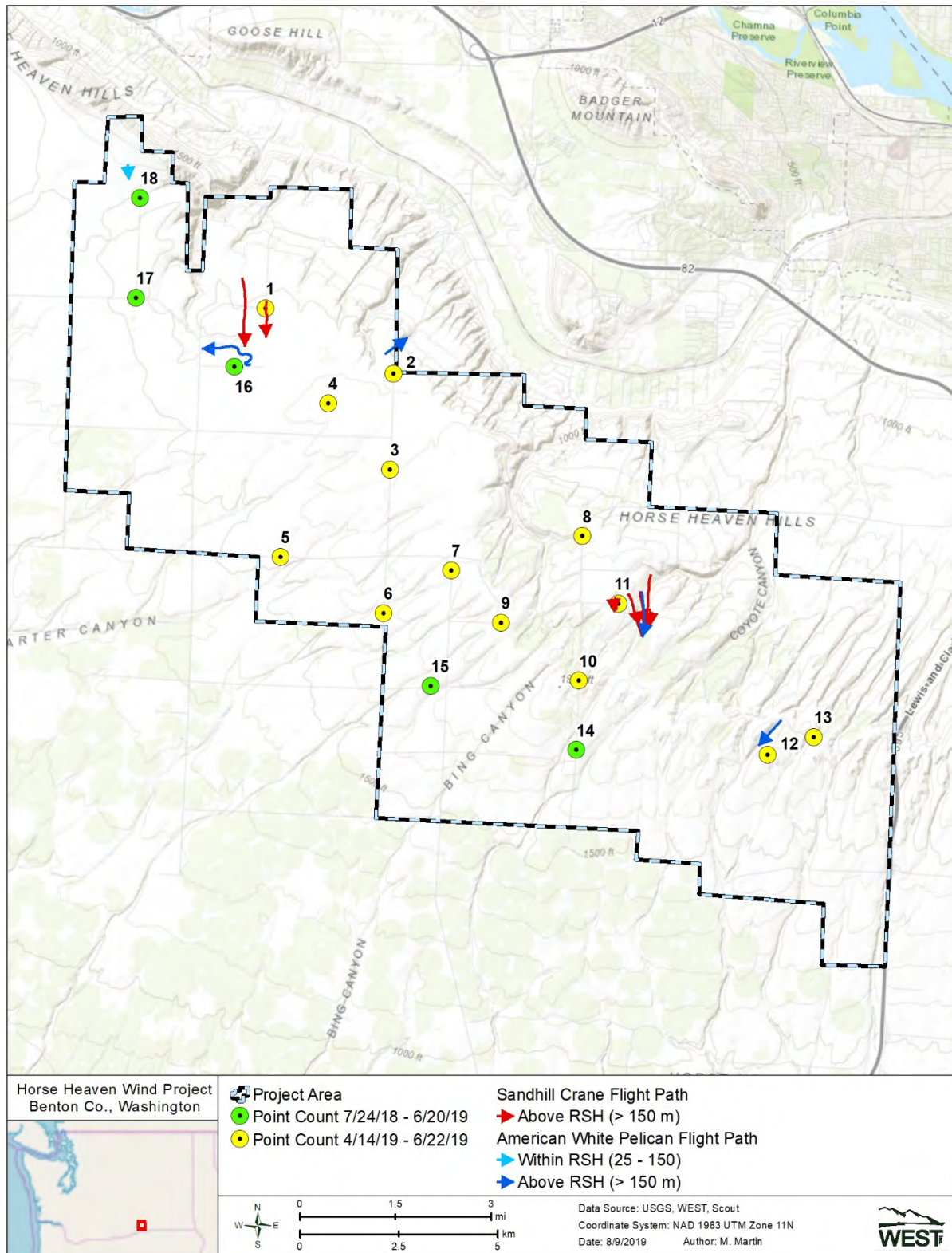


Figure 6. Sandhill crane flight paths at the Horse Heaven Wind Project, Benton County Washington from July 24, 2018 to June 22, 2019.

Raptor Nest Surveys

A total of 36 raptor nests were located during aerial surveys that were conducted at the Project on March 5 and May 16, 2019. Of the 36 nests documented, 24 nests (66%) were occupied; of the 24 occupied nests, 22 nests had adults incubating or young observed in the nest (Appendix D1). Of the occupied nests, six raptor species were recorded within 10-miles of the Project and included red-tailed hawk (8 nests) Swainson's hawk (7 nests), great-horned owl (3 nests), bald eagle (3 nests), and ferruginous hawk (1 nest). Although not considered a raptor, two common raven nests were documented during surveys.

Three bald eagle territories were located within the 10-mile Survey Area: Yakima River Mouth, Port of Pasco, and Sand Station³. The Yakima River Mouth territory (Nest 18) was located at the confluence of the Yakima River and Columbia River, approximately 7.7 miles northeast of the Project (Figure 7 and 8). During the second survey, one adult was present at the nest which contained new nest material, but no eggs or young were observed; thus, the breeding status of the nest was considered inactive. The Port of Pasco territory (Nest 37), located adjacent to a shipping port along the Columbia River, was located approximately 9.5 miles west of the Project. During the second survey, the nest was occupied by two adults and contained two nestlings approximately 21 to 30 days old (Appendix D2). The Sand Station territory (Nest 55) was located approximately 9.3 miles south of the Project along the Columbia River. During the second survey, two adults were present at the nest which contained two eggs (Appendix D3). No bald or golden eagle nests were found within the Project area or in the 2-mi Survey Area.

One ferruginous hawk nest (Nest 03) was located in a deciduous tree within the Project area and contained one adult in an incubating posture (Appendix D4). Eight additional unoccupied nests characteristic of nests built by ferruginous hawk were documented within two miles of the Project. These unoccupied nests were all located in the northwestern portion of the Project within the 13 (Figure 9). All nests were located on the ground and had the size and form typical of ferruginous hawk construction (Photo D5). Seven of the nests were in poor condition, indicating no recent maintenance or nesting activities had occurred and were most likely old territories.

Eight red-tailed hawk nests were observed within two miles of the Project. Of the eight nests, seven were occupied and active with four of the nests containing young approximately 14–30 days old during the second survey (Nest 09, 20, 26, and 27; Figure 8; Appendix D). Nest 26 contained four nestlings at the time of the second survey (Photo D6). The remaining nest (Nest 14) was occupied inactive with an adult present during both surveys but no sign indicative of nesting was observed.

Seven occupied Swainson's hawk nests were located two miles from the Project and contained adults on the nest in an incubating posture. Six of the seven nests were located within the Project area and another nest (Nest 43) was located approximate 2 mi southeast of the Project (Table 8,

³ WEST-defined territory names

Figure 8). In Washington, Swainson's hawks typically arrive later in the season to nest compared to other species, thus adults tending the nests were still incubating during the time of the second survey.

Three great-horned owls were observed nesting within two miles of the Project (Figure 8). All three nests were documented as occupied and active, two of which had owlets present. Located within the Project area, Nest 01 had two owlets standing adjacent to the nest during the second survey and Nest 41 had a juvenile flush from the nest but no adults were present. Located within the 2-mi Study Area, Nest 07 had a red-tailed hawk at the nest during the first survey but by the second survey the nest was occupied by an adult great-horned owl that was incubating (Photo D7).

While not a raptor per se, two common raven (*Corvus corax*) nests (Nest 19 and 33) were documented because ravens and raptors are known to use similar-sized nests. The nests were located within the Project area, one on a cliff with two adults and four chicks present while the other one was in a deciduous tree with one adult present.

The 12 unoccupied inactive nests were located two miles from the Project. Several of the nests were highly dilapidated, of which two (Nests 12 and 13) nest were no longer considered viable nests without substantial rebuilding. Eight nests were characteristic of a ferruginous hawk placement and construction possibly occupied by ferruginous hawks prior to 2017 when surveys at the Project began.

2017–2019 Nest Survey Comparison

Although the number of nests located within the 2-mile Study Area of the Project increased from 2017 to 2019, nest density decreased because the Survey Area was over twice as large in 2019 (Table 6). In addition to a larger Study Area, the increase in the number of nests between years was due to the construction of *Buteo* nests; red-tailed hawks in deciduous trees along an old railroad grade located north of the Project and Swainson's hawks in isolated trees scattered throughout the Project. The number of occupied red-tailed hawk, Swainson's hawk, and ferruginous hawk nests among survey years contributing to the majority of the raptor nest use in 2017 (64%), 2018 (73%), and 2019 (67%; Table 6).

Overall, nest density in 2019 was relatively consistent with densities observed 2018 although lower compared to 2017. Although nest density decreased in 2019 compared to 2017, the proportion of occupied nests (67%) in 2019 was higher than in 2017 when nearly half of the nests were unoccupied (52%; Table 6).

Seven nests were occupied consecutively during all three survey years (Nests 2, 3, 7, 9, 14, 18, and 19). Of the seven nests occupied in successive years, three (43%) contained the same species. The Yakima River Mouth bald eagle territory (Nest 18) was occupied and contained nestlings during 2017 and 2018 survey years but did not show sign of nesting or attempted nesting during 2019. Nest 3 contained a ferruginous hawk that was observed incubating during each survey year. Nest 9 was occupied by a red-tailed hawk and contained at least one nestling each

survey year. Occupied nests with a different species among years typically had a great-horned owl, Swainson's hawk, or a common raven during one of the three survey years.

Table 6. Raptor nest results within 2-miles of the proposed Horse Heaven Wind Project, Washington. Aerial surveys conducted March 31 and May 10 2017, March 05 and May 10 2018, and March 5 and May 16 2019. Supplemental ground surveys were conducted during summer 2018.

Species Obs. On Nest	2017		2018		2019	
	# Nests	Nest Density (#/mi ²) ^a	# Nests	Nest Density (#/mi ²) ^a	# Nests	Nest Density (#/mi ²) ^a
Ferruginous Hawk	2	0.027	1	0.007	1	0.005
Swainson's Hawk	1	0.013	6	0.039	7	0.037
Red-tailed Hawk	4	0.054	8	0.052	8	0.043
Great-horned Owl	2	0.027	2	0.013	3	0.016
Common Raven	1	0.013	1	0.007	2	0.011
Unoccupied	10	0.134	14	0.092	12	0.064
Sum	20	0.268	32	0.210	33	0.176

^a Nest Density = # Nests within 2-mi of Project / (Project Area + 2-mi All Raptor Survey Area):

2017 = 74.66 mi²; 2018 = 152.60 mi²; 2019 = 187.14 mi²

^b Located outside the two-mile Survey Area.

13

Figure 7. Aerial orthophotograph of 2019 raptor nests within 10-miles of the Horse Heaven Wind Project area in Benton County, Washington.

13

Figure 8. Topographic map with 2019 raptor nests within 10-miles of the Horse Heaven Wind Project area in Benton County, Washington.

13

Figure 9. Topographic map of 2019 raptor nests within 2-miles of the Horse Heaven Wind Project area in Benton County, Washington.

Incidental Observations

Four avian species and one mammal species not identified during surveys were observed during the study period (Table 7). Of the four species observed, two species were listed as special status including sandhill crane (state endangered) and sage thrasher (state candidate species for listing). Of additional note, two pronghorn antelope were observed in May during the aerial raptor nest surveys. Two adult males were observed separately running through agricultural fields. While not considered a listed or sensitive species, pronghorn population numbers in Washington are very low (e.g., < 300 individuals) and reintroduction efforts are currently underway (WDFW 2018)

Table 7. Incidental wildlife observed at the Horse Heaven Wind Project area in Benton County, Washington from July 24, 2018 to June 22, 2019.

Species	Scientific Name	# grps	# obs
sandhill crane ¹	<i>Antigone canadensis</i>	7	1,524
snowy owl	<i>Bubo scandiacus</i>	1	1
Bullock's oriole	<i>Icterus bullockii</i>	1	7
sage thrasher ²	<i>Oreoscoptes montanus</i>	1	1
Pronghorn antelope	<i>Antilocapra americana</i>	2	2
Total	5 species	12	1,535

¹ State Endangered

² State Candidate Species

DISCUSSION

The principal objectives of the study were to 1) provide site-specific species occurrence and spatial and temporal patterns of avian use with a particular focus on eagles, other raptors, and non-raptors such as sandhill crane or species of regulatory or management concern (i.e., federal or state-sensitive species), and 2) document raptor nests within the Project and surrounding area. Additionally, surveyors documented observations of rare and sensitive species observed incidental to standardized surveys throughout the course of the study.

The bird species observed in the Project during the study were typical to those commonly found in agricultural, shrub-steppe and grasslands within the Columbia Plateau. Bird use was highest for species common and widespread in the region and the bird community observed coincided with the assemblage expected based on habitat in the Project and surrounding area. For example, waterbirds and waterfowl were primarily observed during spring and fall when individuals were likely moving between their summer and winter ranges.

Overall large bird use was significantly higher during spring and fall, likely due to the Project's location in the Pacific Flyway and the stopover habitat available in the surrounding area. Sandhill crane and snow goose had the highest mean use of all birds in Year 2 due to the large flock numbers that flew over the Project. The region surrounding the Project contains various agricultural and crop lands that could provide valuable stopover locations for migrating cranes and geese; however based on high flight heights and patterns it is likely these species are predominantly passing over the Project area rather than utilizing resources in the area. Certain

areas within the Project (primarily in ravines and small sections of non-cultivated lands) provided some suitable nesting habitat for raptors (e.g., cliff, escarpments or trees). Overall diurnal raptor use was generally consistent across the Project area with overall large bird use concentrated at Points 1 and 11. Several large bird groups of interest for the Project are discussed separately, below.

Waterbirds

The waterbird group accounted for the highest mean use but contained only three species, two of which are of conservation interest; American white pelican (state threatened) and sandhill crane (state endangered).

American white pelican mean use was relatively low when compared to other waterbirds and waterfowl. Of a total of five groups of 65 American white pelicans observed during spring, summer, and fall, only 7.7% were flying within the RSH. In comparison, the Year 1 study observed only one individual American white pelican during the summer flying within the RSH. In Washington, the largest breeding colony of American white pelicans is on Badger Island, located 12 miles northeast of the Project near Kennewick (Stinson 2016). No large bodies of water that provide suitable pelican foraging habitat is present within the Project; however, considering an increasing population (approximate 86% increase on Badger Island since 2009, $n = 3,267$ individuals total), occasional use of the Project area may continue. No behavioral patterns or areas of concentration were observed during the either survey year.

Sandhill crane comprised the majority of large bird observations at the Project in both survey years and had the highest use during spring and fall. Higher crane use was at the center of the Project in both Year 1 and 2 (Point 7 and Point 11, respectively), but there does not appear to be a strong association for observed sandhill crane use at either survey point or the surrounding areas. This suggests individuals observed during surveys were likely passing over the Project. Despite the pattern of high use at the Project, sandhill cranes do not seem especially vulnerable to WTG collisions. This is based primarily on observed flight heights above the RSH in both Year 1 and 2 (90% and 100%, respectively). This flight behavior is supported by studies that have shown sandhill cranes are likely to avoid WTG's (Nagy et al. 2013, Derby et al. 2012, Pearse et al. 2016). In addition, researchers at WEST monitored use by migrating sandhill cranes at five wind energy facilities in North and South Dakota from 2009 – 2013 for three years at each site. Concurrently, they searched underneath all WTG's daily for fatalities of cranes. Cumulatively, observers spent 13,182 hours recording crane use over 1,305 days, and even though 42,727 sandhill crane observations were recorded, no fatalities of cranes were found beneath WTG's (Derby et al. 2018). A crane monitoring study was conducted at the Forward Energy Center, a wind energy facility in southern Wisconsin located within 3.2 km (2.0 mi) of a large wetland used by sandhill cranes. No crane fatalities were found during the crane monitoring study in the fall of 2008, or during regular bird fatality monitoring studies conducted in the fall of 2008, spring and fall of 2009, and in the spring of 2010, even though sandhill cranes were observed in the study area (Grodsky et al. 2013).

Due to the observed numbers of cranes, continued use of the Project during spring and fall is anticipated. However, the absence of suitable breeding and stopover habitat within the Project area, average flight heights above the RSH, and the available data regarding these species' interactions with WTG's, impacts to sandhill crane resulting from Project development and operation are anticipated to be low.

Waterfowl

Two species comprised the waterfowl group: Canada goose and snow goose. Mean use was highest in fall which was attributed to large groups of each species migrating through the Project. Waterfowl do not seem especially vulnerable to WTG collisions. In an analysis of 116 studies of bird mortality at over 70 operating wind facilities, waterfowl composed 2.7% of 4,975 fatalities found (Erickson et al. 2014). Wheat fields within the Project area may become inundated with water in the spring or fall and provide suitable foraging habitat. Waterfowl that enter or exit agricultural fields while foraging for grain crops may be at greater risk of WTG collision.

Diurnal Raptors

Diurnal raptor use was highest during the fall when northern harrier, red-tailed hawks, Swainson's hawks and rough-legged hawk use increased. Fall coincides with migration when large-scale movement of many raptor species to more southern latitudes occurs. The increased use of raptors in fall followed by the subsequent decrease of most raptor species in winter suggests a limited number of raptor species overwinter in the Project area.

Observations of red-tailed hawks and northern harriers increased during fall migration; Swainson's hawk use peaked in summer post nesting but is considered a highly migratory species. Based on the higher relative use of *Buteos* and harriers during fall and flight behavior that is often within the RSH, there is higher potential for *Buteos* fatalities compared to other raptor species. Fatalities of all three raptor species (Swainson's hawk, red-tailed hawk, and northern harrier) have been documented at operating wind projects.

Ferruginous hawks, a state listed threatened species, was observed during large bird surveys and during raptor nest surveys. Observed during fall, overall use was low when compared to other diurnal raptor use in the area. The number of unoccupied nests whose construction was indicative of ferruginous hawk suggests higher nest occupancy in the Horse Heaven Hills prior to 2017 nest surveys; however, one nest has consistently been occupied by ferruginous hawk during the 2017-2019 raptor nest surveys. A 2010 survey of 192 ferruginous hawk territories in Washington resulted in the lowest number of occupied territories (19%) over a 14-year period, which indicates a persistent population decline in Washington (WDFW 2013).

Bald and Golden Eagles

Three adult bald eagles were observed during large bird use surveys for a total of six eagle minutes. Observations of bald eagles within the Project may be associated with the occupied bald eagle nests along the Columbia River that was documented during 2017-2019 raptor nest surveys. Eagle observations occurred in fall, winter, and spring when individuals typically range widely to migrate or in search of food (Kalasz and Buchanan 2016). Occurrence in the Project

was consistent with seasonal occurrence observed in 2017-2018. No open water or typical bald eagle foraging habitat is found in the Project; the nearest being the Columbia River, located approximately 7-miles northwest. In eastern Washington, the risk of bald eagle collision with WTG's may be lower compared to other regions due to lower population densities (Kalasz and Buchanan 2016). Although there are no bald eagle nests within approximately 7 miles of the Project and there are no concentrated prey items within the Project, low use at the Project during the multi-year survey suggests that bald eagles will continue to occur at the Project.

Three golden eagles were observed in fall during Year 2 large bird use surveys for a total of eight eagle minutes. Due to the limited sample size, no patterns of spatial use were observed; although two observations were in the southeast corner of the Project where topography is more complex. Using a nine-year study of 17 golden eagles within the Columbia Plateau that found golden eagle use correlated with the proximity to nests, terrain complexity, and prey abundance researchers were able to create conservative estimates to caution wind development within 8 miles of an active golden eagle nest (Watson et al. 2014). No golden eagle nests were observed within 10 miles of the Project during aerial nest surveys conducted spring 2017–2019. Although no golden eagle year nests were located within 10 miles of the Project and there were no concentrated prey items within the Project, consistent use over several survey years suggests use at the Project by golden eagles will continue to occur.

CONCLUSIONS

Tier 3 studies are used to address questions regarding impacts that could not be sufficiently addressed using available literature (i.e., during Tier 1 and 2 desktop analyses; USFWS 2012). These studies provide additional data that, when combined with available literature reviewed in previous tiers, allow for a better-informed assessment of the risk to species of concern at the project area. Overall, the Project area does not support high use during the avian breeding season, overall avian use may fluctuate annually, and large bird use is typically characterized by seasonally abundant and common species such as geese, ravens, doves, pigeons, and raptors. However, special-status avian species such as eagles, sandhill crane, and American white pelican occur at the Project and pose varying levels of collision risk.

Differences suggest seasonal and annual variability in species composition and use are likely to occur at the Project. Based on data from other publicly available wind projects in Oregon and Washington, diurnal raptor fatality rates are expected to be within the range of fatality rates observed at other facilities. To date, overall fatality rates for birds at wind energy facilities have been consistently low, and the most recent, comprehensive, and robust studies of overall bird fatality rates at wind facilities in the Pacific Northwest have produced fatality rate estimates ranging from 0.03–0.47 birds per MW per year; no Project data suggests the Project would fall outside this range.

This study also was designed to document use of bald and golden eagles, following the ECPG survey recommendations and the Final Rule (USFWS 2013, 2016). During the two-year large bird survey at Horse Heaven conducted 2017-2019, the total bald eagle risk minutes was 12 min

(2017–2018 = 6 min; 2018–2019 = 6 min) and golden eagle was 43 min (2017–2018 = 35 min; 2018–2019 = 8 min). The combined two-year survey effort resulted in 500 hours of large bird use surveys (2017–2018 = 322 hrs; 2018–2019 = 178 hrs). Eagle use varied by season although no observations occurred during summer. Suitable bald and golden eagle nesting, roosting and other areas of concentration were absent within the Project area.

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**Appendix A. All Bird Types and Species Observed at the Horse Heaven Wind Project
during Avian Use Surveys, July 24, 2018 to June 22, 2019.**

Appendix A. Numbers of groups and observations by bird type and species for 60-minute large bird use surveys at the Horse Heaven Wind Project from July 24, 2018 to June 22, 2019.

Type / Species	Scientific Name	Summer		Fall		Winter		Spring		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Waterbirds		1	5	10	1,450	1	1	3	10	15	1,466
sandhill crane	<i>Antigone canadensis</i>	0	0	9	1,400	0	0	0	0	9	1,400
great blue heron	<i>Ardea herodias</i>	0	0	0	0	1	1	0	0	1	1
American white pelican	<i>Pelecanus erythrorhynchos</i>	1	5	1	50	0	0	3	10	5	65
Waterfowl		1	19	11	1,334	2	41	1	42	15	1,436
Canada goose	<i>Branta canadensis</i>	1	19	3	218	1	16	1	42	6	295
snow goose	<i>Chen caerulescens</i>	0	0	5	987	1	25	0	0	6	1,012
unidentified goose		0	0	3	129	0	0	0	0	3	129
Shorebirds		0	0	0	0	0	0	2	5	2	5
killdeer	<i>Charadrius vociferus</i>	0	0	0	0	0	0	1	4	1	4
long-billed curlew	<i>Numenius americanus</i>	0	0	0	0	0	0	1	1	1	1
Diurnal Raptors		54	54	142	142	40	41	75	80	311	317
<u>Accipiters</u>		0	0	2	2	0	0	0	0	2	2
unidentified accipiter	<i>Accipiter</i> spp.	0	0	1	1	0	0	0	0	1	1
sharp-shinned hawk	<i>Accipiter striatus</i>	0	0	1	1	0	0	0	0	1	1
<u>Buteos</u>		31	31	70	70	15	15	47	52	163	168
red-tailed hawk	<i>Buteo jamaicensis</i>	10	10	23	23	1	1	11	11	45	45
rough-legged hawk	<i>Buteo lagopus</i>	0	0	33	33	14	14	11	11	58	58
ferruginous hawk	<i>Buteo regalis</i>	0	0	1	1	0	0	0	0	1	1
unidentified <i>Buteo</i>	<i>Buteo</i> spp.	0	0	1	1	0	0	3	3	4	4
Swainson's hawk	<i>Buteo swainsoni</i>	21	21	12	12	0	0	22	27	55	60
<u>Northern Harrier</u>		19	19	51	51	13	13	23	23	106	106
northern harrier	<i>Circus hudsonius</i>	19	19	51	51	13	13	23	23	106	106
<u>Eagles</u>		0	0	4	4	1	1	1	1	6	6
golden eagle	<i>Aquila chrysaetos</i>	0	0	3	3	0	0	0	0	3	3
bald eagle	<i>Haliaeetus leucocephalus</i>	0	0	1	1	1	1	1	1	3	3
<u>Falcons</u>		4	4	15	15	11	12	4	4	34	35
prairie falcon	<i>Falco mexicanus</i>	1	1	2	2	1	1	1	1	5	5
American kestrel	<i>Falco sparverius</i>	3	3	12	12	10	11	3	3	28	29
unidentified falcon	<i>Falco</i> spp.	0	0	1	1	0	0	0	0	1	1

Appendix A. Numbers of groups and observations by bird type and species for 60-minute large bird use surveys at the Horse Heaven Wind Project from July 24, 2018 to June 22, 2019.

Type / Species	Scientific Name	Summer		Fall		Winter		Spring		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Owls		0	0	0	0	0	0	1	1	1	1
short-eared owl	<i>Asio flammeus</i>	0	0	0	0	0	0	1	1	1	1
Doves/Pigeons		7	19	19	180	6	84	5	104	37	387
rock pigeon	<i>Columba livia</i>	4	16	18	179	5	79	5	104	32	378
mourning dove	<i>Zenaida macroura</i>	3	3	1	1	1	5	0	0	5	9
Large Corvids		14	18	40	87	28	39	50	69	132	213
common raven	<i>Corvus corax</i>	14	18	40	87	28	39	50	69	132	213
Overall		77	115	222	3,193	77	206	137	311	513	3,825

**Appendix B. Bird Use, Percent of Use, and Frequency of Occurrence for Large Birds
Observed during Avian Use Surveys at the Horse Heaven Wind Project Area from July 24,
2018 to June 22, 2019.**

Appendix B. Mean large birds use (number of large birds/plot^a/60-minute survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Horse Heaven Wind Project during fixed-point bird use surveys from July 24, 2018 to June 22, 2019.

Type / Species	Mean Use				% of Use				% Frequency			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
Waterbirds	0.07	27.88	0.03	0.19	2.7	45.4	0.5	3.0	1.4	3.8	2.6	6.3
sandhill crane	0	26.92	0	0	0	43.8	0	0	0	3.8	0	0
great blue heron	0	0	0.03	0	0	0	0.5	0	0	0	2.6	0
American white pelican	0.07	0.96	0	0.19	2.7	1.6	0	3.0	1.4	1.9	0	6.3
Waterfowl	0.26	25.65	1.24	1.08	10.2	41.8	21.9	16.9	1.4	9.6	5.9	2.6
Canada goose	0.26	4.19	0.41	1.08	10.2	6.8	7.2	16.9	1.4	5.8	2.6	2.6
snow goose	0	18.98	0.83	0	0	30.9	14.7	0	0	1.9	3.3	0
unidentified goose	0	2.48	0	0	0	4.0	0	0	0	3.8	0	0
Shorebirds	0	0	0	0.12	0	0	0	1.9	0	0	0	4.4
killdeer	0	0	0	0.10	0	0	0	1.6	0	0	0	2.6
long-billed curlew	0	0	0	0.02	0	0	0	0.3	0	0	0	1.9
Diurnal Raptors	1.28	2.73	1.11	1.60	49.8	4.4	19.6	25.0	67.1	80.8	55.1	72.4
<u>Accipiters</u>	0	0.04	0	0	0	<0.1	0	0	0	3.8	0	0
unidentified accipiter	0	0.02	0	0	0	<0.1	0	0	0	1.9	0	0
sharp-shinned hawk	0	0.02	0	0	0	<0.1	0	0	0	1.9	0	0
<u>Buteos</u>	0.84	1.35	0.42	1.02	32.4	2.2	7.4	16.0	51.8	48.1	33.8	46.6
red-tailed hawk	0.30	0.44	0.03	0.20	11.6	0.7	0.5	3.2	21.6	23.1	2.6	14.8
rough-legged hawk	0	0.63	0.40	0.26	0	1.0	7.0	4.1	0	25.0	31.3	13.2
ferruginous hawk	0	0.02	0	0	0	<0.1	0	0	0	1.9	0	0
unidentified buteo	0	0.02	0	0.06	0	<0.1	0	0.9	0	1.9	0	5.6
Swainson's hawk	0.54	0.23	0	0.50	20.8	0.4	0	7.8	39.0	13.5	0	25.9
<u>Northern Harrier</u>	0.35	0.98	0.34	0.48	13.4	1.6	6.0	7.5	25.8	42.3	29.0	43.2
northern harrier	0.35	0.98	0.34	0.48	13.4	1.6	6.0	7.5	25.8	42.3	29.0	43.2
<u>Eagles</u>	0	0.08	0.03	0.03	0	0.1	0.5	0.4	0	5.8	2.6	2.6
golden eagle	0	0.06	0	0	0	<0.1	0	0	0	3.8	0	0
bald eagle	0	0.02	0.03	0.03	0	<0.1	0.5	0.4	0	1.9	2.6	2.6
<u>Falcons</u>	0.10	0.29	0.32	0.07	4.0	0.5	5.7	1.2	10.2	26.9	27.2	7.4
prairie falcon	0.02	0.04	0.03	0.02	0.7	<0.1	0.6	0.3	1.9	3.8	3.3	1.9
American kestrel	0.08	0.23	0.29	0.06	3.2	0.4	5.1	0.9	8.3	21.2	23.8	5.6
unidentified falcon	0	0.02	0	0	0	<0.1	0	0	0	1.9	0	0
Owls	0	0	0	0.02	0	0	0	0.3	0	0	0	1.9

Appendix B. Mean large birds use (number of large birds/plot^a/60-minute survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Horse Heaven Wind Project during fixed-point bird use surveys from July 24, 2018 to June 22, 2019.

Type / Species	Mean Use				% of Use				% Frequency			
	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring
short-eared owl	0	0	0	0.02	0	0	0	0.3	0	0	0	1.9
Doves/Pigeons	0.55	3.46	2.23	1.95	21.3	5.6	39.3	30.5	12.7	25.0	14.4	10.0
rock pigeon	0.49	3.44	2.06	1.95	19.1	5.6	36.3	30.5	10.8	23.1	11.0	10.0
mourning dove	0.06	0.02	0.17	0	2.2	<0.1	2.9	0	3.8	1.9	3.3	0
Large Corvids	0.41	1.67	1.07	1.43	15.9	2.7	18.8	22.4	26.6	51.9	50.0	61.3
common raven	0.41	1.67	1.07	1.43	15.9	2.7	18.8	22.4	26.6	51.9	50.0	61.3
Overall	2.58	61.40	5.68	6.38	100	100	100	100				

**Appendix C. Mean Use by Point for All Birds, Bird Types, and Diurnal
Raptor Subtypes during Avian Use Surveys at the Horse Heaven Wind Project Area from
July 24, 2018 to June 22, 2019.**

Appendix C. Mean use (number of birds/60-minute survey) by point for all birds^a, major bird types, and diurnal raptor subtypes observed at the Horse Heaven Wind Project during fixed-point large bird use surveys from July 24, 2018 to June 22, 2019.

Bird Type	Survey Point																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Waterbirds	4.91	0.58	0	0	0	0	0	0	0	0	116.33	0.17	0	0	0	0.40	0	1.00
Waterfowl	100.64	0.75	0	5.55	0	12.50	2.08	3.50	3.50	0	0	0	0	0	0	0	0	0
Shorebirds	0	0	0	0	0.33	0	0	0	0	0	0	0	0	0.20	0	0	0	0
Diurnal Raptors	0.82	1.33	1.17	1.36	2.58	2.92	1.75	1.83	1.58	1.45	2.00	1.83	3.33	1.80	1.80	0.60	1.60	0.80
<u>Accipiters</u>	0	0.08	0	0	0	0	0	0	0	0	0	0	0.08	0	0	0	0	0
<u>Buteos</u>	0.09	0.67	0.42	0.73	1.25	2.17	0.67	1.25	0.83	0.82	1.17	0.83	1.42	1.20	1.40	0.40	1.20	0.20
<u>Northern Harrier</u>	0.45	0.25	0.67	0.64	1.00	0.42	0.92	0.08	0.58	0.55	0.42	0.83	1.50	0.60	0.20	0.20	0.40	0.20
<u>Eagles</u>	0	0	0.08	0	0	0	0	0	0.08	0	0.08	0.17	0.08	0	0	0	0	0
<u>Falcons</u>	0.27	0.33	0	0	0.33	0.33	0.17	0.50	0.08	0.09	0.33	0	0.25	0	0.20	0	0	0.40
Owls	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.20	0	0
Doves/Pigeons	0	0	0	0	0	1.25	4.75	21.08	0	0	0.25	0.25	3.92	0	1.80	0	0	0
Large Corvids	0.45	1.92	1.83	0.91	1.25	0.33	0.58	1.17	1.50	1.18	1.75	0.50	2.00	2.40	2.20	0.80	0	0.80
All Large Birds	106.82	4.58	3.00	7.82	4.17	17.00	9.17	27.58	6.58	2.64	120.33	2.75	9.25	4.40	5.80	2.00	1.60	2.60

^a 800-meter (m) radius plot for large birds.

Appendix D. 2019 Raptor Nest Survey Results within 10 miles of the Horse Heaven Wind Project, Benton County, Washington.

Appendix D1. 2019 Raptor Nest Survey Results within 10 miles of the Horse Heaven Wind Project, Benton County, Washington.

Nest ID	Species¹	Status	Nest Substrate	Comments
01	GHOW	Occupied / Active	Deciduous	2 nestlings standing adjacent to nest
02	SWHA	Occupied / Active	Deciduous	1 adult incubating on nest by roadside
03	FEHA	Occupied / Active	Deciduous	1 adult incubating; nest occupied active in 2018 as well
04	UNRA	Unoccupied / Inactive	Ground	Fair condition - characteristic FEHA
07	GHOW	Occupied / Active	Deciduous	1 adult incubating; Nest 07 duplicate
08	UNRA	Unoccupied / Inactive	Ground	Good condition - characteristic FEHA
09	RTHA	Occupied / Active	Deciduous	Adult present, 2 nestlings approximately 4 weeks old
10	UNRA	Unoccupied / Inactive	Ground	Poor condition - characteristic FEHA
11	UNRA	Unoccupied / Inactive	Ground	Poor condition - characteristic FEHA
12	UNRA	GONE	Cliff	Nest mostly gone, sticks on ground very poor condition
13	UNRA	Unoccupied / Inactive	Ground	Nest dilapidated and very poor condition
14	RTHA	Occupied / Inactive	Deciduous	One adult present at nest
15	UNRA	Unoccupied / Inactive	Ground	Poor condition- characteristic FEHA
16	UNRA	Unoccupied / Inactive	Ground	Poor condition - characteristic FEHA
17	UNRA	Unoccupied / Inactive	Ground	Poor condition - characteristic FEHA
18	BAEA	Occupied / Inactive	Deciduous	Yakima River Mouth Territory. One adult flushed from nest, greenery, no eggshells
19	CORA	Occupied / Active	Deciduous	1 adult incubating
20	RTHA	Occupied / Active	Deciduous	2 adults present; 1 nestling 1-2 weeks old, 2 additional nests in tree to the north of RTHA nest
22	UNRA	Unoccupied / Inactive	Ground	Poor condition - characteristic FEHA
23	RTHA	Occupied / Active	Deciduous	1 adult incubating/tending on nest
24	RTHA	Occupied / Active	Deciduous	1 adult incubating/tending on nest
25	UNRA	Unoccupied / Inactive	Deciduous	No sign of nesting
26	RTHA	Occupied / Active	Deciduous	1 adult tending nest with 4 nestlings approximately 1-2 weeks old
27	RTHA	Occupied / Active	Deciduous	2 adults present; one nestling in nest

Appendix D1. 2019 Raptor Nest Survey Results within 10 miles of the Horse Heaven Wind Project, Benton County, Washington.

Nest ID	Species¹	Status	Nest Substrate	Comments
28	SWHA	Occupied / Active	Deciduous	1 adult incubating; flushed, 4 eggs, nest in low shrubbery
30	UNRA	Unoccupied / Inactive	Ground	Poor condition - characteristic FEHA
31	SWHA	Occupied / Active	Deciduous	1 adult incubating on nest, near old farmhouse
32	SWHA	Occupied / Active	Conifer	1 adult incubating on nest; next to commercial building
33	CORA	Occupied / Active	Cliff	2 adults present, 4 nestlings approximately 1-2 weeks old
35	SWHA	Occupied / Active	Conifer	1 adult in incubating posture; nest adjacent to house/road
37	BAEA	Occupied / Active	Deciduous	Port of Pasco Territory. 2 adults present 2 nestlings approximately 3-4 weeks
40	RTHA	Occupied / Active	Deciduous	2 adults present; one adult on nest incubating/tending
41	GHOW	Occupied / Active	Deciduous	1 juvenile flushed from the nest; no adults present
42	SWHA	Occupied / Active	Deciduous	1 adult incubating, 1 adult perched on adjacent power pole
43	SWHA	Occupied / Active	Deciduous	2 nests side-by-side; 1 SWHA adult incubating in one and other with 4 CORA nestlings
55	BAEA	Occupied / Active	Deciduous	Sand Station Territory. 2 adults present, 2 eggs 2nd round

¹ BAEA – Bald Eagle, FEHA – Ferruginous Hawk, SWHA – Swainson's Hawk, RTHA – Red-tailed Hawk, GHOW – Great-horned Owl, CORA – Common Raven, UNRA – Unidentified Raptor



Appendix D2. Nest 37 with two fully gray feathered bald eagle nestlings approximately 21-30 days old. A red prey item can be seen between the two nestlings. Photo taken 05/16/2019.



Appendix D3. Nest 55 with an adult bald eagle tending to the nest with two eggs. Photo taken 05/16/2019



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Appendix D4. Adult ferruginous hawk at Nest 3, incubating. Photo taken 05/16/2019.



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Appendix D5. Characteristics ferruginous hawk (Nest 8) ground nest in good condition. Nest occupied inactive 2017 and was unoccupied in 2018–2019 surveys. Majority of ground nests along the rampart were in poor condition. Photo taken 05/16/2019.



Appendix D6. Red-tailed hawk Nest 08 with four nestlings observed during the second aerial survey. Photo taken 05/16/2019.



Appendix D7. An adult great-horned owl incubating at Nest 07 which was occupied by a red-tailed hawk during the first survey. Photo taken 05/16/2019.



ENVIRONMENTAL & STATISTICAL CONSULTANTS

2725 NW Walnut Boulevard, Corvallis, Oregon 97330
Phone: 307-214-2799 • www.west-inc.com • Fax: 307-637-6981

TECHNICAL MEMORANDUM

DATE: July 12, 2019

TO: Jeffrey Wagner and Micah Engum, wpd Wind Projects Inc.

FROM: Andrea Chatfield, Troy Rintz, and Erik Jansen, WEST, Inc.

RE: Results of the 2019 Raptor Nest Survey for the Four Mile Wind Project, Benton County, Washington.

INTRODUCTION

Four Mile MW LLC (Four Mile) is proposing to develop the Four Mile Wind Project (Project) in Benton County, Washington. Four Mile contracted Western EcoSystems Technology, Inc. (WEST) to conduct aerial raptor nest surveys within the proposed Project and surrounding area, as recommended by the US Fish and Wildlife Service (USFWS; 2012, 2013) and the Washington Department of Fish and Wildlife (WDFW; 2009). Surveys for nests of all raptor species were conducted within a 2-mile (mi; 3.2-kilometer [km]) buffer of the Project, while surveys specifically for bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) nests were conducted within a 10-mi (16-km) buffer of the Project (Survey Area). The initial aerial survey was conducted in early March, 2019, with a follow-up aerial survey completed in mid-May, 2019. This memorandum summarizes the characteristics of the Survey Area, survey methodology, and results of the 2019 aerial raptor nest survey at the Project.

PROJECT AND SURVEY AREA

WEST developed the raptor nest Survey Area by buffering the proposed Project boundary by 2 mi and 10 mi in a Geographic Information System (GIS). The Survey Area consisted of the Project and surrounding buffers, which included portions of Benton, Franklin, and Walla Walla counties, Washington and Umatilla County, Oregon (Figure 1). The Project is located near the eastern extent of the Horse Heaven Hills which is an anticline ridge of the Yakima Folds within the larger Columbia Plateau Ecoregion (Clarke and Bryce 1997). Topography within the Project is composed primarily of rolling hills bisected by meandering canyons that drain primarily to the south into the Columbia River. The Columbia River runs throughout the central portion of the Survey Area, bending around the eastern boundary of the Project. The Yakima River, Snake River, and Walla Walla River all drain into the Columbia River to the north, northeast, and east of the Project, respectively (Figure 1). Areas along these river corridors contain trees and cliffs suitable for nesting raptors.

Land cover within the Survey Area is a mosaic of dryland and irrigated agriculture, shrub-steppe grasslands, and rural/urban development (Figure 2). Agricultural cropland is the dominate land cover throughout the Project and Survey Areas. Shrub-steppe grasslands are found in topographically steep areas where agriculture was not possible. About a quarter of the Survey Area contains rural/urban development including portions of the tri-cities metro area (Richmond, Kennewick, and Pasco), Benton City and unincorporated rural areas. Much of the Survey Area is privately owned and actively managed for agriculture and livestock grazing. A few, scattered trees, primarily associated with farms, residences, or parks and preserves along the Columbia, Snake, and Walla Walla rivers, are scattered throughout the Survey Area. The 96-megawatt (MW) Nine Canyon wind energy facility is located immediately to the north of the proposed Project, and the 300-MW Stateline wind energy facility is located approximately four mi (6.4 km) to the southeast.

METHODS

Prior to conducting the nest surveys, WEST reviewed eagle nest information available from the WDFW (Hayes 2013, Kalasz and Buchanan 2016), as well raptor nest data collected by WEST during previous survey efforts in the region. Pre-flight planning included a review of topographic maps and aerial imagery, and the creation of field maps and GIS files for conducting the surveys. The 2019 aerial surveys were conducted by two qualified WEST biologists from a Bell Jet Ranger helicopter with bubble windows that provided excellent visibility (Pagel et al. 2010, USFWS 2013). The first aerial survey was conducted on March 7, and a follow-up aerial survey was conducted on May 16.

The initial survey in March was conducted during a time period that overlapped the primary early nesting period of bald and golden eagles in Washington, when breeding pairs are exhibiting courtship, nest-building, and/or incubation behaviors. This initial survey utilized an intuitive controlled survey method that focused on identifying and searching specific habitat features within the Survey Area that held the highest potential to support the target species. Within the 2-mi buffer, efforts focused on habitat features typically used by raptors that use large, conspicuous stick nests (e.g., eagles, red-tailed hawk [*Buteo jamaicensis*], Swainson hawk [*B. Swainsoni*], ferruginous hawk [*B. regalis*], and great horned owl [*Bubo virginianus*]). In addition to raptor nests, nests of common ravens (*Corvus corax*) were also documented as raptors and ravens are known to use similar-sized nests. Search efforts beyond the 2-mi buffer out to 10 mi focused on eagle nests specifically. Key habitat features within the Survey Area included cliffs, rock outcrops, incised drainages and canyons, powerline structures, and large/dominant trees.

The second aerial survey, conducted in mid-May, was performed at a time when eagles and other raptors are actively engaged in mid- to late-breeding season reproductive activities (e.g., incubating, brooding, feeding nestlings), and when raptors engaged in ongoing nesting activities would be reliably on or around nests. The second survey was conducted as described above for areas within the 2-mi buffer (i.e., an intuitive controlled search of key habitat features throughout the area), while surveys beyond the 2-mi buffer primarily focused on confirming the status of previously documented eagle nests. However, some additional effort was spent searching for

eagle nests in a few specific areas identified during the initial survey as being most suitable for supporting eagle nests (e.g., cliffs and river corridors).

During each aerial survey, the helicopter was positioned to allow thorough visual inspection of all appropriate habitat features. In some cases, multiple passes were required to thoroughly cover nesting habitat. In general, the helicopter remained within a zone 100 feet (ft; 31 meters [m]) to 500 ft (152 m) above ground level and moved at a relative air speed of approximately 50 mi per hour (80.5 km per hour), with the helicopter maintaining a distance of at least 65 ft (20 m) from cliff faces and nests (Pagel et al. 2010). When nests were located, the helicopter reduced speed and adjusted flight to allow for a clear view of the nest for documentation and photographing. For each nest found, a Global Positioning System location was recorded and nest attribute data were collected, including species (if known), nest type, size, substrate, and condition, along with any comments useful in determining the nest status.

Nesting status for the 2019 nesting season was categorized using definitions originally proposed by Postupalsky (1974) and largely followed today (USFWS 2013). Nests were classified as occupied if any of the following were observed at the nest structure: (1) an adult in an incubating position; (2) eggs; (3) nestlings or fledglings; (4) presence of an adult (sometimes sub-adults); (5) a newly constructed or refurbished stick nest in the area where territorial behavior or a raptor had been observed earlier in the breeding season; or (6) a recently repaired nest with fresh sticks (clean breaks) or fresh boughs on top, and/or droppings and/or molted feathers on its rim or underneath. Occupied nests were further classified as active if an egg or eggs were laid. Nests were classified as inactive if no eggs or chicks were present. Nests not meeting the above criteria for "Occupied" during at least two consecutive surveys were classified as "Unoccupied". A status of "unknown" was assigned to nests that could not be effectively monitored and therefore did not meet the criteria of occupied or unoccupied as described above.

RESULTS

During the spring 2019 nest surveys, six occupied bald eagle nests (nests 18, 37, 48, 53, 54, and 55), located within five separate nesting territories, were documented within the 10-mi Survey Area (Figure 1; Table 1). Of these occupied nests, four (nests 37, 53, 54, and 55) were determined to be active in 2019 (i.e., contained eggs or young; Table 1). The closest nest to the Project boundary, Nest 53 ("Peavine Island" territory) is located approximately 2.5 mi (4.0 km) northeast of the Project along the Columbia River (Figure 1). This nest contained two nestlings estimated to be three weeks old on the May 16 survey (Photo 1). Nest 48, located in a nearby tree in the same nesting territory, is a likely alternate nest to Nest 53 (Figure 1; Table 1). Nest 37 ("Port of Pasco" territory) and Nest 55 ("Sand Station" territory) are also located along the Columbia River, approximately 6.0 mi (9.7 km) north of the Project and 8.0 mi (12.9 km) south of the Project, respectively (Figure 1). Nest 37 contained two nestlings estimated to be 3-4 weeks old and Nest 55 contained an incubating adult and two eggs (Table 1; Photos 2 and 3). The fourth active bald eagle nest (Nest 54) was located in the McNary National Wildlife Refuge (NWR) along the Walla Walla River, approximately 6.3 mi (10.1 km) east of the Project ("McNary NWR" territory; Figure 1). Two adult eagles and two nestlings, estimated to be three

week old, were observed at the nest during the May survey (Table 1; Photo 4). Nest 18 is a historical bald eagle nest located about 10.0 mi north of the Project near the confluence of the Yakima and Columbia rivers (Yakima River Mouth territory; Figure 1; Photo 5). This nest was found to contain greenery (i.e., fresh boughs) and an adult eagle was flushed from the nest in May; however, no evidence of eggs or young were observed during either survey and the nest was, therefore, recorded as occupied but inactive (Table 1). No occupied golden eagle nests were documented during the survey; however, an unoccupied stick nest (Nest 36) located on a cliff above the Columbia River, approximately 2.8 mi (4.5 km) southeast of the Project, was recorded during the May survey (Figure 1; Table 1; Photo 6). While this nest was unoccupied and observed to be in poor to fair condition, it does share characteristics typical of golden eagle nests and should be monitored during any future aerial survey efforts in the region.

Within the 2-mi Survey Area, a total of 13 raptor or common raven nests were documented during surveys (Figure 1; Table 1). Of these, 11 nests were determined to be occupied/active as of the second survey in May including five red-tailed hawk nests, two Swainson's hawk nests, two common raven nests, and one ferruginous hawk nest. Only three of the 13 identified nests (two common raven nests and one Swainson's hawk nest) were located within the proposed Project boundary (Figure 1). The single ferruginous hawk nest (Nest 03) identified during surveys was located in a tree about 13 of the Project boundary (Figure 1; Photo 7). During the May survey, an adult was observed in incubating position on this nest (Table 1; Photo 7).

In Washington, the bald eagle is considered a federal species of concern (USFWS 2008, WDFW 2019) and the golden eagle is a state candidate for listing (WDFW 2013, 2019). Both bald and golden eagles are protected by the federal Bald and Golden Eagle Protection Act (BGEPA; 1940) and Migratory Bird Treaty Act (MBTA; 1918). The ferruginous hawk is considered a federal species of concern (USFWS 2008) but is also listed as state threatened due to population declines (WDFW 2013, 2019). Ferruginous hawk, red-tailed hawk, Swainson's hawk, and common raven are species protected under the MBTA.

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Figure 1. Raptor nest locations documented during aerial surveys for the Four Mile Wind Project, March 7 and May 16, 2019.

Table 1. Results of 2019 raptor nest surveys conducted on March 7 and May 16 for the Four Mile Wind Project, Benton County, Washington.

Nest ID	Species	2019 Nest Status ¹	Substrate	Comments
03	Ferruginous hawk	Occupied/Active	Deciduous tree	Adult incubating in May
18	Bald eagle	Occupied/Inactive	Deciduous tree	"Yakima River Mouth" territory. Greenery present in nest; adult flushed from nest in May, no eggs or young present
31	Swainson's hawk	Occupied/Active	Deciduous tree	Adult incubating on nest, near old farmhouse
36	Unknown Raptor	Unoccupied	Cliff	"Port Kelley" territory. Poor-fair condition, small to medium-sized nest, abundant whitewash; characteristic of golden eagle nest
37	Bald eagle	Occupied/Active	Deciduous tree	"Port of Pasco" territory. Two adults present, 2 nestlings approximately 3-4 weeks old
43	Swainson's hawk	Occupied/Active	Deciduous tree	Two nests side-by-side; Swainson's hawk adult incubating next to nest with four common raven nestlings
44	Common raven	Occupied/Active	Deciduous tree	Adult in nest with 4 nestlings
45	Red-tailed hawk	Occupied/Active	Deciduous tree	Adult nearby, 2 nestlings in nest about 1 week old
46	Common raven	Occupied/Active	Deciduous tree	One nestling in nest; cluster of three nests in single tree
47	Unknown raptor	Unoccupied	Deciduous tree	Small nest in poor condition, adjacent to cropland
48	Bald eagle	Occupied/Inactive	Deciduous tree	"Peavine Island" territory. Alternate nest to Nest 53 which was Occupied/Active in 2019, nest in good condition
49	Unknown raptor	Unoccupied	Deciduous tree	Large nest in good condition, located in 13
50	Red-tailed hawk	Occupied/Active	Deciduous tree	Adult incubating; 2 nests at location; 2nd nest good condition
51	Red-tailed hawk	Occupied/Active	Deciduous tree	Adult brooding; at least 1 nestling observed, approximately 1-2 weeks old
52	Red-tailed hawk	Occupied/Active	Deciduous tree	One nestling in nest
53	Bald eagle	Occupied/Active	Deciduous tree	"Peavine Island" territory. Alternate to Nest 48; 2 adults present, 2 nestlings approximately 3 weeks old.
54	Bald eagle	Occupied/Active	Deciduous tree	"McNary NWR" territory. Two adults present; 2 nestlings approximately 3 weeks old
55	Bald eagle	Occupied/Active	Deciduous tree	"Sand Station" Territory. Two adults present, 2 eggs during second survey. Potential re-nesting attempt
56	Red-tailed hawk	Occupied/Active	Deciduous tree	Adult brooding; 1 chick approximately 1 week old in nest
57	Red-tailed hawk	Occupied/Unknown	Deciduous tree	Did not locate nest during second survey. Tree with heavy leaf-out; no adults in area

¹Highest level of reproductive status determined for the current breeding season: **Occupied** = contained eggs, young, or an incubating eagle, or had a pair of eagles on or near it, or had been recently repaired or decorated. **Active** = an occupied nest in which eggs were laid, as evidenced by the presence of an incubating bird, eggs, young, or any other indication that eggs had been laid in the current year. **Inactive** = no eggs or chicks present. **Unoccupied** = no sign of nesting or territory occupancy in the current nesting season, based on at least two visits. **Unknown** = nest was not located or status as occupied/unoccupied could not be confirmed as defined herein.



Photo 1. Two bald eagle chicks in Nest 53 (“Peavine Island” territory) located along the Columbia River near the mouth of the Snake River. Photo taken May 16, 2019.



Photo 2. Two bald eagle chicks in Nest 37 (“Port of Pasco” territory) located along the Columbia River. Photo taken May 16, 2019.



Photo 3. Adult bald eagle and two eggs in Nest 55 (“Sand Station” territory) located along the Columbia River. Photo taken May 16, 2019.



Photo 4. Two bald eagle chicks in Nest 54 (McNary NWR” territory) located in the McNary Wildlife Refuge along the Walla Walla River. Photo taken May 16, 2019.



Photo 5. Nest 18 (“Yakima River Mouth” territory): Occupied/inactive bald eagle nest located near the confluence of the Yakima and Columbia rivers. Photo taken March 7, 2019.



Photo 6. Nest 36: Unoccupied/inactive raptor nest located along Columbia River. Photo taken May 16, 2019.

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Photo 7. Adult ferruginous hawk in incubating position on Nest 03. Photo taken May 16, 2019.

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ENVIRONMENTAL & STATISTICAL CONSULTANTS

2725 NW Walnut Boulevard, Corvallis, Oregon 97330
Phone: 307-214-2799 • www.west-inc.com • Fax: 307-637-6981

TECHNICAL MEMORANDUM

DATE: July 12, 2019

TO: Jeffrey Wagner and Micah Engum, wpd Wind Projects Inc.

FROM: Andrea Chatfield, Troy Rintz, and Erik Jansen, WEST, Inc.

RE: Results of the 2019 Raptor Nest Survey for the Badger Canyon Wind Project, Benton County, Washington.

INTRODUCTION

Badger Canyon MW LLC (Badger Canyon) is proposing to develop the Badger Canyon Wind Project (Project) in Benton County, Washington. Badger Canyon contracted Western EcoSystems Technology, Inc. (WEST) to conduct aerial raptor nest surveys within the proposed Project and surrounding area, as recommended by the US Fish and Wildlife Service (USFWS; 2012, 2013) and the Washington Department of Fish and Wildlife (WDFW; 2009). Surveys for nests of all raptor species were conducted within a 2-mile (mi; 3.2-kilometer [km]) buffer of the Project, while surveys specifically for bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) nests were conducted within a 10-mi (16-km) buffer of the Project (Survey Area). The initial aerial survey was conducted in early March, 2019, with a follow-up aerial survey completed in mid-May, 2019. This memorandum summarizes the characteristics of the Survey Area, survey methodology, and results of the 2019 aerial raptor nest surveys at the Project.

PROJECT AND SURVEY AREA

WEST developed the raptor nest Survey Area by buffering the proposed Project boundary by 2 mi and 10 mi in a Geographic Information System (GIS). The Survey Area consisted of the Project and surrounding buffers, which included portions of Benton and Franklin counties, Washington and Umatilla County, Oregon (Figure 1). The Project is located within the Horse Heaven Hills which is an anticline ridge of the Yakima Folds within the larger Columbia Plateau Ecoregion (Clarke and Bryce 1997). Topography within the Project is composed primarily of rolling to incised hills with a broad northeast-facing rampart along the northern perimeter of the Project boundary (Figure 1). The highly-eroded drainages along the rampart expose basalt cliffs and ledges that are suitable for nesting raptors. Isolated trees and small tree stands found along drainage bottoms also provide nesting habitat. On the southern side of the rampart, the landscape transitions to relatively rolling topography with shallow, meandering canyons that drain south into the Columbia River. The Yakima River runs through the northern portion of the

Survey Area and small segments of the Columbia River are located along the northeastern and southern edge of the Survey Area. These river corridors contain areas with trees and cliffs suitable for nesting raptors.

Land cover within the Survey Area is a mosaic of dryland and irrigated agriculture, shrub-steppe grasslands, and rural/urban development (Figure 1). Agricultural cropland is the dominate land cover throughout the Project and Survey Areas. Shrub-steppe grasslands are found in topographically steep areas where agriculture is not possible. About a fifth of the Survey Area contains rural/urban development including portions of the tri-cities metro area (Richmond and Kennewick), Benton City and unincorporated rural areas. Much of the Survey Area is privately owned and actively managed for agriculture and livestock grazing. A few, scattered trees, primarily associated with farms, residences, or parks and preserves along the Columbia and Yakima Rivers, are scattered throughout the Survey Area. The 96-megawatt Nine Canyon wind energy facility is located approximately nine mi (14.5 km) east of the proposed Project.

METHODS

Prior to conducting the nest surveys, WEST reviewed eagle nest information available from the WDFW (Hayes 2013, Kalasz and Buchanan 2016), as well raptor nest data collected by WEST during previous survey efforts in the region. Pre-flight planning included a review of topographic maps and aerial imagery, and the creation of field maps and GIS files for conducting the surveys. The 2019 aerial surveys were conducted by two qualified WEST biologists from a Bell Jet Ranger helicopter with bubble windows that provided excellent visibility (Pagel et al. 2010, USFWS 2013). The first aerial survey was conducted on March 7, and a follow-up aerial survey was conducted on May 16.

The initial survey in March was conducted during a time period that overlapped the primary early nesting period of bald and golden eagles in Washington, when breeding pairs are exhibiting courtship, nest-building, and/or incubation behaviors. This initial survey utilized an intuitive controlled survey method that focused on identifying and searching specific habitat features within the Survey Area that held the highest potential to support the target species. Within the 2-mi buffer, efforts focused on habitat features typically used by raptors that use large, conspicuous stick nests (e.g., eagles, red-tailed hawk [*Buteo jamaicensis*], Swainson hawk [*B. Swainsoni*], ferruginous hawk [*B. regalis*], and great horned owl [*Bubo virginianus*]). In addition to raptor nests, nests of common ravens (*Corvus corax*) were also documented as raptors and ravens are known to use similar-sized nests. Search efforts beyond the 2-mi buffer out to 10 mi focused on eagle nests specifically. Key habitat features within the Survey Area included cliffs, rock outcrops, incised drainages and canyons, powerline structures, and large/dominant trees.

The second aerial survey, conducted in mid-May, was performed at a time when eagles and other raptors are actively engaged in mid- to late-breeding season reproductive activities (e.g., incubating, brooding, feeding nestlings), and when raptors engaged in ongoing nesting activities would be reliably on or around nests. The second survey was conducted as described above for areas within the 2-mi buffer (i.e., an intuitive controlled search of key habitat features throughout

the area), while surveys beyond the 2-mi buffer primarily focused on confirming the status of previously documented eagle nests. However, some additional effort was spent searching for eagle nests in a few specific areas identified during the initial survey as being most suitable for supporting eagle nests (e.g., cliffs, large trees, and river corridors).

During each aerial survey, the helicopter was positioned to allow thorough visual inspection of all appropriate habitat features. In some cases, multiple passes were required to thoroughly cover nesting habitat. In general, the helicopter remained within a zone 100 feet (ft; 31 meters [m]) to 500 ft (152 m) above ground level and moved at a relative air speed of approximately 50 mi per hour (80.5 km per hour), with the helicopter maintaining a distance of at least 65 ft (20 m) from cliff faces and nests (Pagel et al. 2010). When nests were located, the helicopter reduced speed and adjusted flight to allow for a clear view of the nest for documentation and photographing. For each nest found, a Global Positioning System location was recorded and nest attribute data were collected, including species (if known), nest type, size, substrate, and condition, along with any comments useful in determining the nest status.

Nesting status for the 2019 nesting season was categorized using definitions originally proposed by Postupalsky (1974) and largely followed today (USFWS 2013). Nests were classified as occupied if any of the following were observed at the nest structure: (1) an adult in an incubating position; (2) eggs; (3) nestlings or fledglings; (4) presence of an adult (sometimes sub-adults); (5) a newly constructed or refurbished stick nest in the area where territorial behavior or a raptor had been observed earlier in the breeding season; or (6) a recently repaired nest with fresh sticks (clean breaks) or fresh boughs on top, and/or droppings and/or molted feathers on its rim or underneath. Occupied nests were further classified as active if an egg or eggs were laid. Nests were classified as inactive if no eggs or chicks were present. Nests not meeting the above criteria for "Occupied" during at least two consecutive surveys were classified as "Unoccupied".

RESULTS

During the spring 2019 nest surveys, two occupied bald eagle nests (nests 58 and 18) were documented within the 10-mi Survey Area (Figure 1; Table 1). Of these two occupied nests, only Nest 58 had evidence of active nesting. Nest 58 ("Prosser" territory), located along the Yakima River approximately 7.4 mi (11.9 km) west of the Project (Figure 1), contained an adult bald eagle and 2-3 chicks estimated to be about four weeks old during the second survey in May (Table 1; Photo 1). Nest 18 ("Yakima River Mouth" territory) is a historical bald eagle nest located about 8.2 mi (13.2 km) northeast of the Project near the confluence of the Yakima River and Columbia River (Figure 1). Greenery (i.e., fresh boughs) was observed in this nest during both the March and May surveys, and an adult eagle was flushed from the nest in May; however, no evidence of eggs or young were observed during either survey. Nest 18 was, therefore, recorded as occupied but inactive (Table 1; Photo 2). No golden eagle nests or nests characteristic of golden eagle nests were documented during the surveys.

Within the 2-mi Survey Area, a total of 19 raptor or common raven nests were documented (Figure 1; Table 1). Of these, 13 nests were determined to be occupied as of the second survey

in May including five Swainson's hawk nests, three red-tailed hawk nests, three common raven nests, and two great horned owl nests (Figure 1; Table 1). Four of the 13 occupied nests (three Swainson's hawk nests and one great horned owl nest) were located within the proposed Project boundary (Figure 1). The majority of occupied nests were in trees, with one nest located on a cliff face and one along a transmission line (both common raven nests; Table 1). Six of the raptor/raven nests identified during surveys were determined to be unoccupied. This included five nests that were located on the ground and characteristic of ferruginous hawk nests; however, each of these five nests was observed to be in poor condition with no sign of occupancy (Figure 1; Table 1).

The bald eagle is considered a federal species of concern (USFWS 2008, WDFW 2019) and is protected under both the Migratory Bird Treaty Act (MBTA; 1918) and the Bald and Golden Eagle Protection Act (BGEPA; 1940). The ferruginous hawk is considered a federal species of concern (USFWS 2008) but is also listed as state threatened due to population declines (WDFW 2013, 2019). Ferruginous hawk, red-tailed hawk, Swainson's hawk, great horned owl, and common raven are species protected under the MBTA.

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Figure 1. Raptor nest locations documented during aerial surveys for the Badger Canyon Wind Project, March 7 and May 16, 2019.

Table 1. Results of 2019 raptor nest surveys conducted on March 7 and May 16 for the Badger Canyon Wind Project, Benton County, Washington.

Nest ID	Species	2019 Nest Status ¹	Substrate	Comments
02	Swainson's hawk	Occupied/Active	Deciduous tree	Adult incubating on nest by roadside
07	Great horned owl	Occupied/Active	Deciduous tree	Adult sitting on nest
08	Unknown raptor	Unoccupied	Ground	Poor condition; characteristic of ferruginous hawk nest
09	Red-tailed hawk	Occupied/Active	Deciduous tree	Adult present, 2 chicks approximately 4 weeks old
10	Unknown raptor	Unoccupied	Ground	Poor condition; characteristic of ferruginous hawk nest
11	Unknown raptor	Unoccupied	Ground	Poor condition; characteristic of ferruginous hawk nest
16	Unknown raptor	Unoccupied	Ground	Poor condition; characteristic of ferruginous hawk nest
18	Bald eagle	Occupied/Inactive	Deciduous tree	"Yakima River Mouth" territory. Greenery present in nest; adult flushed from nest in May, no eggs or young present
19	Common raven	Occupied/Active	Deciduous tree	Adult incubating in nest
28	Swainson's hawk	Occupied/Active	Deciduous tree	Adult incubating; flushed, 4 eggs, nest in low shrubbery
30	Unknown raptor	Unoccupied	Ground	Poor condition; characteristic of ferruginous hawk nest
32	Swainson's hawk	Occupied/Active	Conifer tree	Adult incubating on nest; next to commercial building
33	Common raven	Occupied/Active	Cliff	Two adults present, 4 chicks approximately 1-2 weeks old
34	Unknown raptor	Unoccupied	Cliff	Large nest, good condition
35	Swainson's hawk	Occupied/Active	Conifer tree	Adult in incubating posture; nest adjacent to house/road
38	Common raven	Occupied/Active	Transmission line	Adult present, 2 chicks in nest
39	Red-tailed hawk	Occupied/Active	Deciduous tree	Adult brooding 1 chick approximately 2 weeks old
40	Red-tailed hawk	Occupied/Active	Deciduous tree	Two adults present; one on nest incubating/tending
41	Great horned owl	Occupied/Active	Deciduous tree	One juvenile flushed from the nest; no adults present
42	Swainson's hawk	Occupied/Active	Deciduous tree	Adult incubating, one adult perched on adjacent power pole
58	Bald eagle	Occupied/Active	Deciduous tree	"Prosser" territory; one adult and 2-3 chicks approximately 4 weeks old at nest

¹Highest level of reproductive status determined for the current breeding season: **Occupied** = contained eggs, young, or an incubating eagle, or had a pair of eagles on or near it, or had been recently repaired or decorated. **Active** = an occupied nest in which eggs were laid, as evidenced by the presence of an incubating bird, eggs, young, or any other indication that eggs had been laid in the current year. **Inactive** = no eggs or chicks present. **Unoccupied** = no sign of nesting or territory occupancy in the current nesting season, based on at least two visits.



Photo 1. Bald eagle chicks in Nest 58 (“Prosser” nesting territory) along the Yakima River. Photo taken May 16, 2019.



Photo 2. Occupied/inactive bald eagle nest (Nest 18; “Yakima River Mouth” nesting territory) near the confluence of the Yakima and Columbia rivers. Photo taken March 7, 2019.

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Large Bird Avian Use Report for the Horse Heaven Wind Farm (East) Benton County, Washington

**October 2019 – September 2020
Final Report**



Prepared for:

Horse Heaven Wind Farm, LLC
5775 Flatiron Parkway, Suite 120
Boulder, CO 80301

Prepared by:

Erik W. Jansen

Western EcoSystems Technology, Inc.
2725 NW Walnut Blvd.
Corvallis, Oregon 97330

January 2021



EXECUTIVE SUMMARY

The Horse Heaven Wind Farm, LLC is developing the proposed eastern portion of their wind energy project (Horse Heaven [East] and/or Project) in Benton County, Washington. Western EcoSystems Technology, Inc. (WEST) was contracted to conduct an avian use study to evaluate the potential impacts of the proposed Project on large-sized birds. Survey methods were consistent with protocols used during other past avian studies conducted in the Horse Heaven Hills which were designed to comply with recommendations described by the Washington Department of Fish and Wildlife (WDFW) Wind Power Guidelines (WDFW 2009), Tier 3 of the US Fish and Wildlife Service (USFWS) Land-Based Wind Energy Guidelines (USFWS 2012), Stage 2 of the Eagle Conservation Plan Guidance (USFWS 2013) and associated Final Eagle Rule (USFWS 2016).

The principal objective of the study was to provide site-specific species occurrence and the spatial and temporal patterns of avian use with a particular focus on eagles, other raptors, and non-raptors such as American white pelican or species of regulatory or management concern (i.e., federal or state-sensitive species). This report summarizes the methodology and results of the year-long avian use survey.

The Project is located in the Columbia Plateau Ecoregion located within the Horse Heaven Hills which is an anticline ridge of the Yakima Folds within 4 miles of Kennewick and the larger tri-cities urban area. Fixed-point bird surveys estimated the seasonal, spatial, and temporal use patterns of birds within the Project. All large birds were recorded within an 800-meter radius plot at the same eight fixed-point count stations and protocols used by Chatfield et al. (2019a). Surveys for large birds were conducted for 60-minutes at each point once per month (i.e., one visit) for 12 months.

Twelve visits of large-bird use surveys for a total of 96 surveys were conducted at the Project from October 23, 2019–September 20, 2020. A total of 18 unique bird species and one unidentified accipiter were observed during the survey year. Overall large bird mean use ranged from 2.13 observations/plot/survey to 152.63 observations/plot/survey among seasons and was:

- highest during winter (152.63 observations/plot/survey),
- followed by fall (22.38 observations/plot/survey), and
- then spring (3.33 observations/plot/survey), and summer (2.13 observations/plot/survey).

Three species of federal- or state-protected status were recorded during avian use surveys within the Project area. Of the three species, one state-threatened species, the American white pelican was observed during the study. Observations of five bald eagles and one golden eagle were recorded during the study, both of which are listed under the Bald and Golden Eagle Protection Act of 1940 and golden eagles are also considered a state species of concern.

Bald eagles were observed during fall, winter, and spring with equal mean use in winter and spring (0.08 observations/plot/survey). The bald eagle observed in fall was outside the survey pot and

not used in mean use calculations. The single golden eagle observed during fall had a mean use of 0.04 observations/plot/survey. Collectively, eagles were observed for a total of 30 minutes during the Year 2 study. Of the 47 minutes, 21 minutes were attributed to bald eagles, of which eight minutes were flying within the 800 m plot below 200 m above ground level (eagle exposure minutes). The remaining 26 minutes were from a golden eagles of which 15 minutes were considered exposure minutes.

The bird species observed in the Project during the study were typical to those commonly found in agricultural, shrub-steppe and grasslands within the Columbia Plateau. Overall large bird use was significantly higher during winter due to the Project's location in the Pacific Flyway and high number of snow geese that were observed flying over the Project. Although land cover within the Project does not provide relatively unique nesting or foraging habitat for high concentrations of large birds compared to the surrounding landscape; the Projects location within the Pacific Flyway and proximity to the Columbia River will result in continued use of the area by large birds. Relatively more observations of waterfowl and waterbirds were recorded at survey points closer to the Columbia River than further away. Seasonal and spatial differences in bird species composition, flight behavior, and use occur at the Project and potential impacts to birds from turbine collision of other impacts such as displacement will likely reflect these patterns.

STUDY PARTICIPANTS

Erik Jansen	Project Manager, GIS
Diem Pham	Statistician
Pallavi Sirajuddin	Data Analyst
Ashleigh Boyd	Data Coordinator
Joshua Parrott	Field Biologist

REPORT REFERENCE

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INTRODUCTION

The Horse Heaven Wind Farm, LLC is proposing the development of the Eastern portion of their project (Horse Heaven [East] and/or Project) in Benton County, Washington (Figure 1). Western EcoSystems Technology, Inc. (WEST) was contracted to conduct a one-year avian use study at the Project to evaluate the potential impacts of Project wind turbine generator construction and operation on birds. Additionally, observations of rare and species of concern¹ were documented incidental to protocol avian use surveys. The avian use study was designed to comply with recommendations described by the Washington Department of Fish and Wildlife (WDFW) *Wind Power Guidelines* (WPG; WDFW 2009), the US Fish and Wildlife Service's (USFWS) 2012 *Final Land-Based Wind Energy Guidelines* (WEG), Appendix C(1)(a) of the 2013 USFWS *Eagle Conservation Plan Guidelines* (ECPG), and the USFWS *Revisions to Regulations for Eagle Incidental Take and Take of Eagle Nests* (Final Eagle Rule; 81 FR 91494). In order to comply with the two-year survey criteria as specified in the Final Rule, this avian use study was conducted in the same geographic area at a subset of survey points sampled by Chatfield et al. (2019a; Figure 1). This study was conducted October 23, 2019 through September 20, 2020.

The principal objective of the study was to provide site-specific species occurrence and the spatial and temporal patterns of avian use with a particular focus on eagles, other raptors, and non-raptors such as American white pelican (*Pelecanus erythrorhynchos*), sandhill crane (*Antigone canadensis*) or other species of regulatory or management concern (i.e., federal or state-sensitive species). This report summarizes the methodology and results of the year-long avian use survey.

PROJECT AREA

The Study Area encompasses 5,480 hectares (13,542 acres) of privately owned land within Benton County in southeastern Washington, approximately 6.4 kilometers (km; 4.0 miles [mi]) south of the city of Kennewick (Figure 1). Topography within the Study Area generally consists of rolling hills bisected by meandering canyons that drain primarily to the south and east into the Columbia River. Elevations range from approximately 192 meters (m; 630 feet [ft]) along the northeastern boundary of the Study Area to 613 m (2,010 ft) in the northwest. The 96-megawatt (MW) Nine Canyon Wind Project (Nine Canyon) is located immediately to the north of the Study Area and the 300-MW Stateline Wind Energy Facility (Stateline) is located approximately 6.4 km (4.0 mi) to the southeast (Figure 1).

¹ As defined here, "species of concern" includes any species which 1) is either a) listed as an endangered, threatened or candidate species under the Endangered Species Act, subject to the Migratory Bird Treaty Act, Bald and Golden Eagle Protection Act, or Washington State Environmental Protection Act; b) is designated by federal or state law, regulation, or other formal process for protection and/or management by the relevant agency or other authority; or c) has been shown to be significantly adversely affected by wind energy development, and 2) is determined to be possibly affected by the project (WDFW 2009, USFWS 2012).

Habitat types per WDFW (2009) classification includes croplands that consisted of tilled dry-land agriculture (primarily wheat) with smaller areas of uncultivated grassland, the majority of which is managed as part of the US Department of Agriculture Farm Service Agency's Conservation Reserve Program. There are smaller areas of remnant shrub-steppe, typically in topographically steeper areas that were unsuitable for croplands, such as drainages. Developed areas, that included individual structures, residences, and farms, were scattered throughout the area. Although the areas containing shrub-steppe are relatively small, shrub-steppe is considered an important habitat type for avian species, providing critical nesting and foraging opportunities (WDFW 2009). Trees are generally absent from the Study Area and limited to the farms and residences that are scattered throughout the Study Area.

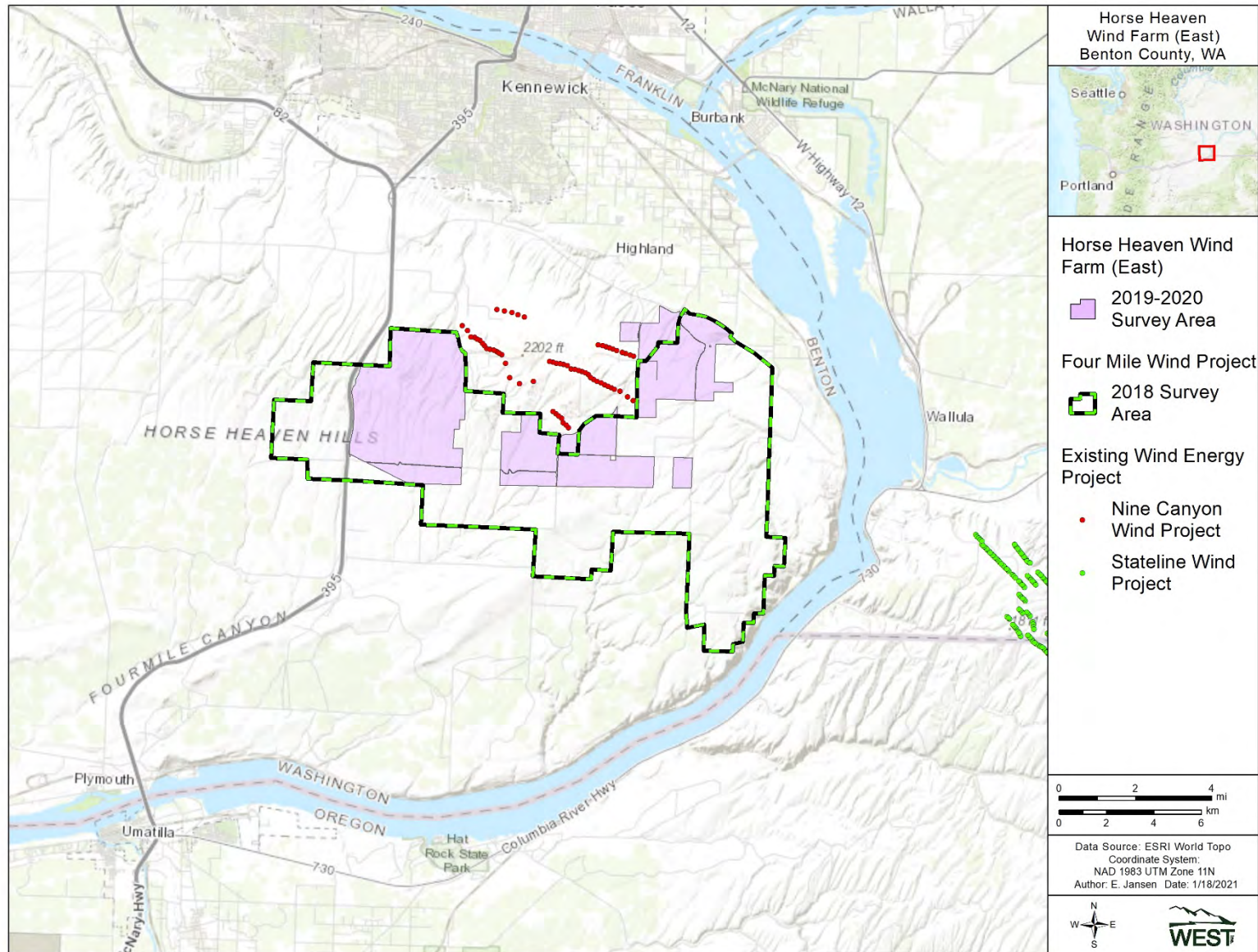


Figure 1. Location of the Horse Heaven Wind Farm (East), Benton County, Washington.

METHODS

The study consisted of the following: 1) fixed-point avian use surveys and 2) incidental wildlife observations. The study design and survey methods followed guidance in the ECPG and the Final Eagle Rule because of the need to collect information on eagles, while also following guidance from the WEG to collect information on other birds, and exceeding standards described in WDFW Wind Power Guidelines (WDFW 2009). Methods described below, therefore, are common for all birds (i.e., large birds, eagles, and other species of concern) except as noted.

Study Design

To maintain consistency between study years, fixed-point count stations were selected from a sample of established points that were surveyed during 2018–2019 (Chatfield et al. 2019a). A total of eight survey points were established within the proposed Project area to comply with Final Rule recommended survey coverage of approximately 30% of the project footprint² at the time survey points were designed. Points were surveyed over two days each month to account for varying weather conditions and the order at which points were surveyed rotated each round to achieve different times of day a point was visited. Surveys were conducted by one observer; points were not surveyed concurrently to minimize the potential for double counting individuals and are considered independent samples.

Seasons were defined as fall (August 16 to November 30), winter (December 1 to February 28), spring (March 1 to May 31), and summer (June 1 to August 15). Surveys were conducted during daylight hours and survey times at points were randomized to cover all daylight hours during a season. Surveys were conducted under all weather conditions except when visibility was less than 800 m from the observer and 200 m above ground level (agl).

Survey Methods

Large Birds

At each point, surveys were conducted for 60 minutes (min); all large birds³ observed or heard within an 800 meter radius from the surveyor were recorded. Biologists recorded the following information for each survey: date, start and end time, and weather (i.e., temperature, wind speed, wind direction, precipitation, and percent cloud cover). Additionally, the following data were recorded for each group of birds observed:

² The project footprint is the minimum-convex polygon that encompassed the wind-project area inclusive of the hazardous area around all turbines.

³ Large birds were defined as waterbirds, waterfowl, shorebirds, gulls/terns, diurnal raptors (i.e., kites, accipiters, *Buteos*, eagles, falcons, northern harrier, and osprey), owls, vultures, upland game birds, doves/pigeons, goatsuckers, and large corvids (e.g., magpies, crows, and ravens).

- Observation number
- Species (or best possible identification)
- Number of individuals
- Sex and age class (if possible)
- Distance from survey plot center to the nearest five m interval (first & closest)
- Flight height AGL to the nearest five m interval (first, lowest, and highest)
- Flight direction (first observed)
- Habitat
- Activity (e.g., flying, perched)
- Observation type (visual or aural)
- Flight paths and perch locations of eagles and other species of concern

Eagles

Data were collected if a golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), or unidentified eagle were observed during the survey period. Biologists recorded eagle behavior (i.e., flight height, distance from observer, activity) each minute, at the top of the minute, to provide an instantaneous count for every eagle observed, whether or not the eagle was flying below 200 m agl and within 800 m of the survey location at any time during the minute; and classified the eagle into age class (juvenile [1st year], immature or sub-adult [2nd to 4th year], adult [\geq 5th year]).

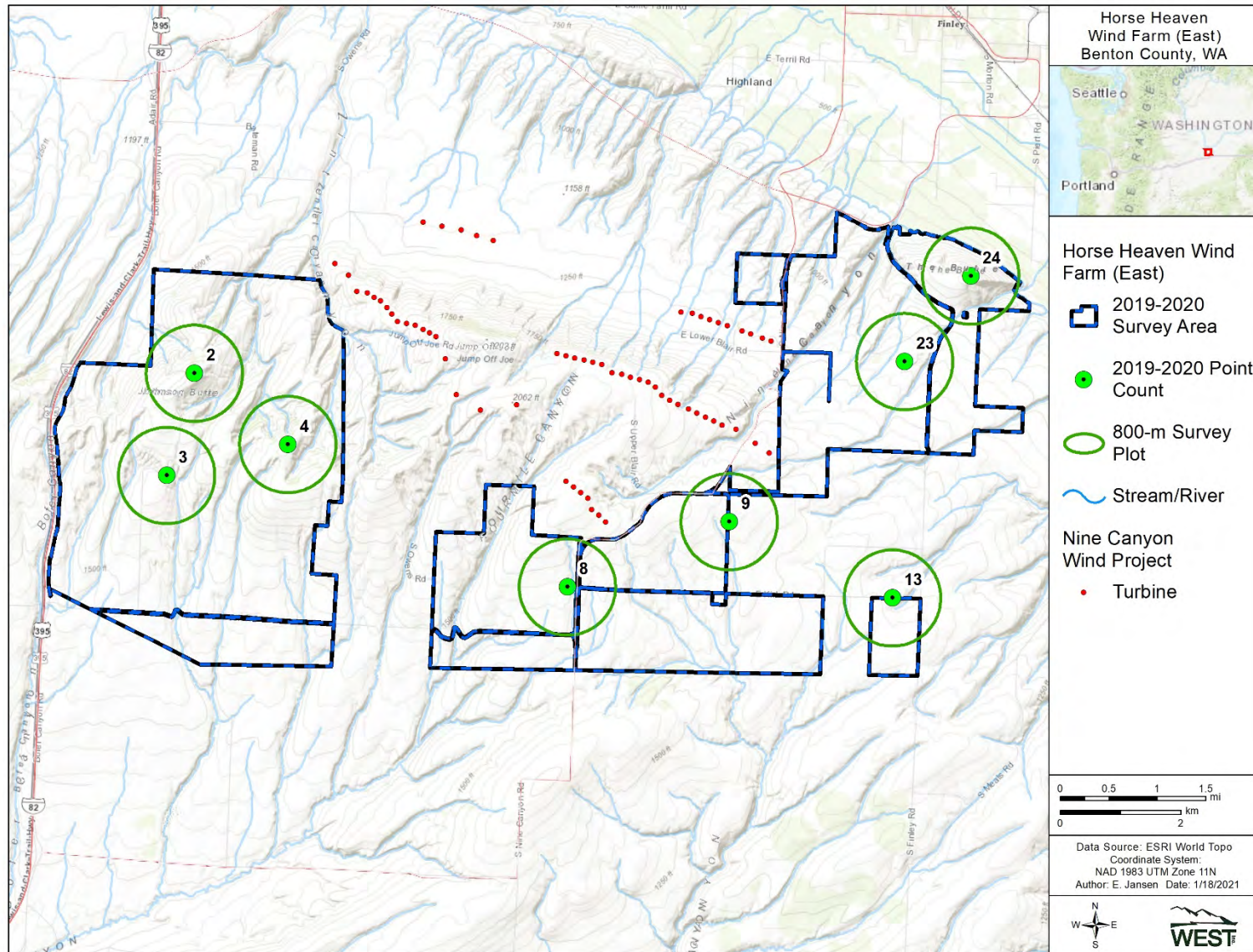


Figure 2. Avian use survey points and plots at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Data Management

Quality Assurance and Quality Control

WEST implemented industry standard quality assurance and quality control (QA/QC) measures at all stages of the study, including in the field, during data entry and analysis, and report writing. Following surveys, biologists were responsible for inspecting data forms for completeness, accuracy, and legibility. If errors or anomalies were found within the data, follow-up measures were implemented including discussions and review of field data with field technicians and/or Project Managers. WEST traced back any errors, omissions, or problems identified in later stages of analysis to the raw data forms where appropriate changes and measures were implemented, no matter what stage of analysis. Multiple reviews were conducted as QA/QC measures.

Data Compilation and Storage

A Microsoft® SQL database was specifically developed to store, organize, and retrieve survey data. Project data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and data analysis. WEST retained all data forms and electronic data files for reference.

Statistical Analysis

A *visit* was defined as surveying all of the survey plots once within the Project area and could occur across multiple dates but had to be completed in a single season (e.g., spring). If extreme weather conditions prevented all plots from being surveyed during a visit, then a visit might not have constituted a complete survey of all plots. A *survey* was defined as a single 60 min count of birds. In some cases, a count of bird observations may represent repeated observations of the same individual. Only observations within the 800 m survey plot were included for data analysis.

Mean Use, Percent of Use, and Frequency of Occurrence

Mean use is the average number of birds observed per plot per survey for large birds. Large bird use (per 800 m plot per 60 min survey) is calculated by: 1) summing birds per plot per visit, 2) averaging number of birds over plots within a visit, and 3) averaging number of birds across visits within a season. Overall mean use was calculated as a weighted average of seasonal values by the number of days in each season. *Percent of use* was calculated as the percentage of large bird use that was attributable to a particular bird type or species. *Frequency of occurrence* was calculated as the percent of surveys in which a particular bird type or species was observed.

Mean use and frequency of occurrence describe different aspects of relative abundance, in that mean use is based on the number of birds (i.e., large groups can produce high estimates), whereas frequency of occurrence is based on the number of groups (i.e., it is not influenced by group size). Qualitative comparisons were made with these metrics among bird types, seasons, and survey points to help one understand how birds are using the Project area over time and space.

Flight Height and Behavior

Bird flight heights are important metrics to assess relative potential exposure to turbine blades and were used to calculate the percentage of large birds and eagles observed flying within the rotor-swept height (RSH) of proposed turbines. A RSH of 10 to 155 m (82 to 492 ft) agl was assumed for the purpose of the analysis. Flight height recorded during the initial observation was used to calculate the percentage of birds flying within the RSH and mean flight height.

The bird exposure index is used as a relative measure of species-specific risk of turbine collision and the species most likely to occur as fatalities at the wind energy facility. A relative index of bird exposure (R) was calculated for bird species observed during the surveys using the following formula:

$$R = A \times P_f \times P_t$$

Where A equals mean relative use for species i (large bird observations within 800 m of the observer) averaged across all surveys, P_f equals the proportion of all observations of species i where activity was recorded as flying (an index to the approximate percentage of time species i spends flying during the daylight period), and P_t equals the proportion of all initial flight height observations of species i within the likely RSH. The exposure index does not account for other possible collision risk factors, such as foraging or courtship behavior. The first flight height was selected because of the concern that the observer could bias the flight height of the bird. The thought was the first flight height would be the most independent measurement if bias from the observer exists.

Spatial Use

Mean use was calculated by survey point for large birds and eagles to make spatial comparisons among the survey points. Additionally, flight paths of eagles were mapped during large bird use surveys to qualitatively show flight path location compared to Project area characteristics (e.g., topographic features) to identify if there were areas of concentration or consistent flight patterns within the Project area.

Eagles

Eagle observations during surveys were summarized to provide flight heights (see *Flight Height*) and flight path maps (see *Spatial Use*). Data collected during each minute eagles were observed were examined to count eagle exposure minutes, defined as the number of minutes an eagle was observed in flight within the risk cylinder (defined as the area within 800 m of the survey point and below 200 m AGL during the 60 min survey periods) and total minutes defined as the amount of time eagles were observed inside and outside the risk cylinder, but still within 800 m of the survey point. The eagle exposure minutes per observation hour were reported by survey plot and month to enable spatial and temporal assessments of eagle exposure minutes recorded in the Project area. Data collected on perched eagles and those outside of survey plots were not considered eagle exposure minutes; however, they were considered in the total eagle minutes. The perch locations and flight paths of all eagles were mapped to qualitatively assess areas of eagle use within the Project area.

Incidental Observations

Incidental observations were wildlife observed outside of the standardized survey plots but within the Project area and were focused on federal- or state-protected species, unusually large congregations of individuals, species not yet recorded during surveys, unusual or unique birds, mammals, reptiles, amphibians, or eagle attractants (e.g., ground squirrel burrows, areas with concentration of carrion). Data recorded for incidentally observed species were similar to that recorded during scheduled surveys.

RESULTS

Fixed-Point Large Bird Use Surveys

Twelve visits of large-bird use surveys for a total of 96 surveys were conducted at the Project from October 23, 2019–September 20, 2020. Survey effort was equal among seasons (Table 1).

Eighteen species of large birds and one unidentified bird type (unidentified accipiter) were observed or heard during the study. The index to species richness was highest during summer and lowest in spring. Survey results are summarized below, supplemented by the appendices, which present species-level detail on the following: scientific names, number of groups and observations within the survey plot by season (Appendices A), avian use, percent of use, and frequency of occurrence by season (Appendices B), relative exposure index (Appendix C), and mean use by survey point (Appendix D).

Table 1. Summary of species richness (species/plot^a/60-min survey), and sample size by season and overall during the fixed-point bird use surveys at the Horse Heaven Wind Farm (East) in Benton County, WA during fixed-point bird use surveys from October 23, 2019 to September 20, 2020.

Season	# Visits	# Surveys Conducted	Species Richness	Index to Species Richness	
				Large Birds	
Summer	3	24	13	2.63	
Fall	3	24	12	2.29	
Winter	3	24	10	1.75	
Spring	3	24	8	1.04	
Overall	12	96	18	1.99	

Species Richness: The total number of unique species observed within survey plots during avian use surveys.

Index to Species Richness: Average number of species observed within the observer survey plot/plot/visit within seasons.

^a 800-meter (m) radius plot.

Species of Concern

Eagles

Mean Use

A total of five bald eagles were observed during fall, winter, and spring. One adult and one juvenile were observed in both winter and spring, with a seasonal mean use of 0.08 observations/plot/survey. The eagle observation in fall was flying beyond the 800 m survey plot

and not calculated in the mean use estimate. Overall bald eagle mean use was 0.04 observations/plot/survey. One adult golden eagle was observed during fall and had a mean use of 0.04 observations/plot/survey.

Eagle Exposure Minutes

A total of 47 eagle minutes were recorded from five bald eagles and one golden eagle during the 96 survey hours. Of the 47 eagle minutes, bald eagles were observed for 21 minutes, of which eight minutes were considered exposure minutes where the eagle was observed flying within the risk cylinder (Table 2). Bald eagles occurred during fall, winter, and spring seasons; however, winter and spring observations were within the survey plot and resulted in 0.1667 seasonal eagle exposure min/hr, respectively (Table 2). Monthly bald eagle exposure was highest during May (0.5 eagle exposure min/hr) followed by February (0.375 eagle exposure min/hr), and January (0.125 eagle exposure min/hr). The remaining 26 eagle minutes were attributed to golden eagles, of which 15 minutes were considered exposure minutes (Table 3). Averaged across all seasons, golden eagle exposure minutes per survey hour was 0.156 eagle exposure min/hr with the only golden eagle observation recorded during fall (0.625 eagle exposure min/hr; Table 3).

Eagle Flight Paths

Golden and bald eagle flight paths were mapped at the Project (Figure 3). Eagles were observed flying at an average flight height of 103 m agl when first observed which is within the 10–155 m RSH of a turbine blade. Because of the small number of individuals observed, no discernable patterns emerged from the flight path data; however, three eagles (one golden eagles and two bald eagle) were observed in the northeastern corner of the Project at Point 24. Point 24 is on top of a predominant hill called The Butte with relatively steep topography compared to the surrounding area with an elevation difference of approximately 630 m within the 800 m survey plot.

Table 2. The bald eagle minutes and observations recorded during avian use surveys in the Horse Heaven Wind Farm (East) in Benton County, WA during fixed-point bird use surveys from October 23, 2019 to September 20, 2020.

Season	Eagle Minutes		Eagle Observations		Survey Hours	Eagle Exposure Mins/Survey Hr
	Within Risk Cylinder ¹	Total ²	Within Risk Cylinder ¹	Total ²		
Fall	0	3	0	1	24	0.0000
Winter	4	8	2	2	24	0.1667
Spring	4	10	2	2	24	0.1667
Summer	0	0	0	0	24	0.0000
Total	8	21	4	5	96	0.0833³

¹ Minutes or observations inside the risk cylinder (within 800 m of observer, below 200 m agl); minutes inside risk cylinder = eagle exposure minutes.

² Total = minutes or observations inside and outside the risk cylinder, but still within 800 m of the survey point.

³ Seasonal average

Table 3. The golden eagle minutes and observations recorded during avian use surveys in the Horse Heaven Wind Farm (East) in Benton County, WA during fixed-point bird use surveys from October 23, 2019 to September 20, 2020.

Season	Eagle Minutes		Eagle Observations		Survey Hours	Eagle Exposure Mins/Survey Hr
	Within Risk Cylinder ¹	Total ²	Within Risk Cylinder ¹	Total ²		
Fall	15	26	1	1	24	0.6250
Winter	0	0	0	0	24	0.0000
Spring	0	0	0	0	24	0.0000
Summer	0	0	0	0	24	0.0000
Total	15	26	1	1	96	0.1562

¹ Minutes or observations inside the risk cylinder (within 800 m of observer, below 200 m agl); minutes inside risk cylinder = eagle exposure minutes.

² Total = minutes or observations inside and outside the risk cylinder, but still within 800 m of the survey point.

³ Seasonal average

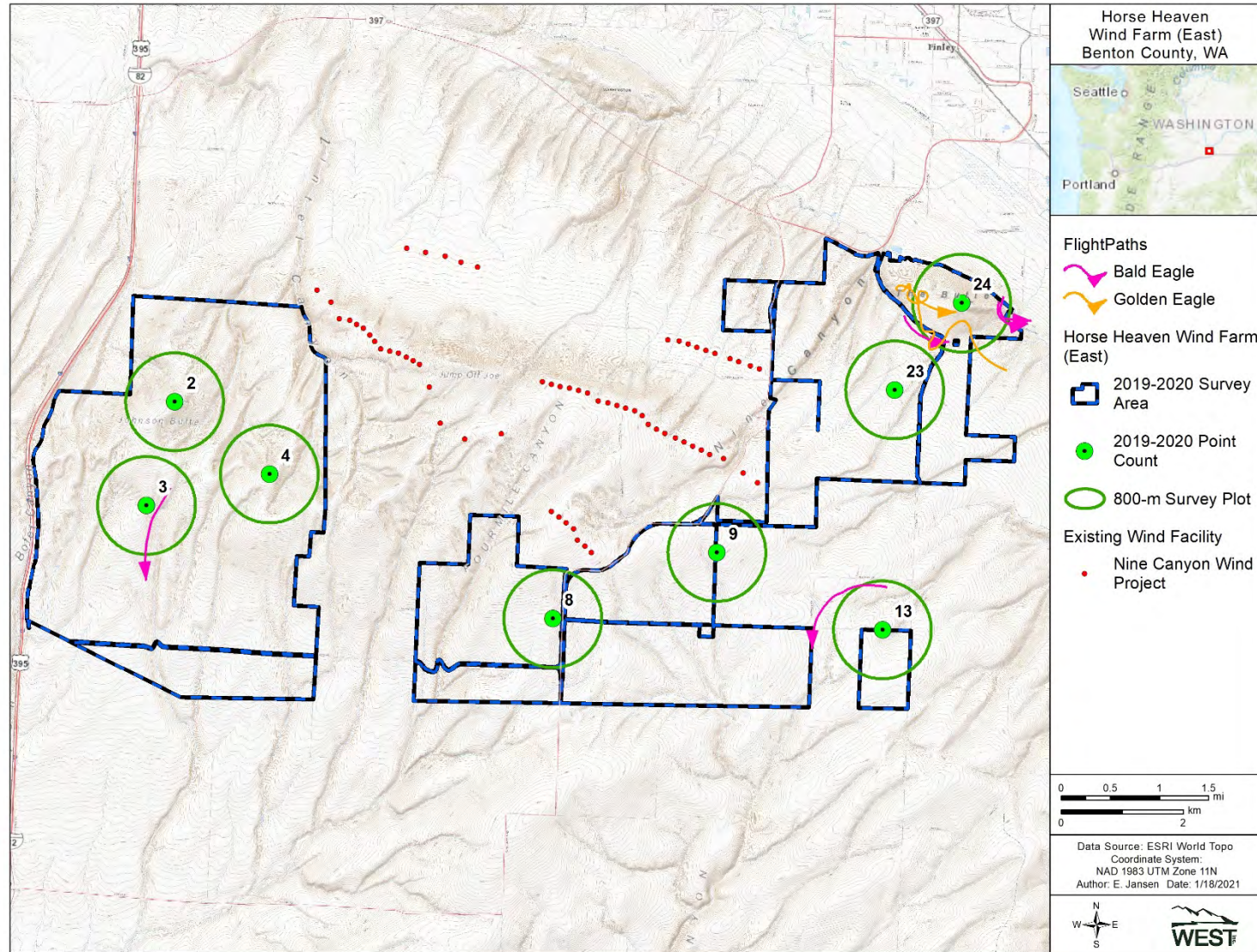


Figure 3. Bald and golden eagle flight path at the Horse Heaven Wind Farm (East) in Benton County, Washington, October 23, 2019 to September 20, 2020.

Federal- and state-protected species

Three species of federal- or state-protected status were recorded during avian use surveys within the Project area (Table 4). One state-threatened species, American white pelican, was observed during the study. Eight groups comprising 39 observations were recorded during point count surveys. American white pelican were observed at five of the eight survey points on the eastern half of the Project with the highest mean use at point 24 which is located on a prominent hill called The Butte (1.33 observations/plot/survey; Appendix D). Five bald eagles and one golden eagle were observed during the year-long study. Both species are listed under the Bald and Golden Eagle Protection Act of 1940 and golden eagle are considered a state species of concern. A permitting process is available that authorizes the incidental take of an eagle that result from but is not the purpose of an otherwise lawful activity (USFWS 2016).

Table 4. Groups and observations of federal- and state-protected species recorded during avian use surveys or as incidental wildlife observations at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Species	Scientific Name	Status	Point Count		Incidental		Total	
			# grps	# obs	# grps	# obs	# grps	# obs
golden eagle	<i>Aquila chrysaetos</i>	SC; BGEPA	1	1	0	0	1	1
bald eagle	<i>Haliaeetus leucocephalus</i>	BGEPA	5	5	0	0	5	5
American white pelican	<i>Pelecanus erythrorhynchos</i>	WA-T	8	39	0	0	8	39
Total	3 species		14	45	0	0	14	45

WA-T = State Threatened

SC = State Candidate Species

BGEPA = Bald and Golden Eagle Protection Act

Large Birds

Eighteen species of large birds were observed or heard during 96 survey hours for a total of 4,332 observations of 258 groups (Appendix A). One unidentified accipiter (observation that could not be identified to species) was recorded during surveys.

Mean Use, Percent of Use, and Frequency of Occurrence

Mean use, percent of use, and frequency of occurrence were calculated by season for large bird types (Figures 4a-c) and species (Appendix B). Large bird mean use ranged from 2.13 observations/plot/survey to 152.63 observations/plot/survey among seasons and was highest during winter (152.63 observations/plot/survey), followed by fall (22.38 observations/plot/survey), spring (3.33 observations/plot/survey), and summer (2.13 observations/plot/survey; Figure 4a). Species composition of avian use varied by season and showed distinct patterns for several groups. Waterfowl (i.e., snow goose [*Anser caerulescens*], Canada goose [*Branta canadensis*]) comprised nearly all avian use during winter (98%; 149.79 observations/plot/survey) yet none were observed during spring and summer (Appendix B). Diurnal raptors were observed during all

seasons but typically had the highest use during fall when proportionately more *Buteos* and northern harrier were observed compared to other seasons (Appendix B). Seasonally, large corvids had the highest use during fall and spring (2.88 observations/plot/survey and 1.38 observations/plot/survey, respectively). Although waterbirds comprised the majority of mean use and percent of mean use during fall and winter, species within the group were observed comparatively less frequently than diurnal raptors and large corvids that were recorded during more than half of all surveys in fall, winter, and spring (Figures 4b-c, Appendix B).

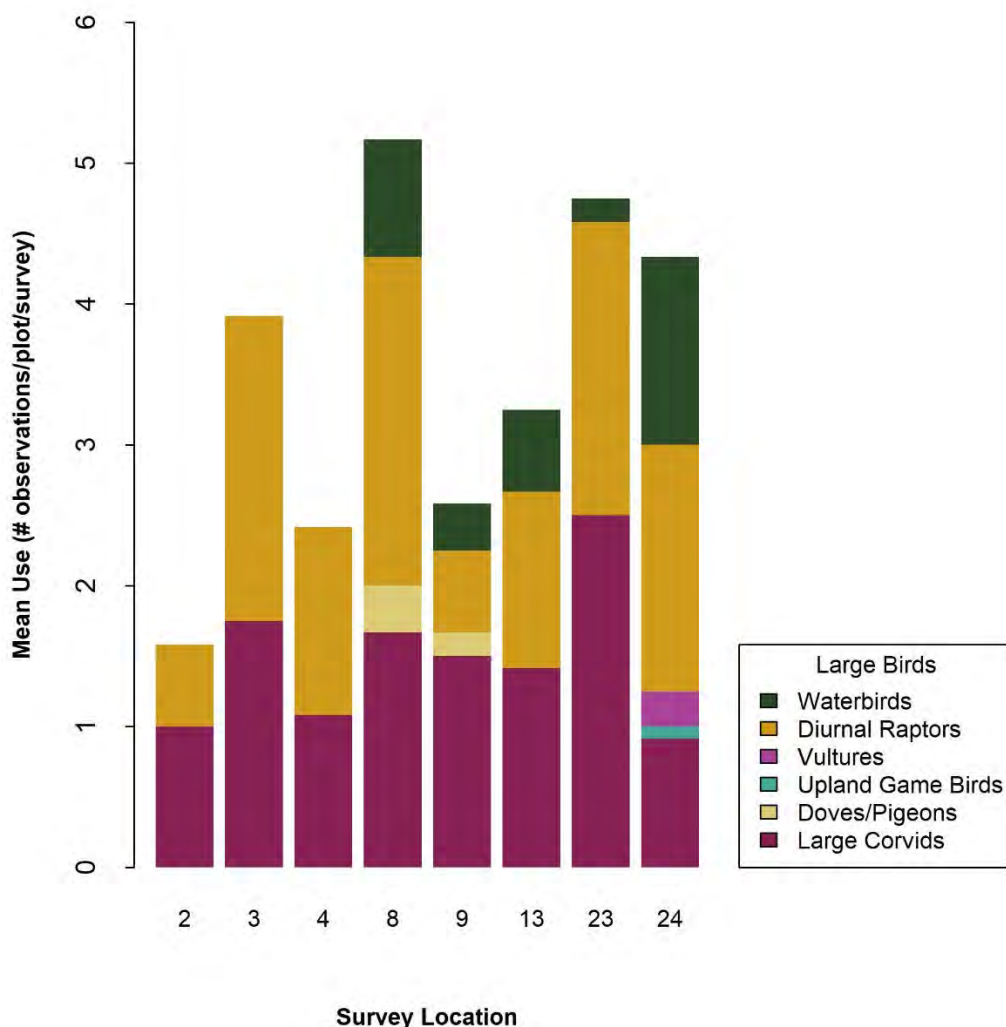


Figure 4a. Large bird mean use by season and bird type at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

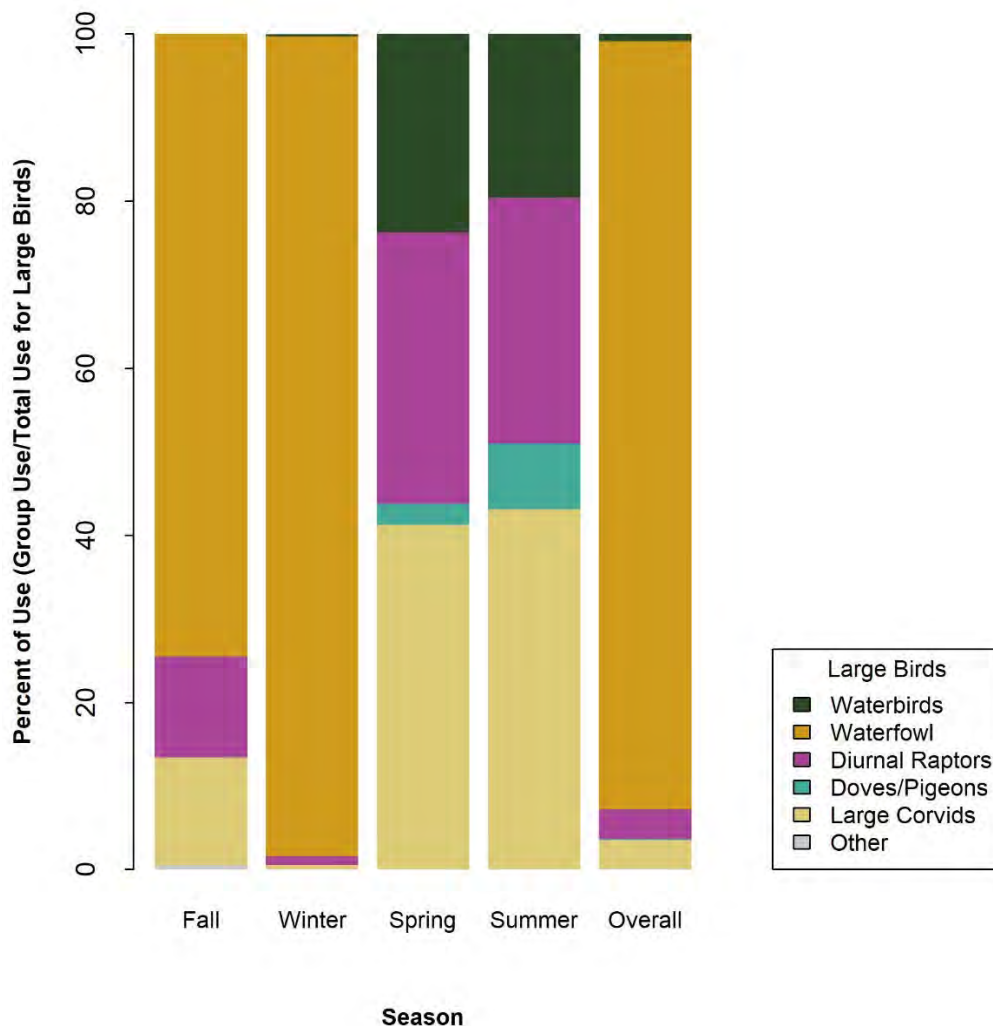


Figure 4b. Large bird percent of use by season and bird type at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

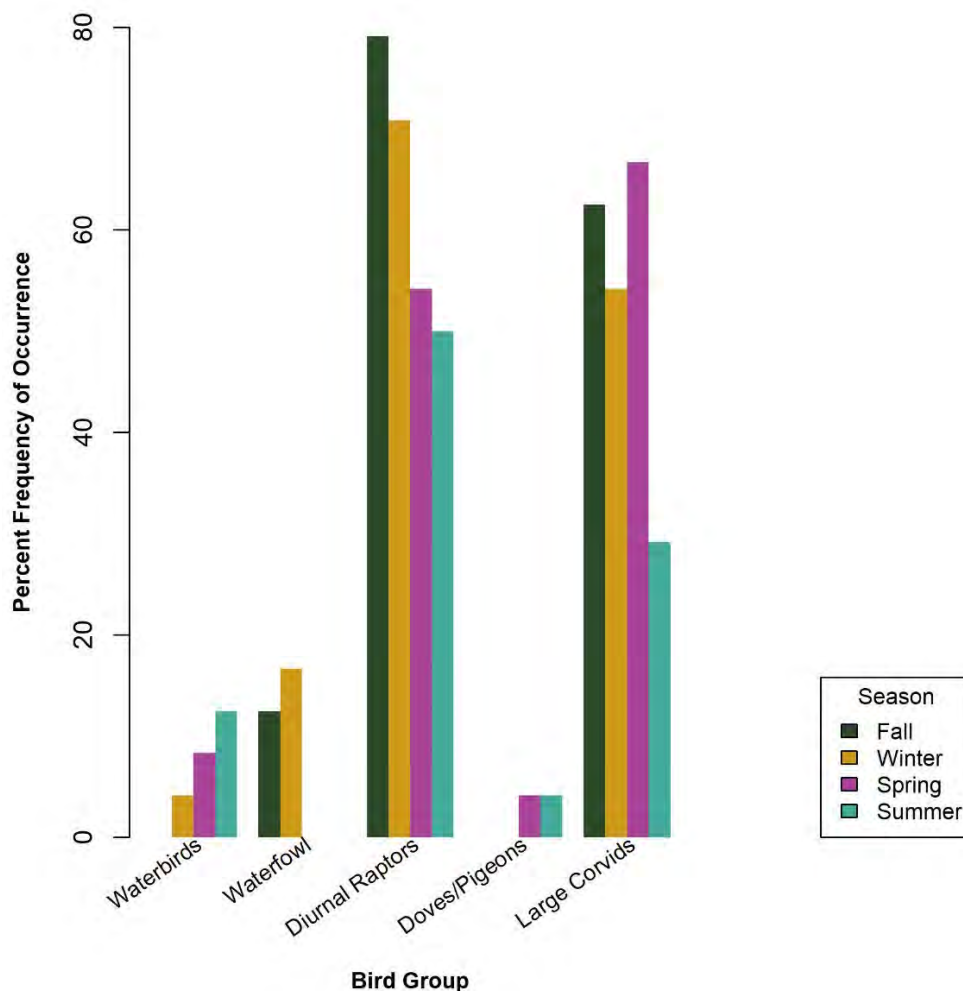


Figure 4c. Large bird frequency of occurrence by season and bird type at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Bird Flight Height

There was large variability in flight heights among species and species groups that ranged from an average of 20 m for northern harrier to 130 m for American white pelican. Waterfowl, the species type with highest mean use, flew within the RSH approximately 82% of the groups recorded and had the highest relative exposure index (33.31; Table 5; Appendix C). Overall mean use was a primary contributing factor in the exposure index as illustrated by the difference between snow goose (33.28) and the species with the second highest mean use, Canada goose (1.89). Within the diurnal raptor type, the group with the highest mean use (*Buteos*) were observed within the RSH the majority (89%) of the time followed by northern harrier, which typically flew low to the ground and within the RSH approximately 40% of the time (Table 5). For this analysis, the maximum RSH of 155 m agl was used; if a taller turbine technology were considered, the percent and species composition of birds flying with RSH would shift but likely be proportionately similar.

Four of the five eagle recorded within the 800 m survey plot were within the RSH when first observed which resulted in an average of 126 m (Table 5) but all eagles flew within the RSH during the course of the observation but had a relatively low exposure index because of low mean use (Appendix C).

Table 5. Flight height characteristics by large bird type and raptor subtype during 60-minute use surveys at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Bird Type	# Groups Flying	# Obs Flying	% Obs Flying	Mean Flight Height (m)	% within Flight height Categories		
					<10 m	10 - 155 m ^b	> 155 m
Waterbirds	8	39	100	130	0	82.1	17.9
Waterfowl	16	3,665	91.7	114	0	91.7	8.3
Diurnal Raptors	112	112	77.2	50	21.4	74.1	4.5
<u>Accipiters</u>	3	3	100	65	0	100	0
<u>Buteos</u>	56	56	71.8	65	5.4	89.3	5.4
<u>Northern Harrier</u>	32	32	100	20	59.4	40.6	0
<u>Eagles</u>	5	5	100	126	0	60.0	40.0
<u>Falcons</u>	15	15	57.7	24	13.3	86.7	0
<u>Osprey</u>	1	1	100	85	0	100	0
Vultures	3	3	100	77	0	100	0
Upland Game Birds	0	0	0	NA	NA	NA	NA
Doves/Pigeons	2	6	100	43	0	100	0
Large Corvids	73	131	92.3	33	19.8	80.2	0
Large Birds Overall	214	3,956	91.3	52	1.3	90.7	8.0

^a 800-meter (m) radius plot for large birds.

^b The likely RSH for potential collision with a turbine blade, or 10 to 155 m (33 to 508 ft) above ground level.

^c Zeroes and NA values indicate that the species was observed but was not flying.

Spatial Variation

Mean Use by Point

The spatial variation of large bird use ranged widely across the Project from a mean use of 1.58 observations/plot/survey to 319.33 observations/plot/survey across points. Mean use was highest at Point 13 in the southeastern corner of the Project and lowest at Point 2 located in the western edge of the Project (Figure 5a). High avian use at survey point 13 was influenced by large groups of waterfowl, specifically snow goose during fall and winter (Figure 5a; Appendix B). Mean use by point of the diurnal raptor type was variable throughout the Project and reflected the same spatial pattern observed in the *Buteo* sub-type. Observations of American white pelican, osprey [*Pandion haliaetus*], snow goose and Canada goose were recorded primarily at survey points (i.e., points 8–24) located in the eastern half of the Project, closer to the Columbia River.

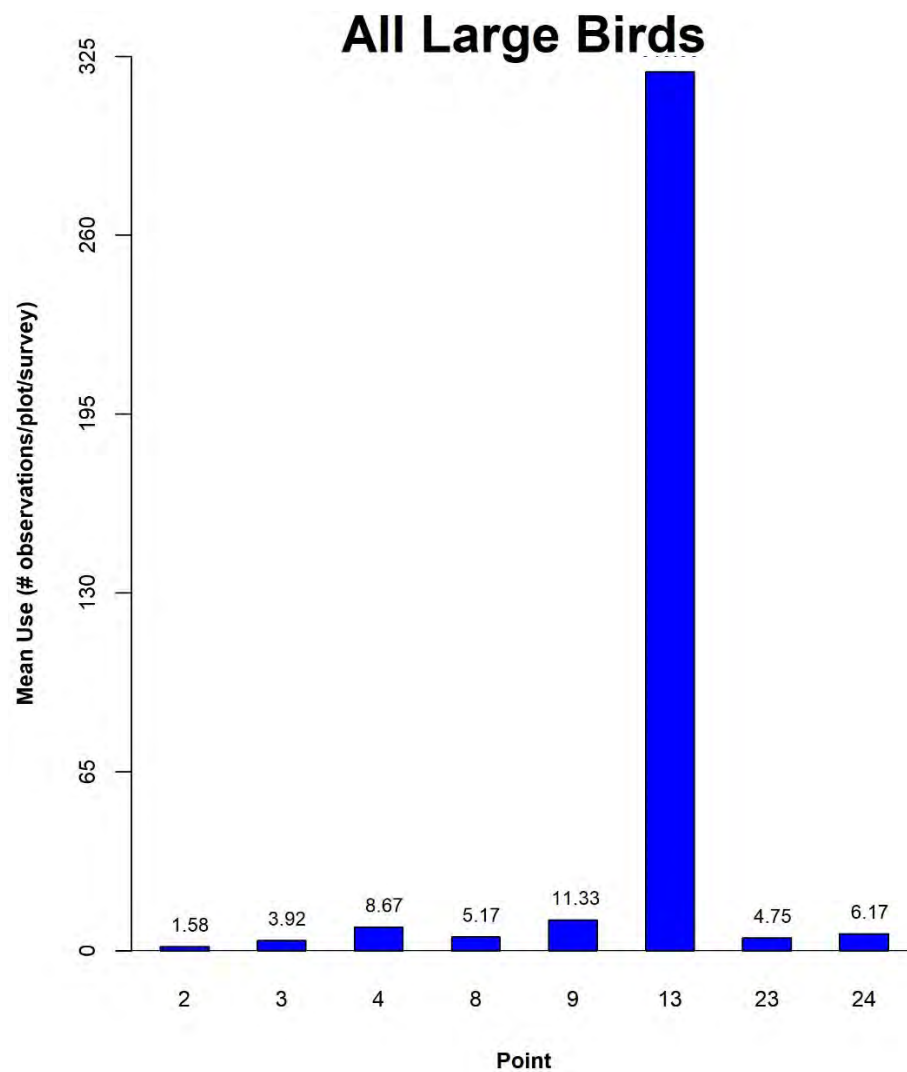


Figure 5a. Overall large bird mean use by survey point at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Diurnal Raptors

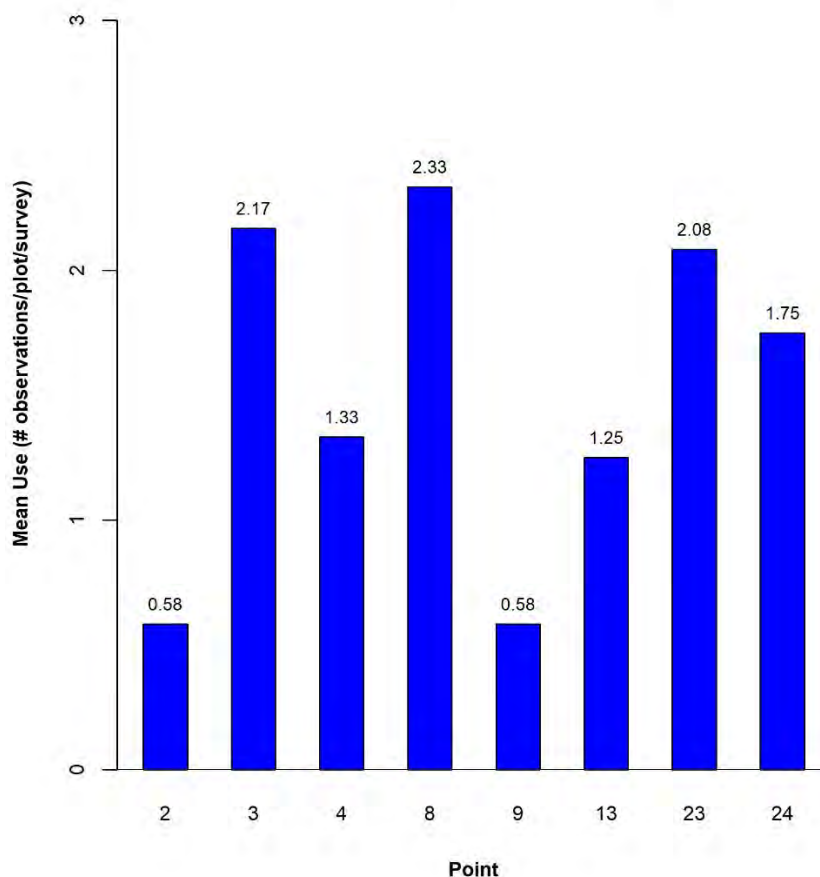


Figure 5b. Diurnal raptor mean use by survey point at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Flight Paths

Flight paths of eight groups of 39 American white pelican were mapped at the Project. Groups were observed during winter, spring, and summer and ranged between 1-10 observations (mean = 5 observations). Groups occurred at survey points located throughout the Project area and flight patterns were typically parallel to drainages as recorded at points 8, 9, 13, 23 or traversing a north-facing slope adjacent to point 24 (Figure 6). The overall mean flight height when first observed was 130 m agl (range 65–300 m agl).

Flight paths of 13 groups of 3,782 snow goose were mapped at the Project. Records of groups were limited to fall and winter and ranged between 9–1,500 observations (mean = 290 observations). Groups occurred primarily at survey point 13 and flight patterns were typically oriented in a straight north or south direction (Figure 6). Of the 11 groups with flight heights recorded, the overall mean flight height when first observed was 119 m agl (range 35–200 m agl).

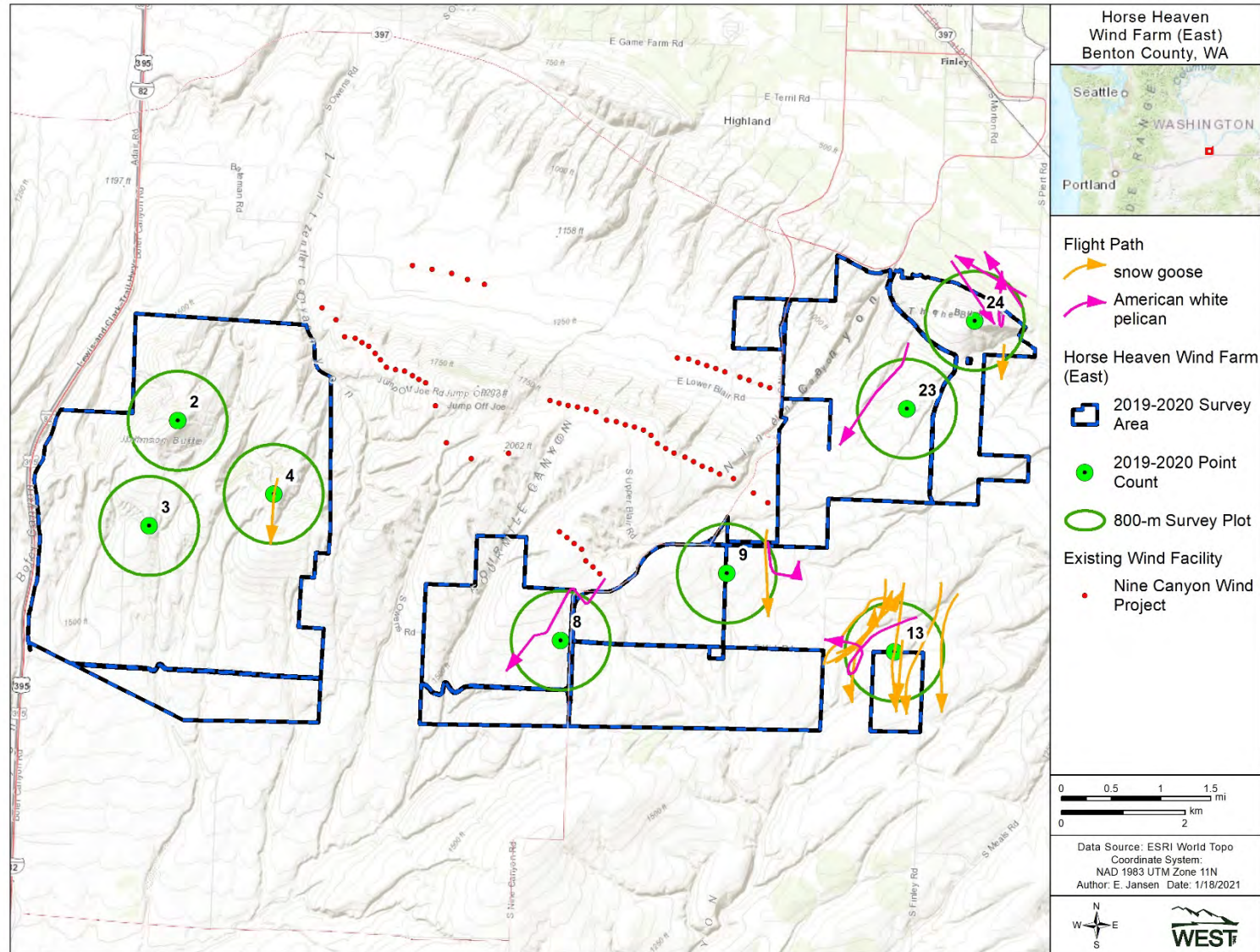


Figure 6. American white pelican and snow goose flight paths at the Horse Heaven Wind Farm (East), Benton County Washington from October 23, 2019 to September 20, 2020.

Incidental Observations

Four avian species were recorded incidental to point count surveys during the study period (Table 6). None of the species were listed as special status species but were recorded because of the substantial group size or a species of note that was not recorded during point count surveys.

Table 6. Incidental wildlife observed at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Species	Scientific Name	# grps	# obs
snow goose	<i>Anser caerulescens</i>	3	4,650
rough-legged hawk	<i>Buteo lagopus</i>	1	1
osprey	<i>Pandion haliaetus</i>	2	4
varied thrush	<i>Ixoreus naevius</i>	1	1
Total	4 species	7	4,656

DISCUSSION

The principal objective of the study was to provide site-specific species occurrence and the spatial and temporal patterns of avian use with a particular focus on eagles, other raptors, and non-raptors such as American white pelican or species of regulatory or management concern (i.e., federal or state-sensitive species). Additionally, surveyors documented observations of rare and sensitive species observed incidental to standardized surveys throughout the course of the study.

The bird species observed in the Project during the study were typical to those commonly found in agricultural, shrub-steppe and grasslands within the Columbia Plateau. Bird use was highest for species common and widespread in the region and the bird community observed coincided with the assemblage expected based on the time of year and habitat in the Project and surrounding area. For example, snow goose were primarily observed during fall and winter when individuals were likely moving between their summer and winter ranges. Certain raptor species such as Swainson's hawk [*Buteo swainsoni*] were observed during spring and summer when the species migrates from southern latitudes to nest in southeastern Washington.

Overall large bird use was significantly higher during fall and winter, likely due to the Project's location in the Pacific Flyway and the stopover habitat available in the surrounding area. Patterns of high waterfowl use during fall and winter are consistent with patterns observed during other avian studies conducted in the Horse Heaven Hills by Chatfield et al. (2019a, 2019b) and Jansen et al. (2019). Several large bird groups of interest for the Project are discussed separately, below.

Waterbirds

A species of conservation interest, American white pelican (state threatened), comprised the waterbird group. Year-round use of American white pelican within the Horse Heaven Hills has been documented in previous studies and use has fluctuated seasonally (Jansen and Brown 2018, Chatfield et al. 2019a, Chatfield et al. 2019b, and Jansen et al. 2019). Chatfield et al. (2019a) documented high use during summer (9.01 observations/plot/survey) whereas Jansen et

al. (2019) documented relatively higher use during fall (0.96 observations/plot/survey). Spatial use tends to be relatively higher at points located further east, in proximity to the Columbia River. In the Great Basin⁴, of the 43 wind facilities with publically available post-construction fatality data, no American white pelican fatalities have been documented (WEST 2019, 2020). In Washington, the largest breeding colony of American white pelicans is on Badger Island, located approximately 3.5 miles east of the Project in the Columbia River (Stinson 2016). No large bodies of water provide suitable pelican foraging habitat within the Project; however, considering an increasing population (approximate 86% increase on Badger Island since 2009, $n = 3,267$ individuals total; Stinson 2016), occasional use of the Project area may continue. However, based on the absence of the American white pelicans at a large number of wind facilities within the migration and breeding range of the pelican, potential collisions with wind turbines appears to be low.

Waterfowl

Snow goose had the highest mean use of all large birds due to the large groups that flew over the Project. The Project and surrounding region contains various agricultural and croplands that could provide valuable stopover habitat for migrating geese. Wheat fields within the Project area may become inundated with water in the spring or fall and provide suitable foraging habitat. Waterfowl that enter or exit agricultural fields while foraging for grain crops may be at greater risk of turbine collision. However, waterfowl do not seem especially vulnerable to turbine collisions. In an analysis of 116 studies of bird mortality at over 70 operating wind facilities, waterfowl composed 2.7% of 4,975 fatalities found (Erickson et al. 2014). No waterfowl fatalities have been reported at the adjacent Nine Canyon Wind Project since carcass monitoring began in 2002 (Erickson et al. 2003, Energy Northwest 2020). Based on flight behavior and seasonality of observations, it is likely snow geese are predominantly passing over the Project area rather than utilizing resources in the area.

Diurnal Raptors

Diurnal raptor comprised a comparatively large proportion of avian use at the Project. Despite their relatively low fatality rates at wind facilities compared to passerines, raptors are a group of concern due to flight behavior that increases risk of collisions with turbines combined with their low reproductive rates. Diurnal raptor use was highest during the fall and spring when red-tailed hawk [*Buteo jamaicensis*], Swainson's hawk and rough-legged hawk [*Buteo lagopus*] use increased. Fall and spring coincide with migration when large-scale movement of many raptor species from their nesting or overwintering occurs, respectively. Conversely, use of some species such as American kestrel [*Falco sparverius*] increased in winter. A golden eagle was observed during fall whereas bald eagles were observed more often during fall, winter, and spring, which is consistent with the seasonal patterns recorded during previous studies in the Horse Heaven Hills (Jansen and Brown 2018, Chatfield et al. 2019a, Chatfield et al. 2019b, and Jansen et al. 2019). Five raptor species (American kestrel, red-tailed hawk, Swainson's hawk, rough-legged hawk, and golden eagle) that comprise the majority of raptor fatalities in the Pacific Region⁵ had

⁴ USFWS Bird Conservation Region 9, Great Basin (BCR 9; USFWS 2008)

⁵ USFWS Pacific Region (Idaho, Oregon, and Washington; USFWS 2020); WEST 2019

relatively higher use compared to other raptor species at the Project which suggests turbine collision probability will likely be species- and seasonally-specific.

CONCLUSIONS

Tier 3 studies are used to address questions regarding impacts that could not be sufficiently addressed using available literature (i.e., during Tier 1 and 2 desktop analyses; USFWS 2012) and designed to document use of bald and golden eagles, following the ECPG survey recommendations and the Final Rule (USFWS 2013, 2016). Overall, the Project area does not support high use during the avian breeding season or large water bodies or other habitats that attract concentrations of birds. Overall avian use fluctuated seasonally and large bird use was typically characterized by seasonally abundant and common species such as geese, raptors, and ravens. However, special-status avian species such as American white pelican, golden eagle and bald eagle occurred at the Project and pose varying levels of likelihood to collide with operational turbines. Seasonal differences in species composition and use occur at the Project and potential impacts to birds will likely reflect these patterns.

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Appendix A. All Bird Types and Species Observed during Avian Use Surveys at the Horse Heaven Wind Farm (East), Benton County, Washington from October 23, 2019 to September 20, 2020.

Appendix A. Summary of all groups and individual observations, regardless of distance from observer, by bird type and species during avian bird surveys at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Type/Species	Scientific Name	Fall		Winter		Spring		Summer		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
Waterbirds		0	0	1	10	4	19	3	10	8	39
American white pelican	<i>Pelecanus erythrorhynchos</i>	0	0	1	10	4	19	3	10	8	39
Waterfowl		6	400	12	3,595	0	0	0	0	18	3,995
snow goose	<i>Anser caerulescens</i>	5	365	8	3,417	0	0	0	0	13	3,782
Canada goose	<i>Branta canadensis</i>	1	35	4	178	0	0	0	0	5	213
Diurnal Raptors		66	66	39	39	26	26	15	15	146	146
<u>Accipiters</u>		2	2	0	0	1	1	0	0	3	3
Cooper's hawk	<i>Accipiter cooperii</i>	1	1	0	0	1	1	0	0	2	2
unidentified accipiter		1	1	0	0	0	0	0	0	1	1
<u>Buteos</u>		33	33	16	16	18	18	11	11	78	78
red-tailed hawk	<i>Buteo jamaicensis</i>	19	19	8	8	12	12	6	6	45	45
rough-legged hawk	<i>Buteo lagopus</i>	14	14	8	8	3	3	0	0	25	25
Swainson's hawk	<i>Buteo swainsoni</i>	0	0	0	0	3	3	5	5	8	8
<u>Northern Harrier</u>		20	20	9	9	2	2	1	1	32	32
northern harrier	<i>Circus hudsonius</i>	20	20	9	9	2	2	1	1	32	32
<u>Eagles</u>		2	2	2	2	2	2	0	0	6	6
golden eagle	<i>Aquila chrysaetos</i>	1	1	0	0	0	0	0	0	1	1
bald eagle	<i>Haliaeetus leucocephalus</i>	1	1	2	2	2	2	0	0	5	5
<u>Falcons</u>		8	8	12	12	3	3	3	3	26	26
prairie falcon	<i>Falco mexicanus</i>	2	2	1	1	0	0	0	0	3	3
American kestrel	<i>Falco sparverius</i>	6	6	11	11	3	3	3	3	23	23
<u>Osprey</u>		1	1	0	0	0	0	0	0	1	1
osprey	<i>Pandion haliaetus</i>	1	1	0	0	0	0	0	0	1	1
Vultures		3	3	0	0	0	0	0	0	3	3
turkey vulture	<i>Cathartes aura</i>	3	3	0	0	0	0	0	0	3	3
Upland Game Birds		0	0	1	1	0	0	0	0	1	1
California quail	<i>Callipepla californica</i>	0	0	1	1	0	0	0	0	1	1
Doves/Pigeons		0	0	0	0	1	2	1	4	2	6
rock pigeon	<i>Columba livia</i>	0	0	0	0	1	2	1	4	2	6
Large Corvids		27	69	16	18	25	33	12	22	80	142

Appendix A. Summary of all groups and individual observations, regardless of distance from observer, by bird type and species during avian bird surveys at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Type/Species	Scientific Name	Fall		Winter		Spring		Summer		Total	
		# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
common raven	<i>Corvus corax</i>	25	67	15	17	25	33	11	20	76	137
black-billed magpie	<i>Pica hudsonia</i>	2	2	1	1	0	0	1	2	4	5
Overall		102	538	69	3,663	56	80	31	51	258	4,332

^a grps = groups; obs = observations.

**Appendix B. Bird Use, Percent of Use, and Frequency of Occurrence for Large Birds
Observed during Avian Use Surveys at the Horse Heaven Wind Farm (East) from October
23, 2019 to September 20, 2020.**

Appendix B. Mean large birds use (number of large birds/plot^a/60 minute survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species by season during avian bird use surveys at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Type/Species	Mean Use				% of Use				% Frequency			
	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer
Waterbirds	0	0.42	0.79	0.42	0	0.3	23.8	19.6	0	4.2	8.3	12.5
American white pelican	0	0.42	0.79	0.42	0	0.3	23.8	19.6	0	4.2	8.3	12.5
Waterfowl	16.67	149.79	0	0	74.5	98.1	0	0	12.5	16.7	0	0
snow goose	15.21	142.38	0	0	68.0	93.3	0	0	12.5	12.5	0	0
Canada goose	1.46	7.42	0	0	6.5	4.9	0	0	4.2	12.5	0	0
Diurnal Raptors	2.71	1.63	1.08	0.63	12.1	1.1	32.5	29.4	79.2	70.8	54.2	50.0
<u>Accipiters</u>	<i>0.08</i>	<i>0</i>	<i>0.04</i>	<i>0</i>	<i>0.4</i>	<i>0</i>	<i>1.3</i>	<i>0</i>	<i>4.2</i>	<i>0</i>	<i>4.2</i>	<i>0</i>
Cooper's hawk	0.04	0	0.04	0	0.2	0	1.3	0	4.2	0	4.2	0
unidentified accipiter	0.04	0	0	0	0.2	0	0	0	4.2	0	0	0
<u>Buteos</u>	<i>1.38</i>	<i>0.67</i>	<i>0.75</i>	<i>0.46</i>	<i>6.1</i>	<i>0.4</i>	<i>22.5</i>	<i>21.6</i>	<i>58.3</i>	<i>50.0</i>	<i>50.0</i>	<i>37.5</i>
red-tailed hawk	0.79	0.33	0.50	0.25	3.5	0.2	15.0	11.8	45.8	25.0	45.8	20.8
rough-legged hawk	0.58	0.33	0.13	0	2.6	0.2	3.8	0	25.0	29.2	12.5	0
Swainson's hawk	0	0	0.13	0.21	0	0	3.8	9.8	0	0	8.3	20.8
<u>Northern Harrier</u>	<i>0.83</i>	<i>0.38</i>	<i>0.08</i>	<i>0.04</i>	<i>3.7</i>	<i>0.2</i>	<i>2.5</i>	<i>2.0</i>	<i>62.5</i>	<i>37.5</i>	<i>8.3</i>	<i>4.2</i>
northern harrier	0.83	0.38	0.08	0.04	3.7	0.2	2.5	2.0	62.5	37.5	8.3	4.2
<u>Eagles</u>	<i>0.04</i>	<i>0.08</i>	<i>0.08</i>	<i>0</i>	<i>0.2</i>	<i>0.1</i>	<i>2.5</i>	<i>0</i>	<i>4.2</i>	<i>8.3</i>	<i>4.2</i>	<i>0</i>
golden eagle	0.04	0	0	0	0.2	0	0	0	4.2	0	0	0
bald eagle	0	0.08	0.08	0	0	0.1	2.5	0	0	8.3	4.2	0
<u>Falcons</u>	<i>0.33</i>	<i>0.50</i>	<i>0.13</i>	<i>0.13</i>	<i>1.5</i>	<i>0.3</i>	<i>3.8</i>	<i>5.9</i>	<i>25.0</i>	<i>37.5</i>	<i>12.5</i>	<i>12.5</i>
prairie falcon	0.08	0.04	0	0	0.4	<0.1	0	0	8.3	4.2	0	0
American kestrel	0.25	0.46	0.13	0.13	1.1	0.3	3.8	5.9	20.8	37.5	12.5	12.5
<u>Osprey</u>	<i>0.04</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>0.2</i>	<i>0</i>	<i>0</i>	<i>0</i>	<i>4.2</i>	<i>0</i>	<i>0</i>	<i>0</i>
osprey	0.04	0	0	0	0.2	0	0	0	4.2	0	0	0
Vultures	0.13	0	0	0	0.6	0	0	0	4.2	0	0	0
turkey vulture	0.13	0	0	0	0.6	0	0	0	4.2	0	0	0
Upland Game Birds	0	0.04	0	0	0	<0.1	0	0	0	4.2	0	0
California quail	0	0.04	0	0	0	<0.1	0	0	0	4.2	0	0
Doves/Pigeons	0	0	0.08	0.17	0	0	2.5	7.8	0	0	4.2	4.2
rock pigeon	0	0	0.08	0.17	0	0	2.5	7.8	0	0	4.2	4.2
Large Corvids	2.88	0.75	1.38	0.92	12.8	0.5	41.3	43.1	62.5	54.2	66.7	29.2

Appendix B. Mean large birds use (number of large birds/plot^a/60 minute survey), percent of total use (%), and frequency of occurrence (%) for each large bird type and species by season during avian bird use surveys at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Type/Species	Mean Use				% of Use				% Frequency			
	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer	Fall	Winter	Spring	Summer
common raven	2.79	0.71	1.38	0.83	12.5	0.5	41.3	39.2	58.3	50.0	66.7	25.0
black-billed magpie	0.08	0.04	0	0.08	0.4	<0.1	0	3.9	8.3	4.2	0	4.2
Overall	22.38	152.63	3.33	2.13	100	100	100	100				

^a 800-meter (2,625 foot) radius plot for large birds

Sums of values may not equal totals shown due to rounding.

Appendix C. Relative exposure index and flight characteristics for bird species during avian bird use surveys at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Appendix C. Relative exposure index and flight characteristics for bird species^a during avian bird use surveys at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
snow goose	11	39.56	91.3	92.1	33.28	92.4
Canada goose	5	2.26	100	83.6	1.89	100
common raven	70	1.51	92.7	80.3	1.13	94.5
American white pelican	8	0.39	100	82.1	0.32	87.2
red-tailed hawk	30	0.49	66.7	80.0	0.26	90.0
rough-legged hawk	22	0.28	88.0	100	0.25	100
northern harrier	32	0.37	100	40.6	0.15	65.6
American kestrel	13	0.24	56.5	84.6	0.12	100
rock pigeon	2	0.06	100	100	0.06	100
Swainson's hawk	4	0.07	50.0	100	0.04	100
turkey vulture	3	0.04	100	100	0.04	100
black-billed magpie	3	0.05	80.0	75.0	0.03	100
prairie falcon	2	0.03	66.7	100	0.02	100
Cooper's hawk	2	0.02	100	100	0.02	100
bald eagle	4	0.04	100	50.0	0.02	100
osprey	1	0.01	100	100	0.01	100
golden eagle	1	0.01	100	100	0.01	100
unidentified accipiter	1	0.01	100	100	0.01	100

^a Only includes species with actual exposure index values; California quail was not observed flying.

^b The assumed "rotor-swept height" for potential collision with a turbine blade, or 10 to 155 m (33 to 509 ft) above ground level.

^c 800 meter (2,625 foot) radius plot for large birds.

^d obs = observations

**Appendix D. Mean Use by Point for All Birds, Bird Types, and Diurnal
Raptor Subtypes during Avian Use Surveys at the Horse Heaven Wind Farm (East) from
October 23, 2019 to September 20, 2020.**

Appendix D. Mean use (number of birds/60 minute survey) by point for all large bird^a types observed during avian bird use surveys at the Horse Heaven Wind Farm (East) in Benton County, Washington from October 23, 2019 to September 20, 2020.

Bird Type	Survey Point							
	2	3	4	8	9	13	23	24
Waterbirds	0	0	0	0.83	0.33	0.58	0.17	1.33
Waterfowl	0	0	6.25	0	8.75	316.08	0	1.83
Diurnal Raptors	0.58	2.17	1.33	2.33	0.58	1.25	2.08	1.75
<u>Accipiters</u>	0	0	0	0	0	0.08	0	0.17
<u>Buteos</u>	0.33	1.42	0.83	1.17	0.33	0.50	1.00	0.92
<u>Northern Harrier</u>	0.25	0.42	0.33	0.67	0.17	0.25	0.50	0.08
<u>Eagles</u>	0	0.08	0	0	0	0.08	0	0.25
<u>Falcons</u>	0	0.25	0.17	0.50	0.08	0.33	0.50	0.33
<u>Osprey</u>	0	0	0	0	0	0	0.08	0
Vultures	0	0	0	0	0	0	0	0.25
Upland Game Birds	0	0	0	0	0	0	0	0.08
Doves/Pigeons	0	0	0	0.33	0.17	0	0	0
Large Corvids	1.00	1.75	1.08	1.67	1.50	1.42	2.50	0.92
All Large Birds	1.58	3.92	8.67	5.17	11.33	319.33	4.75	6.17

^a 800 meter (2,625 foot) radius plot for large birds.

Sums of values may not equal totals shown due to rounding.

Botany and Habitat Survey Report for Horse Heaven Wind Farm

Benton County, Washington

Prepared for
Horse Heaven Wind Farm, LLC

Prepared by



19803 North Creek Parkway
Bothell, WA 98011

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LIST OF ATTACHMENTS

Attachment A.	Special-Status Plant Species with Potential to Occur within the Survey Area
Attachment B.	Vascular Plants Observed within the Survey Area
Attachment C.	Representative Habitat Photographs

ACRONYMS AND ABBREVIATIONS

GPS	Global Positioning System
NLCD	National Land Cover Database
Project	Horse Heaven Wind Farm Project
Tetra Tech	Tetra Tech, Inc.
Turbine	wind generator turbine
USFWS	U.S. Fish and Wildlife Service
WNHP	Washington Natural Heritage Program

1 INTRODUCTION

This report presents the methods and results for botanical and habitat surveys conducted by Tetra Tech, Inc. (Tetra Tech) for the Horse Heaven Wind Farm (Project). The Project is located within Benton County, approximately 2.5 miles south of Benton City and 6 miles south of Kennewick, Washington (Figure 1). The purpose of the botanical and habitat surveys was to document the presence of special status vascular plant and noxious weed species and verify, map, and characterize habitat at 44 proposed wind turbine generator (Turbine) locations preliminarily identified as occurring within native habitat, in support of permitting for the Project.

2 METHODS

2.1 Survey Area

Tetra Tech conducted botanical and habitat surveys at 44 proposed Turbine locations (based on the Project Turbine layout dated April 15, 2020) sited in areas mapped as native habitat (i.e., shrub-steppe, eastside [interior] grassland, herbaceous, shrub/scrub and/or grassland) based on National Land Cover Database (NLCD) data and information collected during previous reconnaissance-level surveys (Chatfield and Brown 2018a, 2018b; Chatfield and Thompson 2018a, 2018b; Jansen and Brown 2018). The survey area included a minimum 200 foot buffer around these Turbine locations as well as areas that were traversed on foot or vehicle between the 44 Turbine locations (Figure 2). The survey area generally coincided with the portions of the Micrositing Corridor¹ around and in between these 44 Turbine locations, but habitat was also mapped beyond the Micrositing Corridor where the surveyor was able to visually scan the surrounding area and determine the habitat type with the assistance of aerial imagery.

2.2 Background Review

2.2.1 *Special Status Plant Species*

Prior to conducting field surveys, Tetra Tech conducted a pre-field review of existing information on special status plant species with the potential to occur within the survey area. For purposes of this report, the term “special status plant” includes federally or state-listed endangered, threatened, or candidate vascular plant species and state-listed sensitive vascular plant species as defined by the Washington Natural Heritage Program (WNHP). Specific sources of information that were reviewed prior to conducting field surveys include the following:

- U.S. Fish and Wildlife Service (USFWS) species lists for Benton County (USFWS 2020a);
- List of Known Occurrences of Rare Plants in Washington by County (WNHP 2019a);
- Washington Vascular Plant Species of Special Concern (WNHP 2019b); and
- Field Guide to the Rare Plants of Washington (WNHP 2020a)

Based on review of the above sources, Tetra Tech compiled a list of special status plant species known to occur or with the potential to occur in the survey area (Attachment A). No federally listed plant species

¹ The Project’s Micrositing Corridor (dated July 15, 2020) consists of the area in which facilities would be sited during the final design. The Micrositing Corridor is larger than the Project’s final footprint to allow minor rerouting to optimize the design and to avoid resources that may be discovered during the final design and pre-construction process.

are suspected or known to occur within the survey area; therefore, the target species list was limited to species listed as threatened, endangered, or sensitive in Washington by the WNHP.

In addition to the sources listed above, the WNHP database of known occurrences of special status plant species was reviewed to determine plant element occurrence records located within 5 miles of the Project Lease Boundary (WNHP 2019c). Two state threatened plant species, woven-spore lichen (*Texosporium sancti-jacobi*) and grey cryptantha (*Cryptantha leucophaea*), have been documented within 5 miles of the Project Lease Boundary. Woven spore-lichen has been documented at four separate locations within approximately 3 miles of the Project Lease Boundary, with the closest occurrence approximately 0.4 mile to the north. One occurrence of grey cryptantha has been documented approximately 5 miles from the eastern border of the Project Lease Boundary; however, this occurrence is across the Columbia River from the Project Lease Boundary.

Each of the 30 species identified as potentially occurring within the survey area was assigned a “likelihood of occurrence” (i.e., unlikely, low, moderate, high) based on the proximity of known occurrences and the likelihood of suitable habitat occurring within the survey area. Tetra Tech also reviewed aerial imagery of the survey area to identify potential habitat for special status plant species within the survey area.

Prior to conducting field surveys, Tetra Tech reviewed existing literature, herbarium records, and other sources to generate fact sheets or “field guides” for each special status plant species with the potential to occur within the survey area. These fact sheets were used by surveyors in the field and included:

- Photographs of each species and its habitat;
- Information detailing habitat associations;
- Range and flowering period;
- Identifying features; and
- Characteristics distinguishing the target species from similar species within its range.

2.2.2 Noxious Weeds

Prior to field surveys, Tetra Tech reviewed lists of species designated as noxious weeds in Washington State and Benton County (BCNWCB 2020; WSNWCB 2020). Additionally, existing literature and other sources were reviewed to familiarize surveyors with identification of designated noxious weeds that would potentially be encountered within the survey area.

2.2.3 Habitat

Prior to conducting field surveys, Tetra Tech conducted a desktop review to identify habitat types mapped within the survey area. Sources reviewed included the following:

- NLCD data (Homer et al. 2020);
- Site Characterization Study Report, Badger Canyon Wind Project (Chatfield and Thompson 2018a);
- Site Characterization Study Report, Four Mile Wind Project (Chatfield and Thompson 2018b);
- Results of the 2018 vegetation and land cover mapping for the Badger Canyon Wind Project (Chatfield and Brown 2018a);

- Results of the 2018 vegetation and land cover mapping for the Four Mile Wind Project (Chatfield and Brown 2018b);
- Wildlife Survey Report for the Horse Heaven Wind Project (Jansen and Brown 2018);
- Washington Department of Fish and Wildlife priority species and habitat database (WDFW 2020);
- WNHP element occurrence of rare and imperiled species and plant communities (WDNR 2018);
- USFWS National Wetland Inventory database (USFWS 2020b); and
- U.S. Geological Survey National Hydrography Database (USGS 2020).

2.3 Field Surveys

Field surveys were conducted June 1-5, 2020. The survey dates were chosen as they coincide with the identification period for the majority of special status plant species with the potential to occur within the survey area.

2.3.1 Special Status Plant Survey Methods

Special status plant field surveys were conducted using the Intuitive Controlled survey method, a standard and commonly accepted survey protocol (USFS and BLM 1998). This method incorporates meandering transects that traverse the survey area, and that target the full array of major vegetation types, aspects, topographical features, habitats, and substrate types. While en route, the surveyors searched for special status plant species, and when the surveyors arrive at an area of high potential habitat, they conducted a complete survey for the special status species. Complete surveys include an examination of 100 percent of the habitat.

Standard Tetra Tech survey methods would include recording the Global Positioning System (GPS) location of any special status plant species encountered with a tablet using ArcGIS Collector software. Additionally, for any special status plant species observations, methods would include completing a WNHP siting form for each population and taking photos to serve as digital specimen vouchers to illustrate identifying characteristics, plant habits, and habitat. Data collected for each special status plant population would include the following:

- Species phenology;
- Number of plants observed;
- Age class;
- Habitat information and associated species; and
- Visible threats.

During surveys, Tetra Tech maintained a running list of vascular plant species encountered within the survey area and made informal collections of unknown species for later identification. In addition to noting plants observed within each of the 44 surveyed Turbine locations, vascular plant species encountered while the surveyor traversed on foot between the turbine locations were also documented. Identification was verified by the use of appropriate plant keys, in particular, *Flora of the Pacific Northwest* (Hitchcock and Cronquist 2018). The final vascular plant species list for the survey area is included as Attachment B in this report.

2.3.2 Noxious Weeds

Noxious weed surveys were conducted concurrently with special status plant and habitat surveys. Tetra Tech recorded observations of state- and county-designated noxious weeds. When a noxious weed was encountered in the survey area, the location was recorded with a GPS point and the species, estimated size of the infestation, and relative abundance was recorded. In addition to documenting noxious weeds at each of the 44 surveyed Turbine locations, noxious weeds were also documented while the surveyor travelled between survey locations.

2.3.3 Habitat

Tetra Tech conducted habitat verification, mapping, and characterization surveys concurrently with special status and noxious weed surveys. Habitats were characterized by recording the dominant plant species and general condition of the habitat. In addition to characterizing and mapping habitat within the 44 surveyed Turbine locations, the surveyor also characterized and mapped habitats encountered while traversing or travelling between Turbine locations on foot or vehicle, and mapped habitat out beyond these areas where the habitat type could be determined from a distance in conjunction with aerial imagery. In general, habitat types were adapted from habitat descriptions in the *Washington Department of Fish and Wildlife Wind Power Guidelines* (WDFW 2009) and *Wildlife-habitat Relationships in Oregon and Washington* (Johnson and O'Neil 2001). However, two of the habitat types observed during field surveys (i.e., rabbitbrush shrubland and non-native grassland) were not readily classified following either of those sources. Descriptions of these habitat types, as well as all habitat types observed during field surveys are provided in Section 3.3.

3 RESULTS

3.1 Special Status Plants

No special status plant species were observed within the survey area (i.e., within each of the 44 surveyed Turbine locations or in areas traversed between Turbine locations). In addition, very little suitable habitat for special status plant species was observed.

3.2 Noxious Weeds

Tetra Tech recorded six state- and county-designated noxious weed species during field surveys. In addition, the location, estimated extent, and estimated abundance of noxious weeds observed was documented. Table 1 lists the noxious weed species observed, their noxious weed designation, and the frequency of observations. Figure 3 shows the locations of noxious weeds observed during field surveys.

Table 1. Noxious Weeds Observed During Botanical Field Surveys

Scientific Name	Common Name	State and County Status ¹	Frequency
<i>Bassia (Kochia) scoparia</i>	kochia	B	Observed in several locations scattered throughout survey area.
<i>Centaurea</i> sp. ²	knapweed	B	Frequently observed in central portion of survey area.
<i>Centaurea solstitialis</i>	yellow starthistle	B	Observed in two locations in central portion of survey area.
<i>Chondrilla juncea</i>	rush skeletonweed	B	Abundant. Frequently observed throughout survey area.
<i>Onopordum acanthium</i>	Scotch thistle	B	Observed in two locations in south-central portion of survey area.
<i>Secale cereale</i>	Cereal rye	C	Abundant. Frequently observed throughout survey area.

Notes:

¹ "Class B" weeds: Non-native species presently limited to portions of the state. Species are designated for required control in regions where they are not yet widespread. Preventing new infestations in these areas is a high priority. In regions where a Class B species is already abundant, control is decided at the local level, with containment as the primary goal. "Class C" weeds: Noxious weeds that are typically widespread in the state or are of special interest to the state's agricultural industry. The Class C status allows county weed boards to require control if locally desired, or they may choose to provide education or technical consultation (WSNWCB 2020).

² Individuals observed were not flowering at the time of surveys; therefore, positive identification was not possible. Based on observations of rosettes and leaves, individuals and populations are believed to be either diffuse knapweed or spotted knapweed which are both designated "Class B" weeds.

Three noxious weed species were abundant throughout the survey area: knapweed (*Centaurea* sp.), rush skeletonweed (*Chondrilla juncea*), and cereal rye (*Secale cereale*). Knapweed was primarily observed in the central portion of the survey area. Patches ranged from small (<0.1 acre) to large (1-5 acres) patches that consisted of sparse, scattered individuals to areas with a high cover of knapweed. The knapweed individuals were not flowering at the time of the field surveys; however, based on the rosettes and leaf characteristics, it is assumed that individuals observed were either diffuse knapweed (*Centaurea diffusa*) or spotted knapweed (*Centaurea stoebe*). Tetra Tech documented rush skeletonweed throughout all but the northwest corner of the survey area. Although most patches of rush skeletonweed were either small (<0.1 acre) or medium (0.1-1 acre) in size, several larger infestations (1-5 acres) were observed scattered throughout the central portion of the survey area. Typically, observations of rush skeletonweed consisted of small patches or individuals scattered throughout the area, instead of occurring in dense populations. Large (greater than 1 acre), dense patches of cereal rye were frequently observed throughout the survey area. This noxious weed was often observed on hillslopes or adjacent to drainages, and cereal rye formed almost a complete monoculture in many of the locations where it was observed.

Kochia (*Bassia [Kochia] scoparia*) was primarily observed alongside Nicoson Road in the center of the survey area, where it was commonly observed in sparse to dense patches. Kochia was also observed along roadsides in the western and eastern portions of the survey area. Yellow starthistle (*Centaurea solstitialis*) and Scotch thistle (*Onopordum acanthium*) were each observed in only two locations in the survey area. All observations of yellow starthistle and Scotch thistle were located in the south-central portion of the survey area (Figure 3). One observation of yellow starthistle was a small (<0.1 acre) patch consisting of just a few individuals, while the other observation was larger (0.1-1 acre) and relatively dense (high cover). Both observations of Scotch thistle were small (<0.1 acre) patches. One of these observations consisted of just a few individuals, while the other observations consisted of a dense patch of Scotch thistle.

Cereal rye is a Class C noxious weed, indicating that it is either widespread in the state or is of interest to the state's agricultural industry. The other five noxious weed species observed are "Class B" noxious weeds, meaning that they are designated for required control in regions where they are not yet widespread and preventing new infestations in these areas is a high priority. In regions where these species are already abundant, control is decided at the local level, with containment as the primary goal (WSNWCB 2020).

3.3 Habitat

In general, vegetation within the majority of the survey area has been heavily modified due to historic and current agriculture and grazing activity. Non-native invasive grasses and forbs are prevalent throughout the survey area due to historic and current farming and grazing activity.

The following seven habitat types were field verified and/or mapped within the survey area:

- Agricultural land
- Developed/disturbed
- Dwarf shrub-steppe
- Non-native grassland
- Planted grassland
- Rabbitbrush shrubland
- Sagebrush shrub-steppe

Each of these habitat types is discussed briefly below. Locations of habitat types field-verified and/or mapped during field surveys are presented in Figure 4. Representative photos of habitat types observed during field surveys are provided in Attachment C.

3.3.1 Agricultural Land

Areas mapped as agricultural land within the survey area consisted of active wheat fields and fallow wheat fields (i.e., fields in active rotation but not planted during the current season). Areas mapped as agricultural land primarily include areas that during the background review had been mapped as native habitat (e.g., eastside [interior] grassland, sagebrush shrub-steppe), but which during field surveys were determined to be cultivated agricultural land, primarily active or fallow wheat fields.

3.3.2 Developed/Disturbed

Two areas, both in the northeastern portion of the survey area, were field-verified as developed/disturbed. One of these areas is associated with a gravel pit and the other includes buildings and structures associated with ranching and farming activities.

3.3.3 Dwarf Shrub-steppe

One small area of dwarf shrub-steppe was mapped within the survey area (Figure 4a). This area is located on a ridgetop in the northwest corner of the Project boundary and occurs on lithosol soils. Lithosols are shallow soils with poorly defined layers that consist mainly of partially weathered rock fragments (Azerrad et al. 2011). Dominant species observed within this habitat type include the native sub-shrub/dwarf shrub rock buckwheat (*Eriogonum sphaerocephalum*), the native perennial grasses bluebunch wheatgrass (*Pseudoroegneria spicata*) and Sandberg bluegrass (*Poa secunda*), and the non-

native annual grasses cheatgrass (*Bromus tectorum*) and cereal rye (*Secale cereale*). Forbs and subshrubs commonly observed in this habitat type include common yarrow (*Achillea millefolium*), rosy balsamorhiza (*Balsamorhiza rosea*), hoary aster (*Dieteria canescens*), Douglas' dustymaidens (*Chaenactis douglasii*), cushion fleabane (*Erigeron poliospermus*), narrowleaf goldenweed (*Nestotus stenophyllus*), tall tumbled mustard (*Sisymbrium altissimum*), and yellow salsify (*Tragopogon dubius*). Scattered shrubs, including rubber rabbitbrush (*Ericameria nauseosa*), green rabbitbrush (*Chrysothamnus viscidiflorus*) and big sagebrush (*Artemisia tridentata*), were also observed in areas mapped as the dwarf shrub-steppe habitat type; however, cover of these shrub species did not exceed 5 percent cover. This habitat type matches the description of the rock buckwheat/Sandberg bluegrass dwarf-shrub herbaceous vegetation type, which is listed by the WNHP as a rare and/or high-quality plant community (WNHP 2020b). Representative photos of this habitat type are presented in Attachment C, Photo 2.

3.3.4 Non-native Grassland

Non-native grassland habitat was commonly observed in the survey area. This habitat type was often observed on hillslopes and adjacent draws; however, it was also found adjacent to agricultural fields or in other flat areas where formerly planted and/or native grassland is now dominated by non-native grass and forb species. Dominant species observed in this habitat type include cereal rye, cheatgrass, prickly lettuce (*Lactuca serriola*), tall tumbled mustard, and yellow salsify. Although native forbs including common yarrow, hoary-aster, and slender hareleaf (*Lagophylla ramosissima*) were occasionally observed in this habitat type, they typically represented only a small percent cover of the overall vegetative cover. Several areas mapped as non-native grassland habitat consisted of vast areas dominated by dense cover of cereal rye (Attachment C, Photos 3 and 6). As noted in Section 3.2, cereal rye is listed as a Class C noxious weed in Washington State and Benton County.

3.3.5 Planted Grassland

The planted grassland habitat type was the most prevalent habitat type mapped within the survey area. This habitat type consists of former agricultural lands that have been planted with non-native grasses, native grasses, and/or native shrubs. These areas may have been or may currently be enrolled in the Conservation Reserve Program (CRP) but their current legal status is unknown.

Areas mapped as planted grassland include areas planted with the non-native perennial grass crested wheatgrass (*Agropyron cristatum*), as well as areas planted primarily with the native perennial grasses bluebunch wheatgrass and big bluegrass (*Poa ampla*; a cultivar of *P. secunda*). Rabbitbrush, primarily rubber rabbitbrush, was also commonly observed in this habitat type. Areas mapped as planted grassland typically contained less than approximately five percent cover of rabbitbrush. However, small (less than 1 acre) dense patches of rabbitbrush occur in this habitat type. Areas where high cover of rabbitbrush was observed were mapped as the rabbitbrush shrubland habitat type (see Section 3.3.5).

The quality of planted grassland habitat type within the survey area varied, with some areas of planted grassland habitat containing a higher predominance of native species such as bluebunch wheatgrass, big bluegrass, common yarrow, and large-flowered agoseris (*Agoseris grandiflora*) and lower cover of non-native invasive species. Other areas of planted grassland habitat contain a high predominance of non-native species including the planted perennial grass crested wheatgrass, as well as higher cover of non-native invasive species such as cheatgrass, cereal rye, prickly lettuce, and yellow salsify. In general, planted grassland habitat contained a low diversity of forb species.

3.3.6 Rabbitbrush Shrubland

Rabbitbrush shrubland habitat was the second most common habitat type mapped within the survey area. Similar to the planted grassland habitat type, this habitat type was often observed in former agricultural lands that have been planted with native grasses, native shrubs, and/or non-native grasses. These areas may have been or may currently be enrolled in CRP, but their current status is unknown. Shrub cover in the rabbitbrush shrubland habitat type ranged between approximately 10 to 80 percent cover, but was typically greater than 50 percent. Rubber rabbitbrush was the dominant shrub species observed, although green rabbitbrush was occasionally observed in this habitat type as well. It is unknown whether rubber and green rabbitbrush were planted in these areas or have established naturally.

Other common species observed in rabbitbrush shrubland habitat include the native grasses big bluegrass and the non-native grasses crested wheatgrass, cheatgrass, and cereal rye. Common forbs observed included the native common yarrow and hoary-aster and the non-native prickly lettuce, tall tumblemustard, and yellow salsify.

3.3.7 Sagebrush Shrub-steppe

Sagebrush shrub-steppe habitat was primarily mapped in the north-central and northeastern portions of the survey area. In addition, a small patch of remnant sagebrush shrub-steppe habitat was mapped in the northwestern portion of the survey area (Figure 4).

Shrub cover in sagebrush shrub-steppe habitat type ranged between approximately 10 to 75 percent cover, but was typically less than 50 percent and included areas of grassland habitat in between patches of shrubs. The dominant shrub species in this habitat type was big sagebrush. Other shrub species commonly observed include spineless horsebrush (*Tetradymia canescens*), rubber rabbitbrush, and green rabbitbrush. Cover and diversity of grasses and forbs was variable within this habitat type; however, cover of the non-native cheatgrass was typically high. Other grasses and forbs observed in sagebrush shrub-steppe habitat include the native grasses and forbs: bluebunch wheatgrass, Sandberg bluegrass, Carey's balsamroot (*Balsamorhiza careyana*), common yarrow, long-leaf phlox (*Phlox longifolia*), low pussytoes (*Antennaria dimorpha*), shaggy fleabane (*Erigeron pumilus*), woolly plantain (*Plantago patagonica*), woollypod milkvetch (*Astragalus purshii*), and the non-native forbs: redstem stork's bill (*Erodium cicutarium*), prickly lettuce, and yellow salsify.

4 CONCLUSIONS

Botanical surveys conducted in 2020 did not document any special status plant species within the survey area. Six noxious weed species were documented during field surveys conducted within 44 proposed Turbine locations, several of which were abundant within the survey area. Seven habitat types were mapped and characterized within the survey area. The most abundant habitat type observed in the survey area (corresponding to the 44 proposed Turbine locations) was planted grassland, followed by rabbitbrush shrubland. However, as noted in Sections 1 and 2, surveys were only conducted within 44 proposed Turbine locations preliminarily mapped as occurring in native habitat; therefore, these results only reflect observations within the areas surveyed and are not indicative of the overall Project Lease Boundary. Habitat within the majority of the Project Lease Boundary consists of agricultural lands.

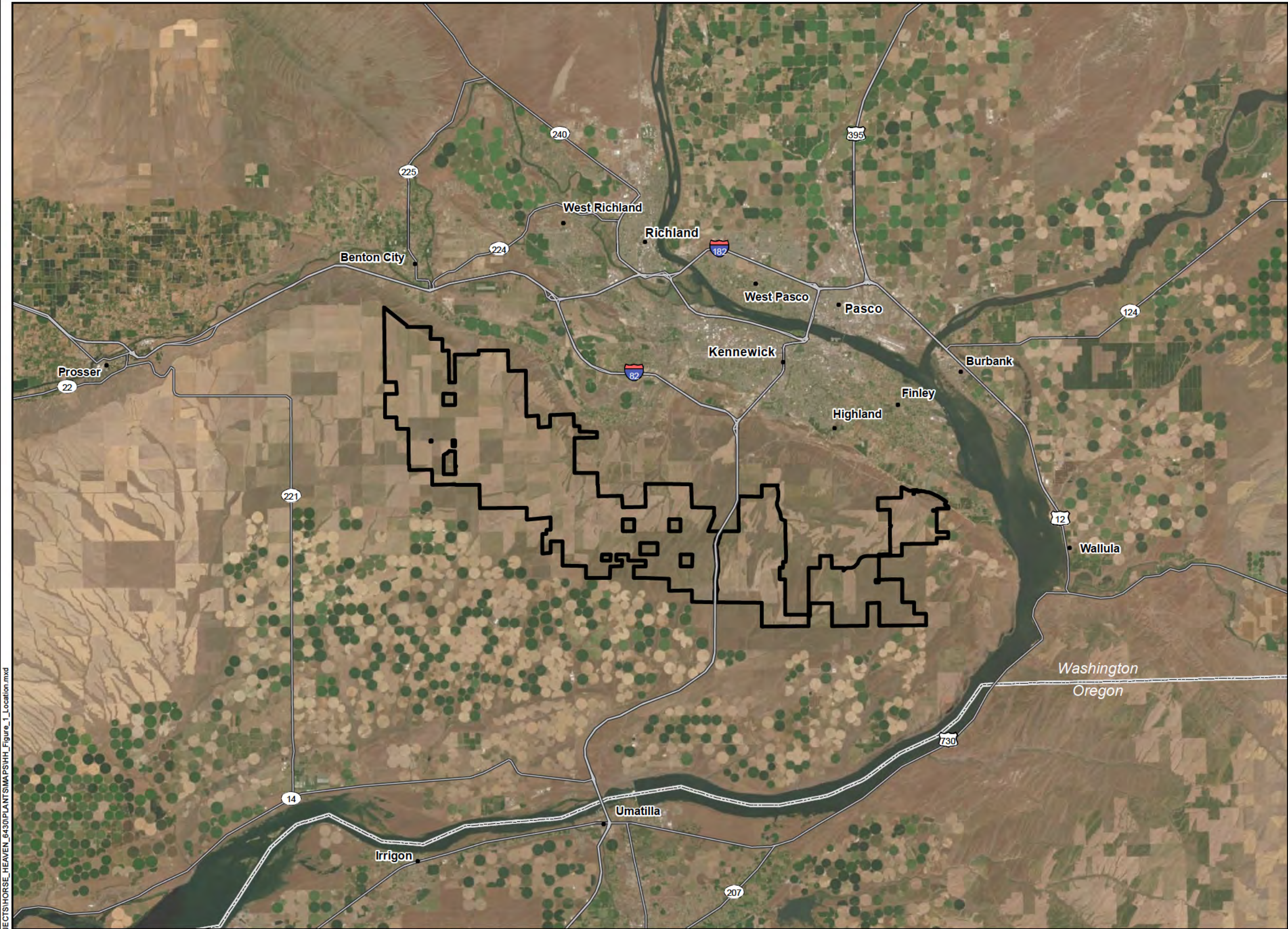
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FIGURES

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Horse Heaven
Wind Farm



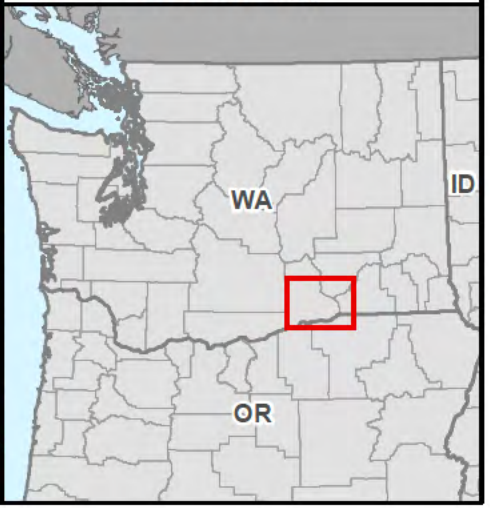
Figure 1
Project Location

BENTON COUNTY, WA

 Project Boundary (4/17/20)



Reference Map

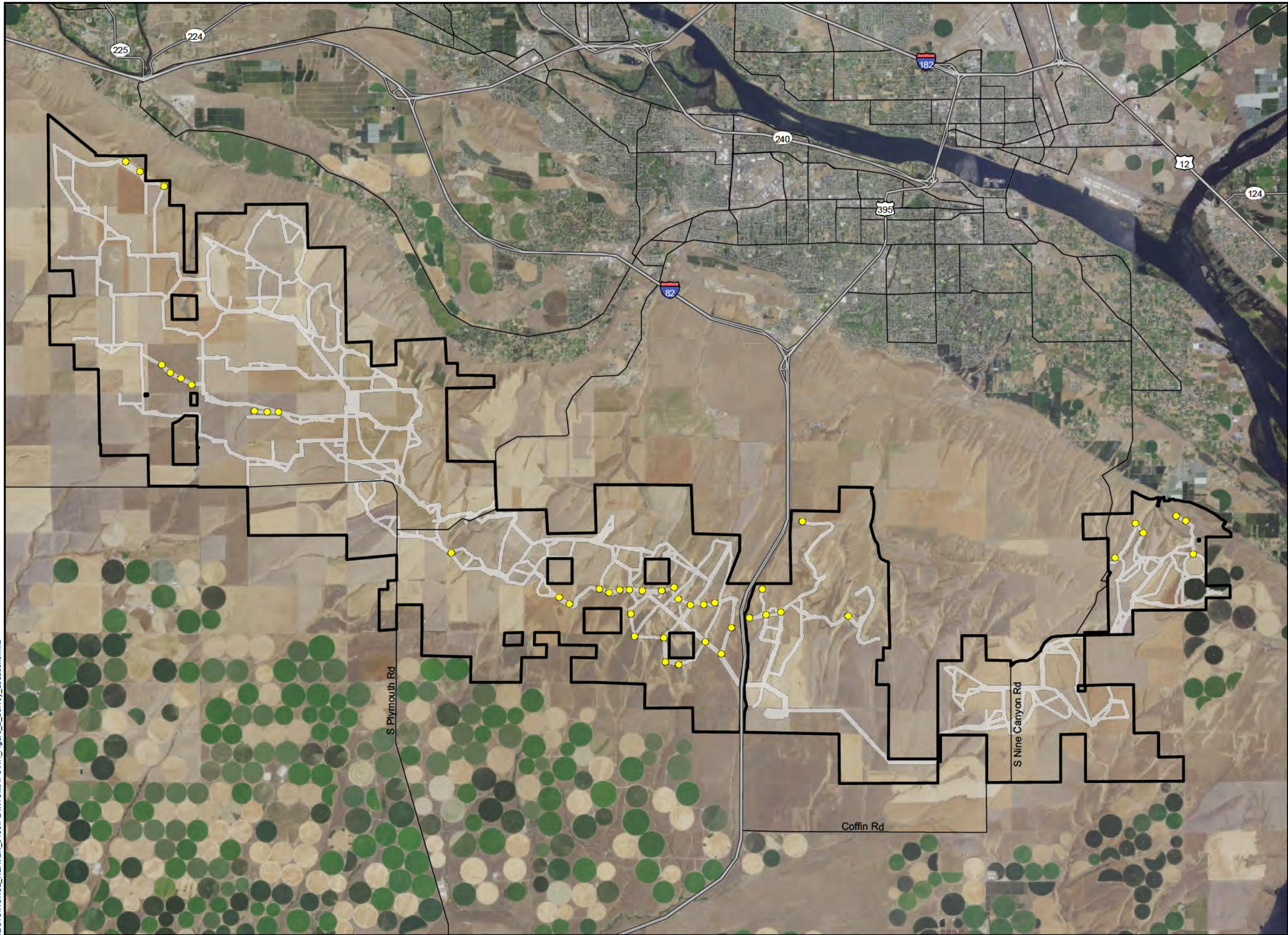


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Horse Heaven Wind Farm



Figure 2
Surveyed Turbine Locations

BENTON COUNTY, WA

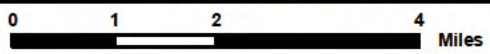
- Project Boundary (4/17/20)
- Micrositing Corridor (7/15/20)
- Turbine Survey Locations
 - Turbines (4/15/20)



Reference Map



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Horse Heaven
Wind Farm



Figure 3a
Noxious Weeds

BENTON COUNTY, WA

Project Boundary (4/17/20)

Turbine Survey Locations

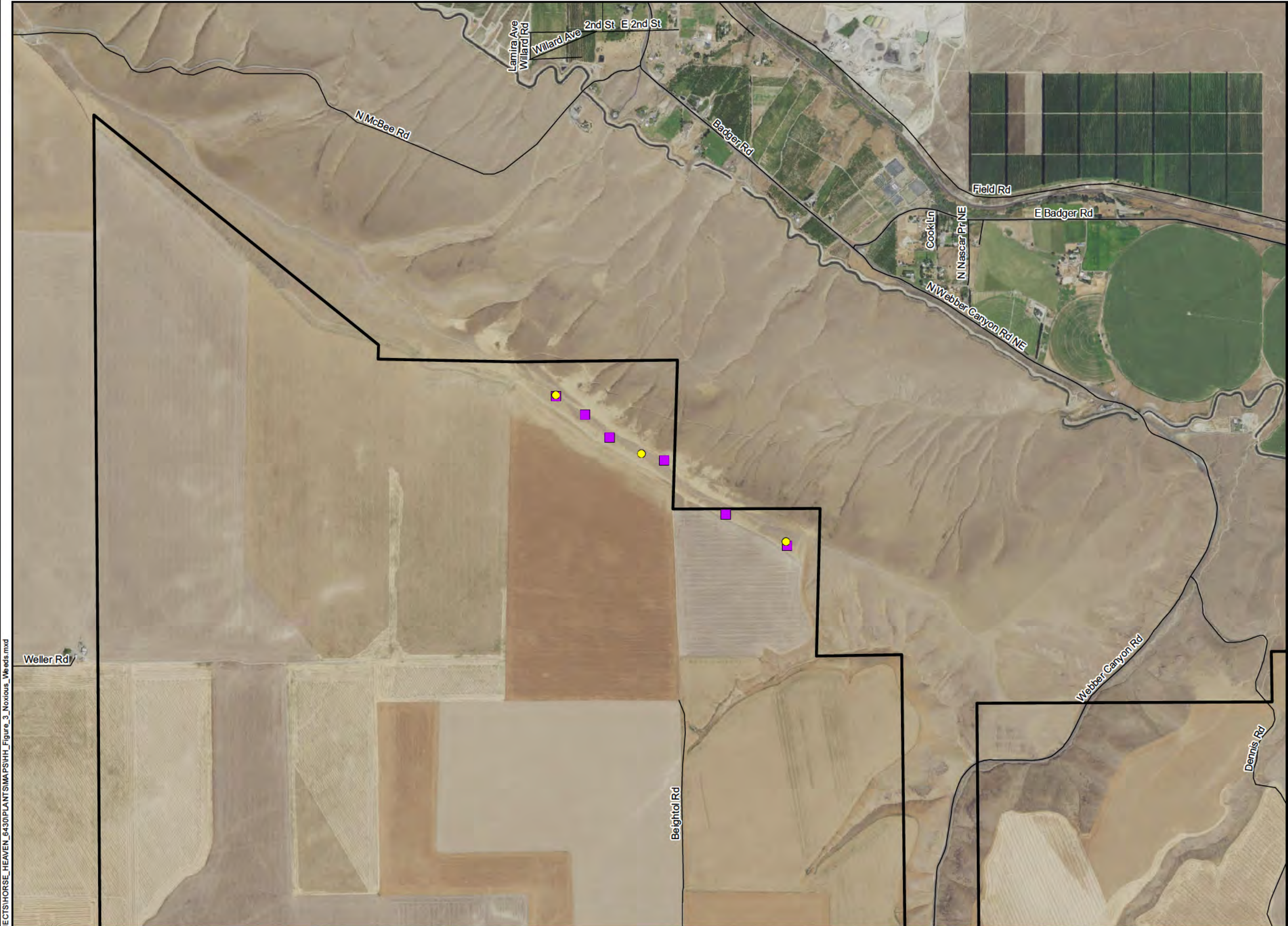
Turbines (4/15/20)

Noxious Weed

- *Centaurea solstitialis* (yellow starthistle)
- *Centaurea* spp. (knapweed)
- *Chondrilla juncea* (rush skeleton weed)
- *Kochia scoparia* (kochia)
- *Onopordum acanthium* (Scotch thistle)
- *Secale cereale* (cereal rye)



Reference Map



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Horse Heaven
Wind Farm




Figure 3b
Noxious Weeds







BENTON COUNTY, WA

 Project Boundary (4/17/20)

Turbine Survey Locations

 Turbines (4/15/20)

Noxious Weed

-  *Centaurea solstitialis* (yellow starthistle)
-  *Centaurea* spp. (knapweed)
-  *Chondrilla juncea* (rush skeleton weed)
-  *Kochia scoparia* (kochia)
-  *Onopordum acanthium* (Scotch thistle)
-  *Secale cereale* (cereal rye)



Reference Map



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Horse Heaven Wind Farm



Figure 3c Noxious Weeds

BENTON COUNTY, WA

Project Boundary (4/17/20)

Turbine Survey Locations

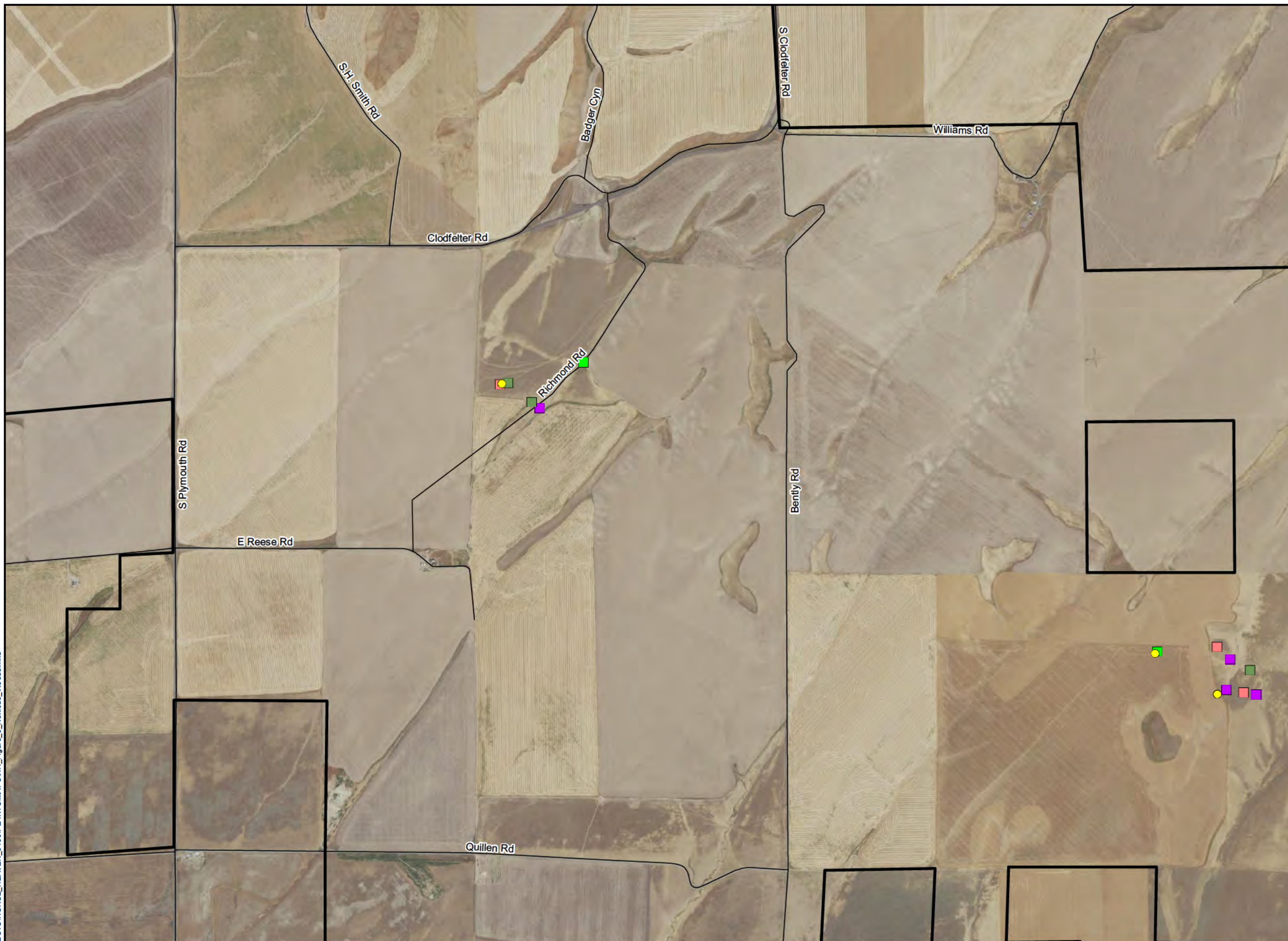
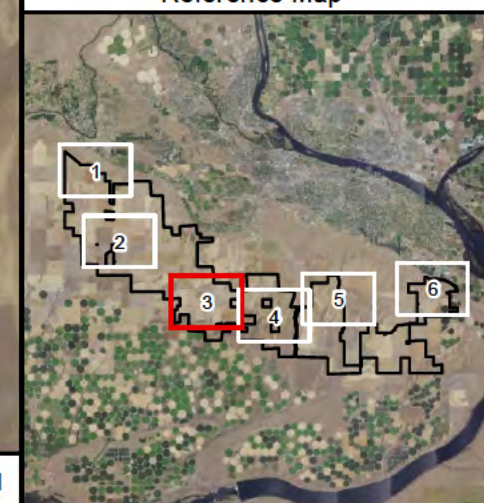
Turbines (4/15/20)

Noxious Weed

- Centaurea solstitialis* (yellow starthistle)
- Centaurea* spp. (knapweed)
- Chondrilla juncea* (rush skeleton weed)
- Kochia scoparia* (kochia)
- Onopordum acanthium* (Scotch thistle)
- Secale cereale* (cereal rye)



Reference Map



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Horse Heaven Wind Farm



Figure 3d Noxious Weeds

BENTON COUNTY, WA

Project Boundary (4/17/20)

Turbine Survey Locations

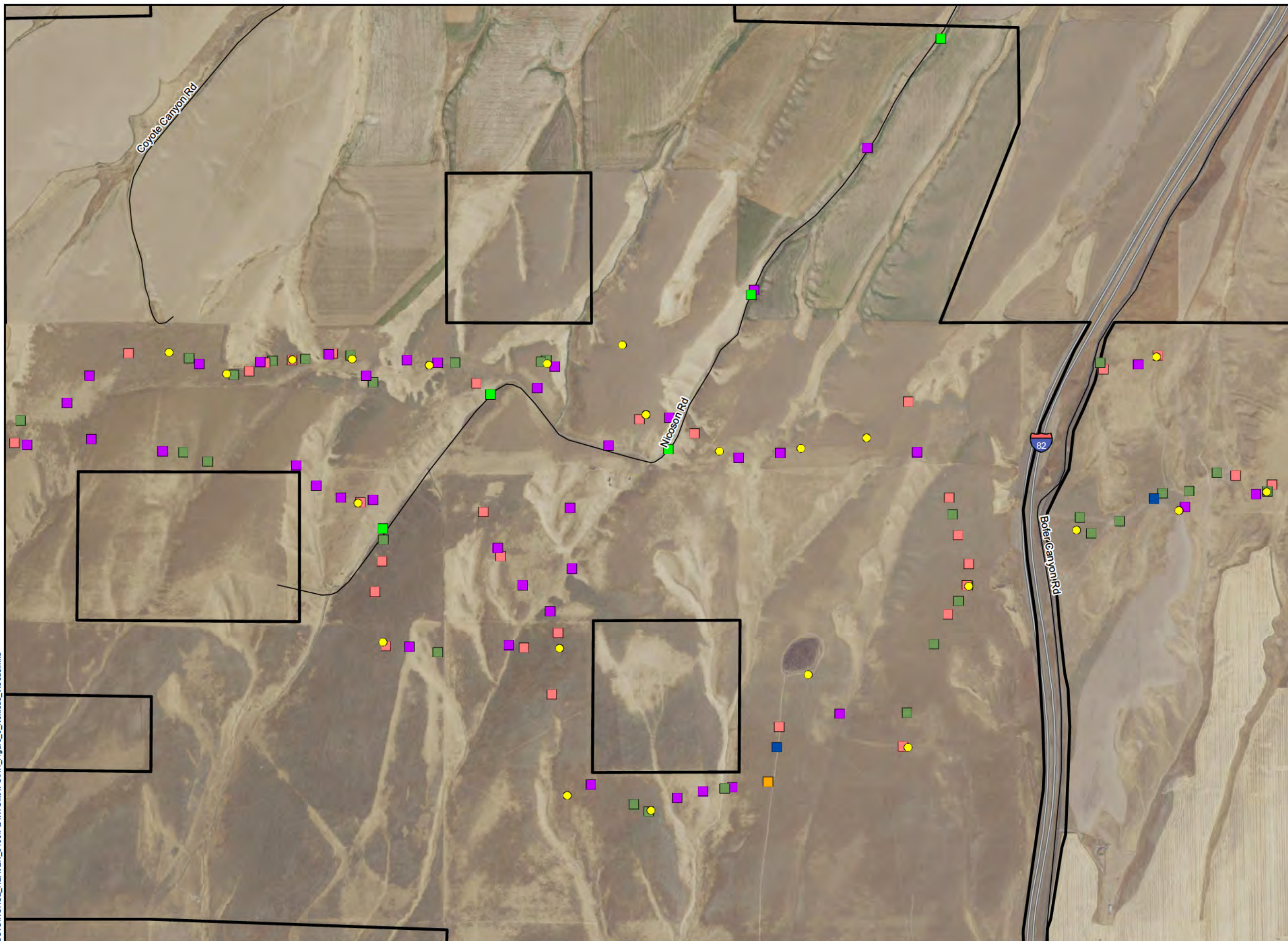
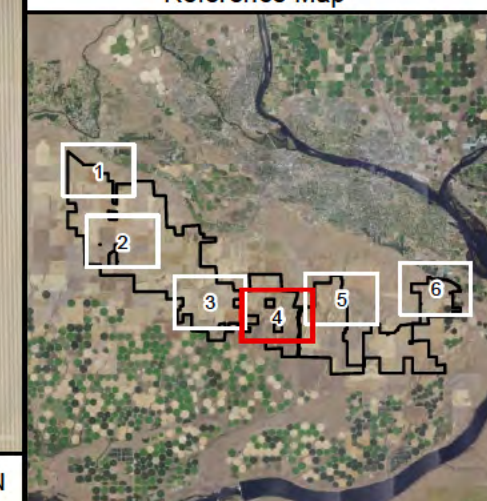
Turbines (4/15/20)

Noxious Weed

- Centaurea solstitialis* (yellow starthistle)
- Centaurea* spp. (knapweed)
- Chondrilla juncea* (rush skeleton weed)
- Kochia scoparia* (kochia)
- Onopordum acanthium* (Scotch thistle)
- Secale cereale* (cereal rye)



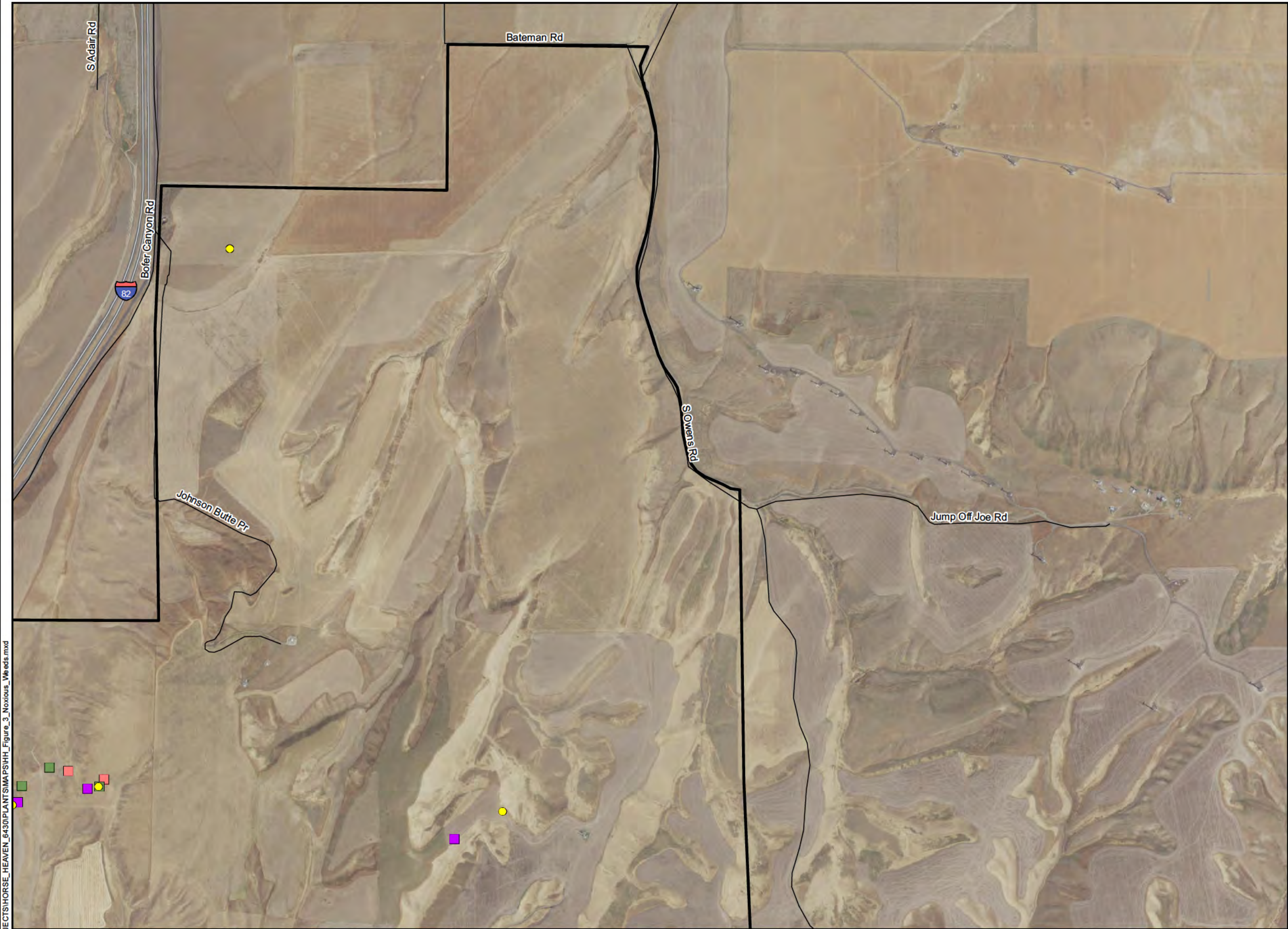
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Horse Heaven Wind Farm



**Figure 3e
Noxious Weeds**

BENTON COUNTY, WA

Project Boundary (4/17/20)

Turbine Survey Locations

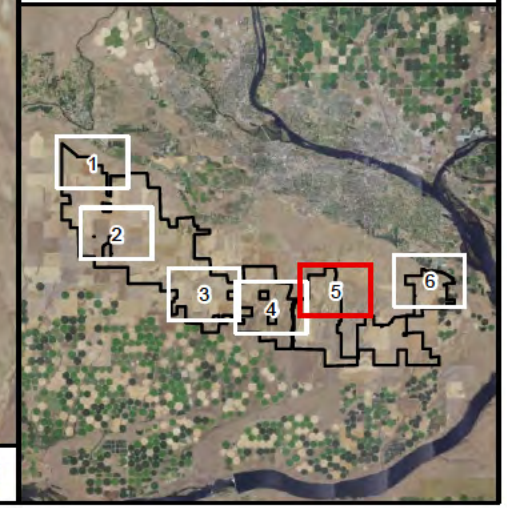
Turbines (4/15/20)

Noxious Weed

- Centaurea solstitialis* (yellow starthistle)
- Centaurea* spp. (knapweed)
- Chondrilla juncea* (rush skeleton weed)
- Kochia scoparia* (kochia)
- Onopordum acanthium* (Scotch thistle)
- Secale cereale* (cereal rye)



Reference Map



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Horse Heaven Wind Farm



Figure 3f Noxious Weeds

BENTON COUNTY, WA

Project Boundary (4/17/20)

Turbine Survey Locations

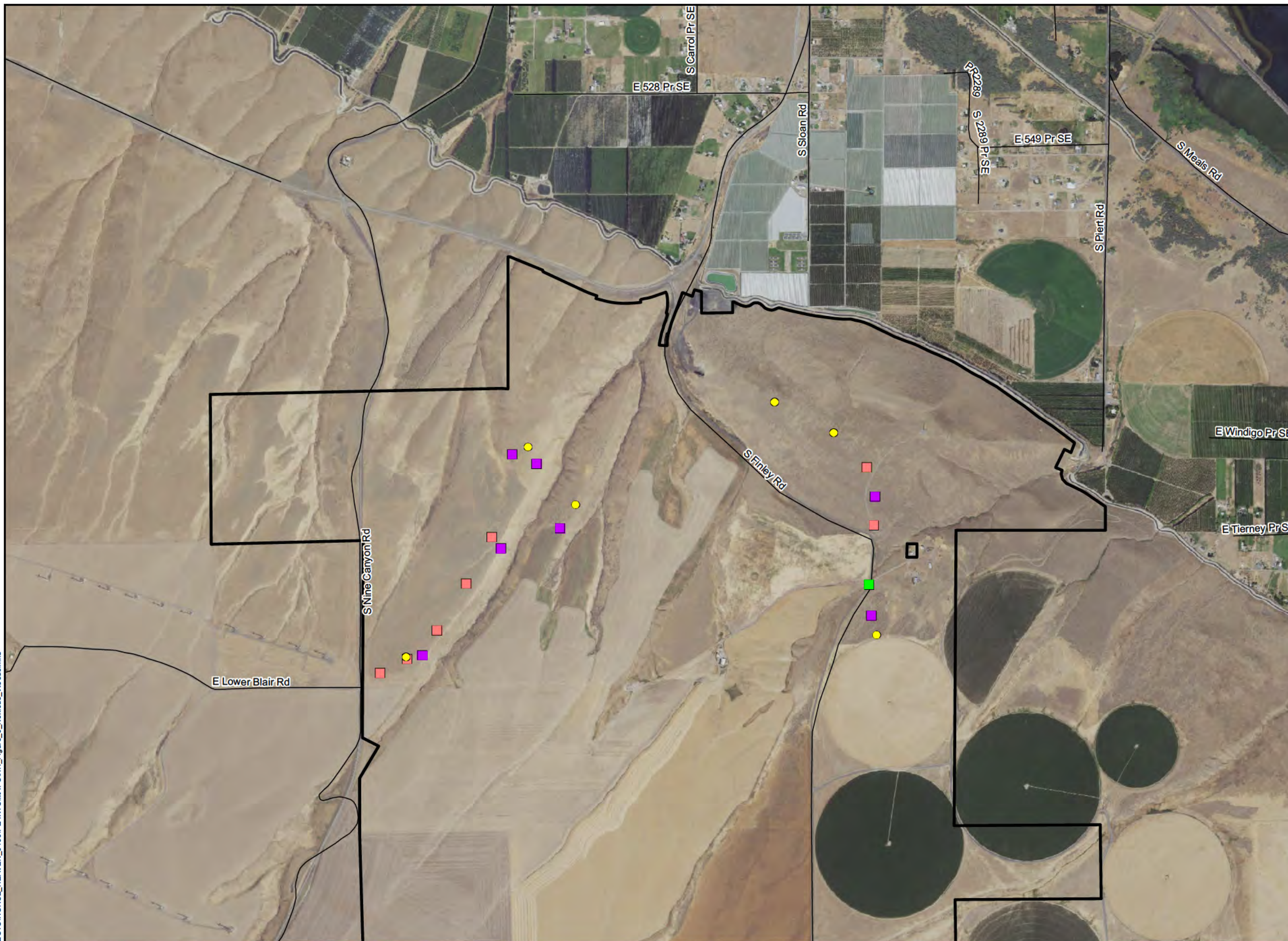
Turbines (4/15/20)

Noxious Weed

- Centaurea solstitialis* (yellow starthistle)
- Centaurea* spp. (knapweed)
- Chondrilla juncea* (rush skeleton weed)
- Kochia scoparia* (kochia)
- Onopordum acanthium* (Scotch thistle)
- Secale cereale* (cereal rye)



Reference Map



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Horse Heaven Wind Farm



**Figure 4a
Habitat Mapping**

BENTON COUNTY, WA

Project Boundary (4/17/20)

Turbine Survey Locations

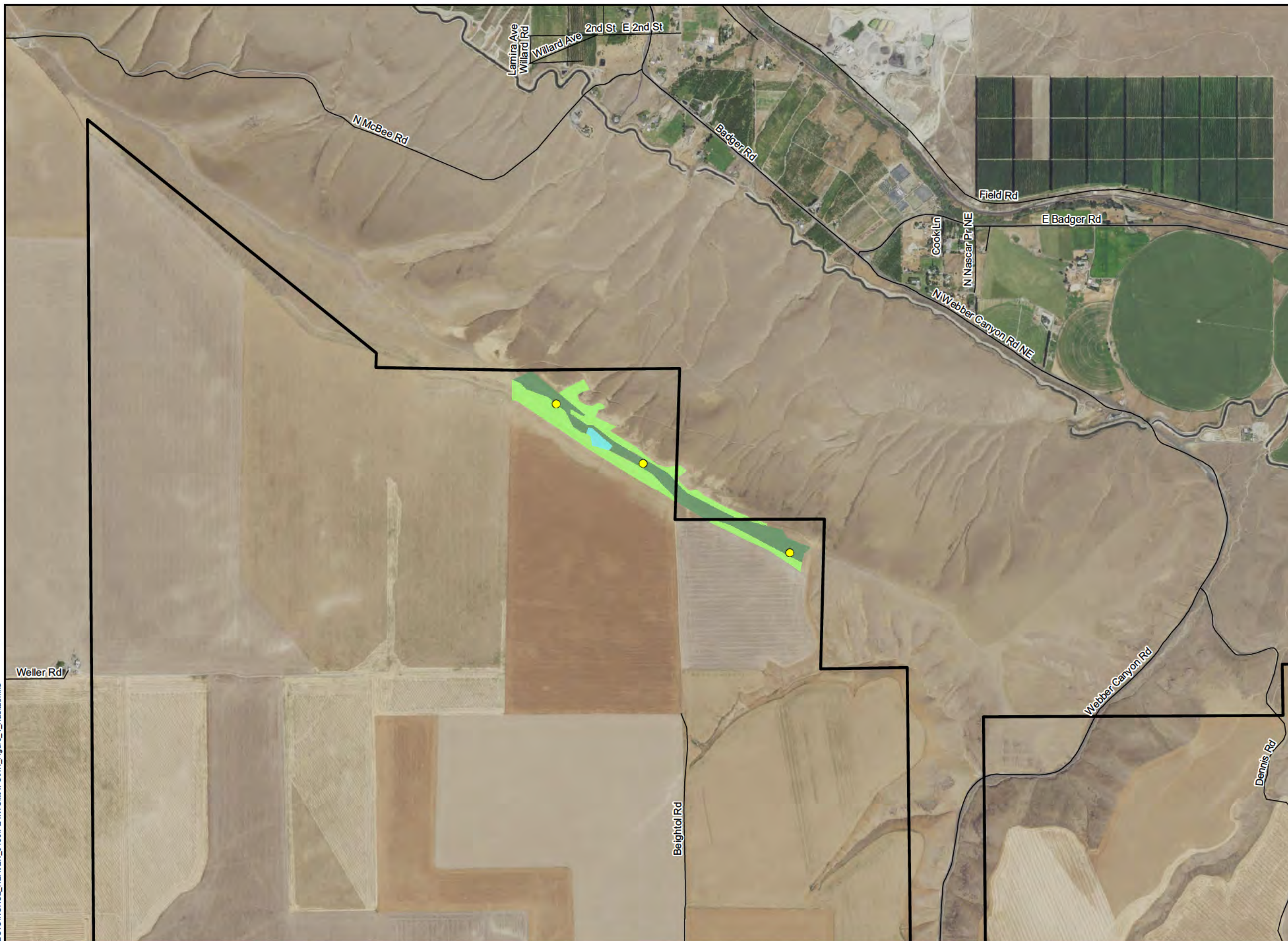
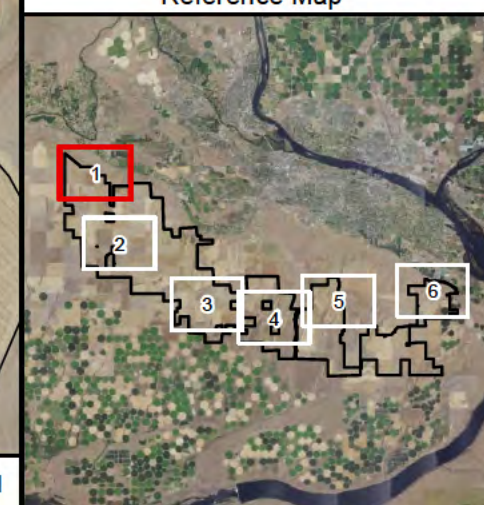
Turbines (4/15/20)

Habitat Type

- Agricultural land
- Developed/disturbed
- Dwarf shrub-steppe
- Non-native grassland
- Planted grassland
- Rabbitbrush shrubland
- Sagebrush shrub-steppe



Reference Map



1:20,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet

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Horse Heaven Wind Farm



Figure 4b Habitat Mapping

BENTON COUNTY, WA

Project Boundary (4/17/20)

Turbine Survey Locations

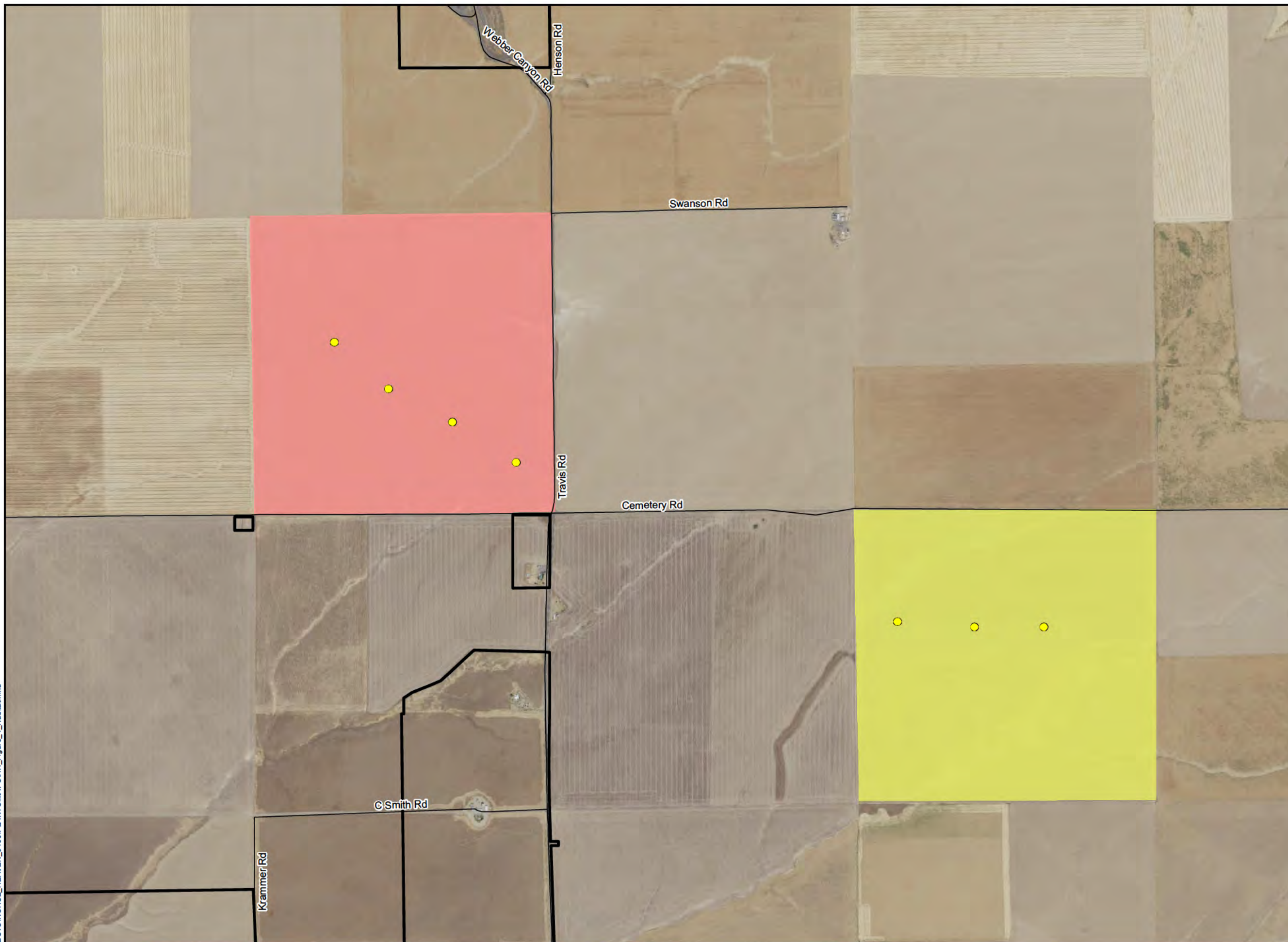
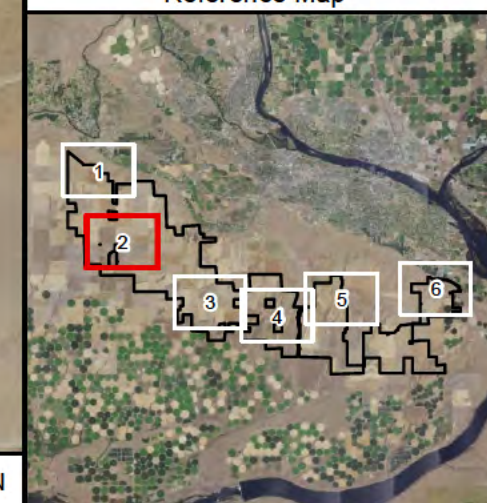
Turbines (4/15/20)

Habitat Type

- Agricultural land
- Developed/disturbed
- Dwarf shrub-steppe
- Non-native grassland
- Planted grassland
- Rabbitbrush shrubland
- Sagebrush shrub-steppe



Reference Map



1:20,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet

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NOT FOR CONSTRUCTION

Horse Heaven Wind Farm



**Figure 4c
Habitat Mapping**

BENTON COUNTY, WA

Project Boundary (4/17/20)

Turbine Survey Locations

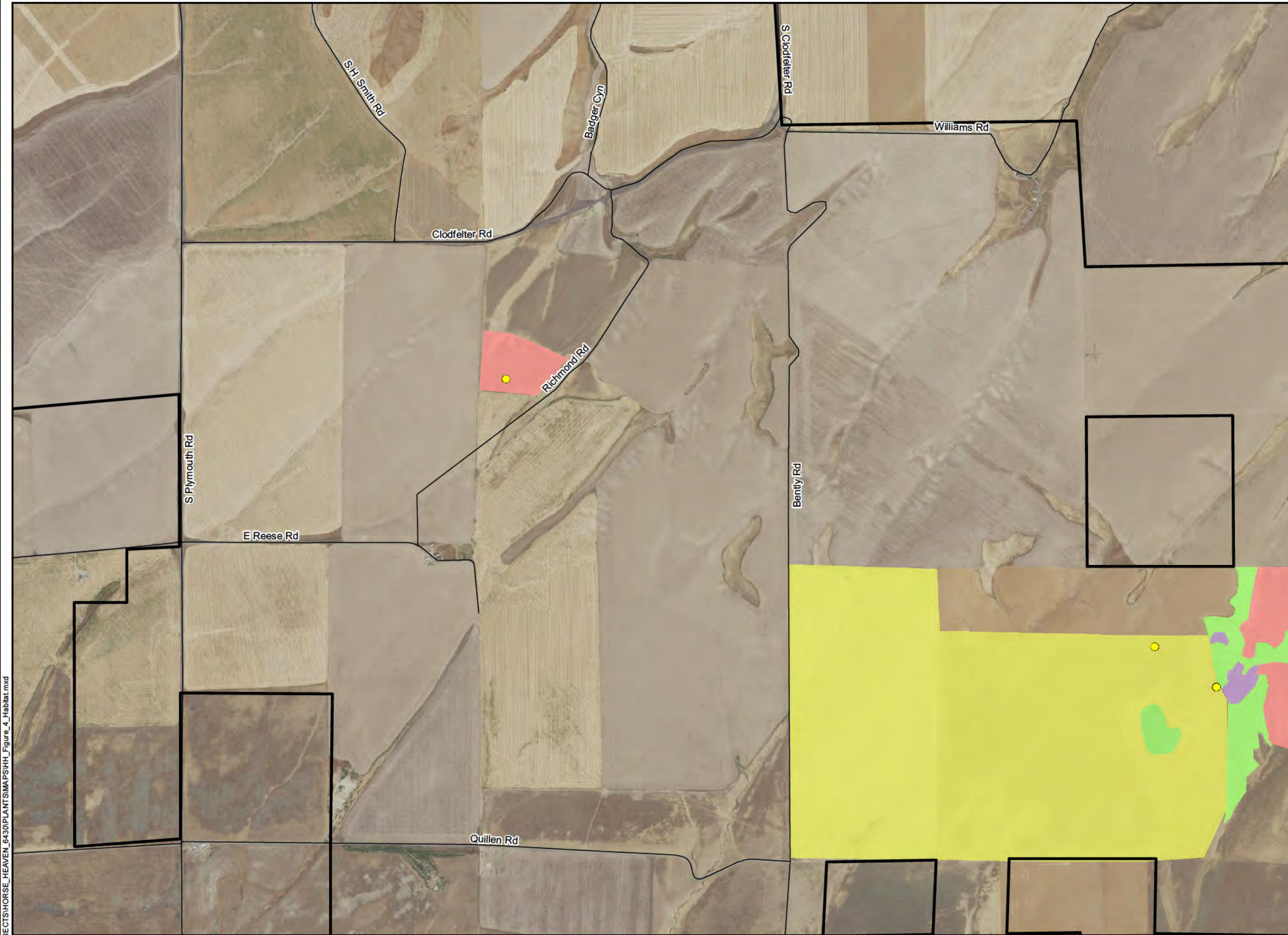
Turbines (4/15/20)

Habitat Type

- Agricultural land
- Developed/disturbed
- Dwarf shrub-steppe
- Non-native grassland
- Planted grassland
- Rabbitbrush shrubland
- Sagebrush shrub-steppe



Reference Map



R:\PROJECTS\HORSE_HEAVEN_6430\PLANT\MAPS\HH_Figure_4_Habitat.mxd

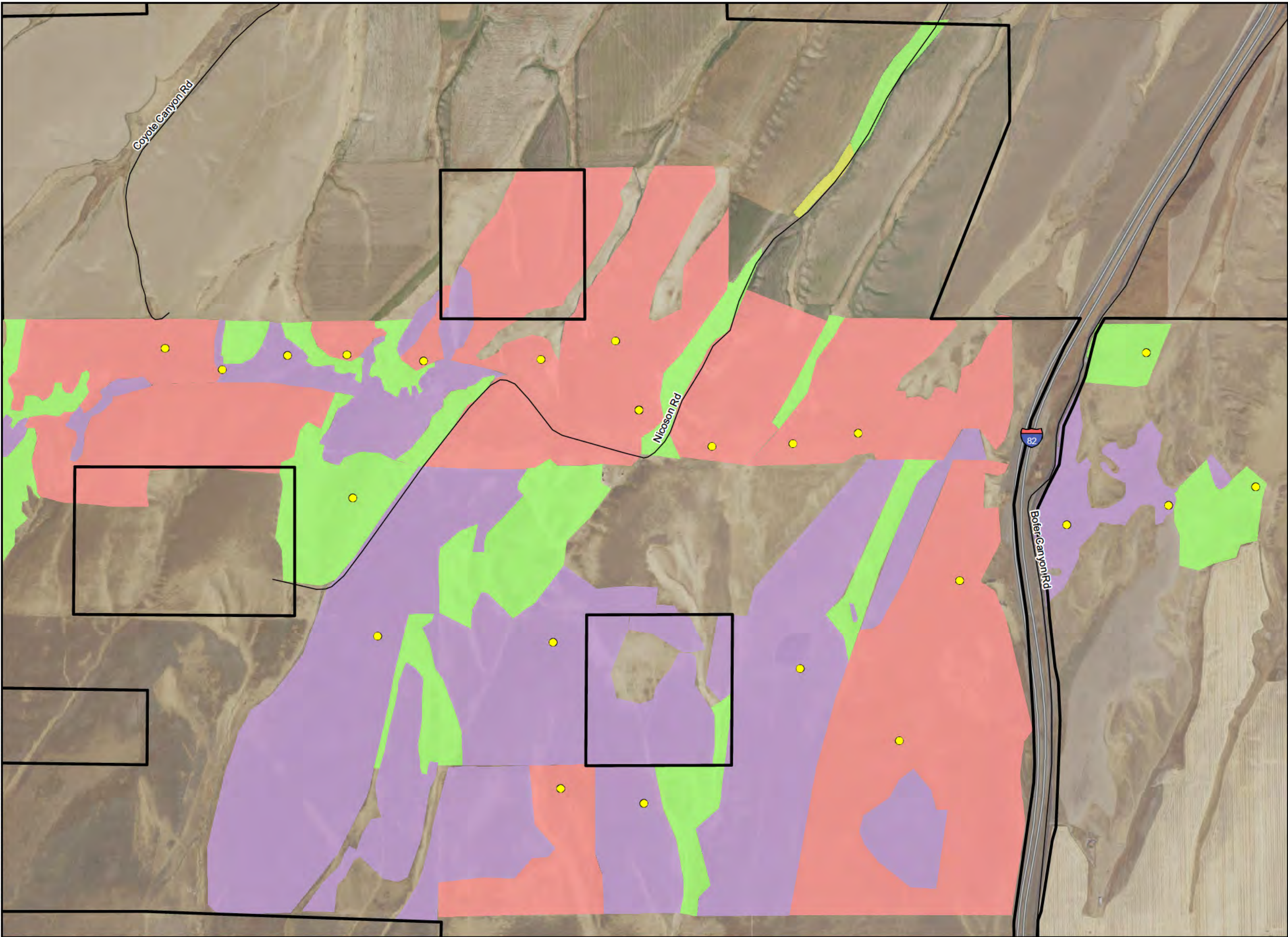


1:20,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet

0 1,000 2,000 4,000 Feet

NOT FOR CONSTRUCTION

R:\PROJECTS\HORSE_HEAVEN_6430\PLANT\SMAPS\HH_Figure_4_Habitat.mxd



Horse Heaven
Wind Farm



Figure 4d
Habitat Mapping

BENTON COUNTY, WA

Project Boundary (4/17/20)

Turbine Survey Locations

Turbines (4/15/20)

Habitat Type

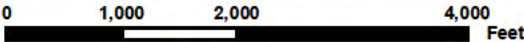
- Agricultural land
- Developed/disturbed
- Dwarf shrub-steppe
- Non-native grassland
- Planted grassland
- Rabbitbrush shrubland
- Sagebrush shrub-steppe



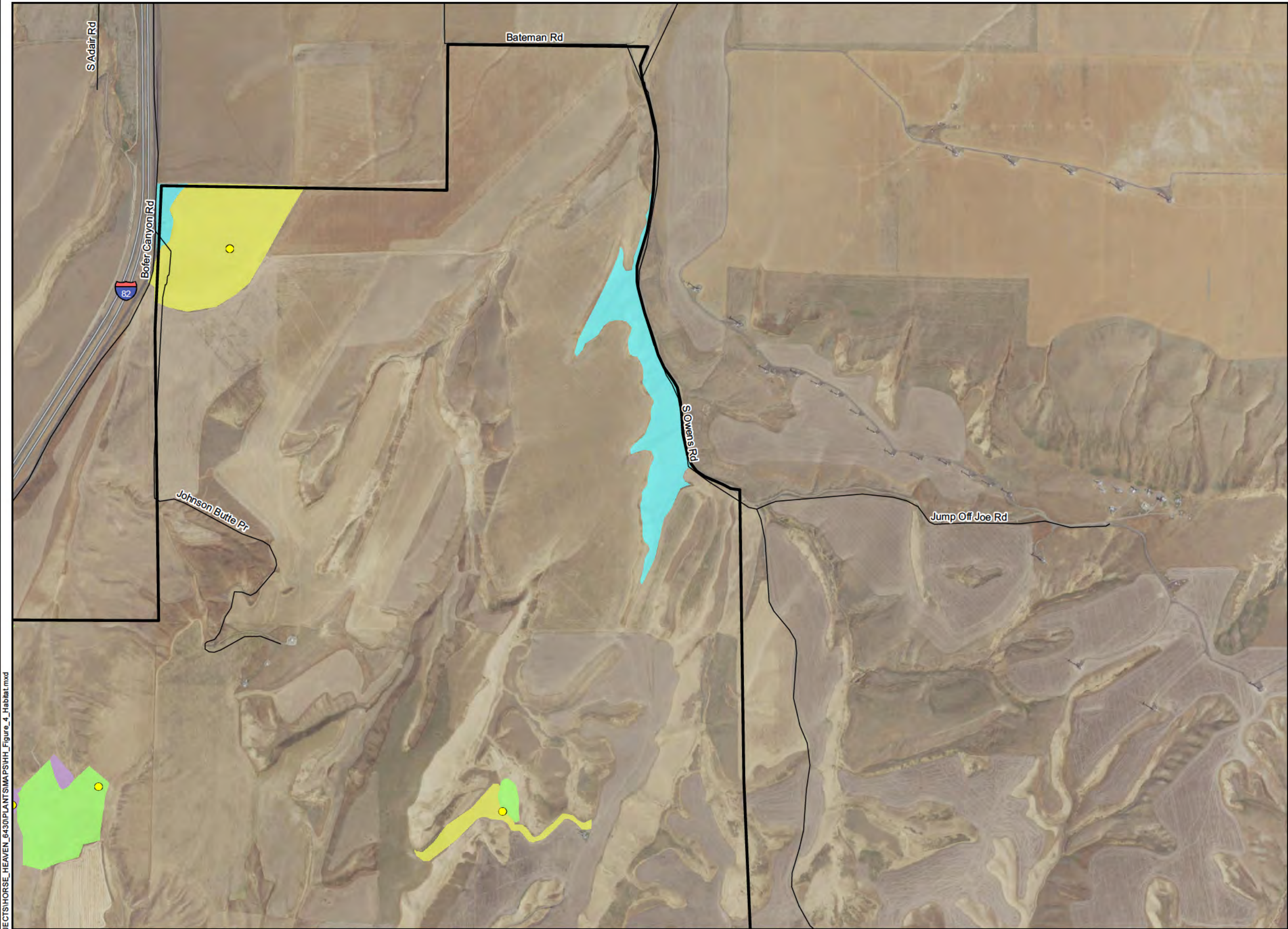
Reference Map



1:20,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet



NOT FOR CONSTRUCTION



Horse Heaven Wind Farm



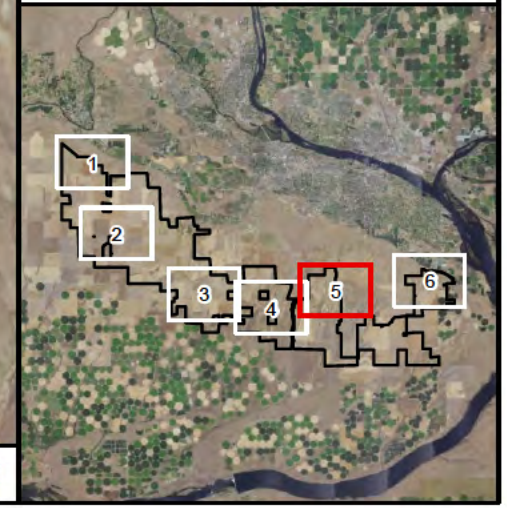
**Figure 4e
Habitat Mapping**

BENTON COUNTY, WA

- Project Boundary (4/17/20)
- Turbine Survey Locations**
 - Turbines (4/15/20)
- Habitat Type**
 - Agricultural land
 - Developed/disturbed
 - Dwarf shrub-steppe
 - Non-native grassland
 - Planted grassland
 - Rabbitbrush shrubland
 - Sagebrush shrub-steppe



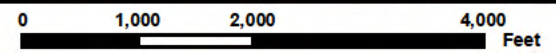
Reference Map



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1:20,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet



NOT FOR CONSTRUCTION

Horse Heaven Wind Farm



**Figure 4f
Habitat Mapping**

BENTON COUNTY, WA

Project Boundary (4/17/20)

Turbine Survey Locations

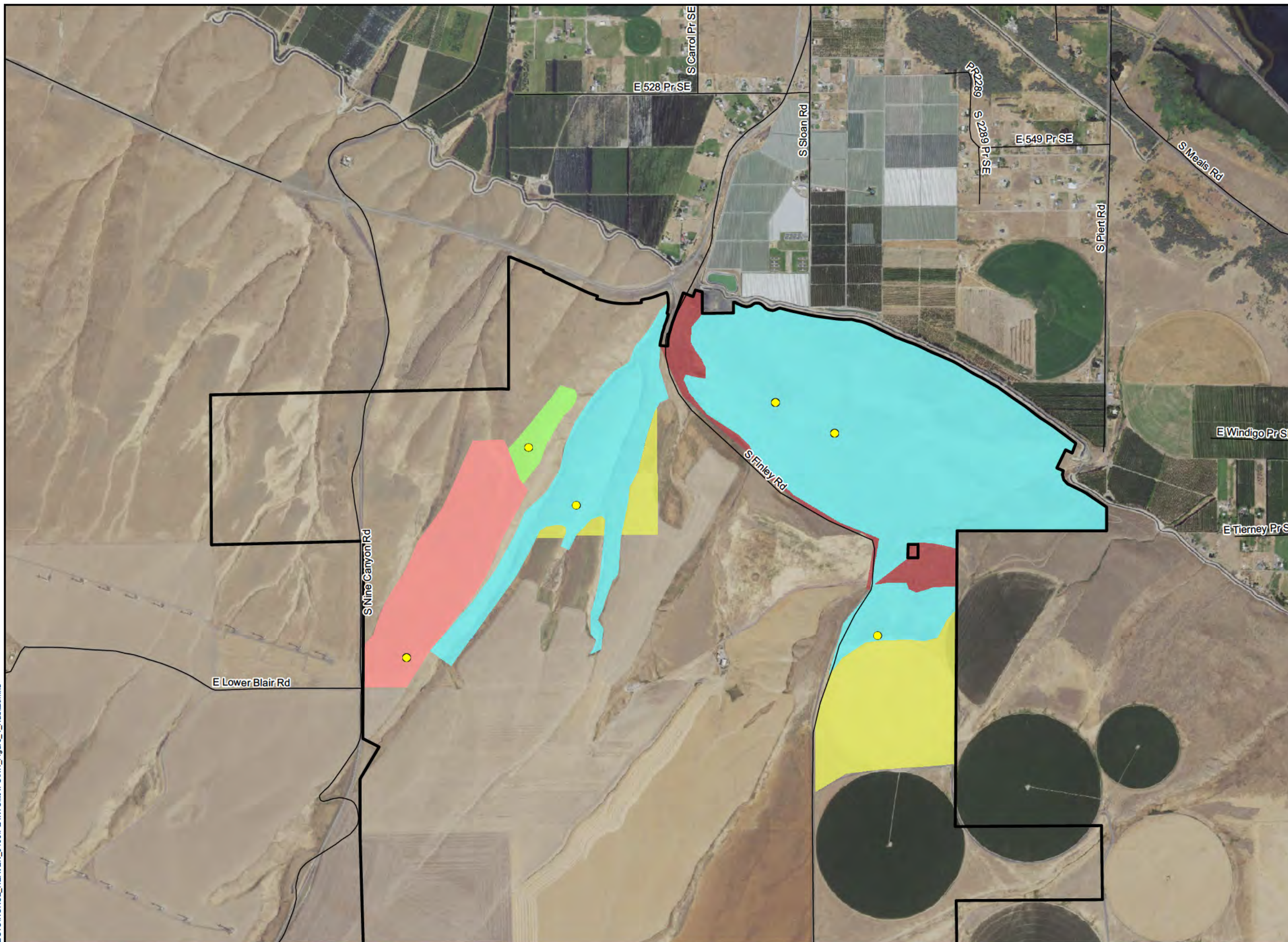
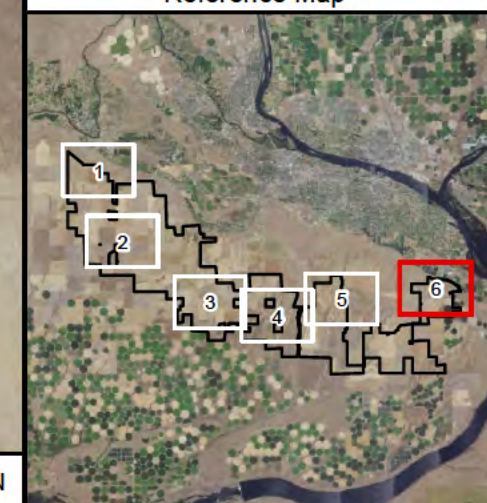
Turbines (4/15/20)

Habitat Type

- Agricultural land
- Developed/disturbed
- Dwarf shrub-steppe
- Non-native grassland
- Planted grassland
- Rabbitbrush shrubland
- Sagebrush shrub-steppe



Reference Map



1:20,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet

0 1,000 2,000 4,000 Feet

NOT FOR CONSTRUCTION

**ATTACHMENT A
SPECIAL-STATUS PLANT SPECIES
WITH POTENTIAL TO OCCUR WITHIN THE
SURVEY AREA**

Table A-1. Special-Status Plant Species with Potential to Occur within the Survey Area

Scientific name (Common Name)	State Status ^{1/}	Habitat Characteristics/ Identifying Features ^{2/}	Potential to Occur in Survey Area	Survey Period
<i>Aliciella leptomeria</i> (Great Basin gilia)	T	Open habitats in semiarid regions, on dry bluffs or in sandy swales. Substrates are often hard, gravelly or sandy, fine reddish to blackish basalt soils, or fine nonbasalt gravel with caliche fragments. Associated species include: <i>Artemisia tridentata</i> , <i>Grayia spinosa</i> , and <i>Gilia sinuata</i> . Elev. 470 - 1,140 feet.	Low; limited suitable likely present in survey area.	May
<i>Ammania robusta</i> (grand redstem)	T	Shoreline and islands along the Columbia River, in riparian mudflats dominated by annual species. Also known from lakeshores in the channeled scablands. Sites are inundated until midsummer and periodically throughout the growing season, depending on upstream management of the river. Associated species include <i>Rotala ramosior</i> , <i>Eleocharis acicularis</i> , <i>Cyperus</i> spp., <i>Limosella aquatica</i> , <i>Lindernia dubia</i> , and occasionally <i>Rorippa columbiae</i> .	Unlikely; suitable habitat unlikely to occur within survey area.	May - June
<i>Artemisia campestris</i> var. <i>wormskioldii</i> (Wormskiold's northern wormwood)	E	Known from 2 occurrences in the Columbia River floodplain on basalt, compacted cobble, and sand in shrub-steppe vegetation. Associated species include: <i>Phacelia hastata</i> , <i>Rumex venosus</i> , <i>Artemisia campestris</i> var. <i>scouleriana</i> , <i>Lupinus polyphyllus</i> , <i>Eriogonum compositum</i> , <i>Sisymbrium altissimum</i> , <i>Penstemon acuminatus</i> , and <i>Centaurea diffusa</i> .	Unlikely; only known from 2 disjunct sites along the Columbia River.	April - May
<i>Astragalus columbianus</i> (Columbia milkvetch)	S	Shrub-steppe habitats on sandy or gravelly loams, silts, rocky silt loams, and lithosols. Associated species include: <i>Artemisia tridentata</i> , <i>A. rigida</i> , <i>Pseudoroegneria spicata</i> , <i>Astragalus caricinus</i> , <i>A. purshii</i> , <i>A. speirocarpus</i> , and <i>A. succumbens</i> . Elev. 420 - 2,320 feet.	Low to moderate; suitable habitat potentially present in survey area.	Mid-April – mid-June
<i>Astragalus kentrophyta</i> var. <i>douglasii</i> (thistle milkvetch)	X	On sandy ground, dunes, or eroded riverbanks at low elevations. Not seen since 1883; this taxon is likely extinct.	Unlikely; species is believed to be extirpated in Washington.	June
<i>Astragalus misellus</i> var. <i>pauper</i> (pauper milk-vetch)	S	Open ridgetops and upper slopes, rarely middle and lower slopes, along western margin of the Columbia Basin province. In <i>Artemisia tridentata</i> / <i>Pseudoroegneria spicata</i> community. Associated species include: <i>Artemisia rigida</i> , <i>A. tridentata</i> , <i>Crepis atriobarba</i> , <i>C. occidentalis</i> , <i>Eriogonum sphaerocephalum</i> , <i>Pseudoroegneria spicata</i> , <i>Poa secunda</i> , <i>Astragalus purshii</i> , <i>Erigeron linearis</i> , <i>Lomatium macrocarpum</i> , <i>Phlox longifolia</i> , and <i>P. hoodii</i> . Elev. 500 to 3,280 feet.	Unlikely; known occurrences in Benton County are historical occurrences.	April – mid-May
<i>Calyptridium roseum</i> (rosy pussypaws)	T	Sagebrush desert to arid montane forest, in sandy to gravelly soils. In Washington, grows in very dry shrub-steppe, in low swales in dark sandy soil. In spring, the swale microsites may be moister than the surrounding habitat. Associated species include: <i>Artemisia tridentata</i> , <i>Bromus tectorum</i> , <i>Poa secunda</i> , <i>Cryptantha circumscissa</i> , <i>Holosteum umbellatum</i> , <i>Draba verna</i> , <i>Erythranthe suksdorfii</i> , <i>Microsteris gracilis</i> , <i>Loeflingia squarrosa</i> subsp. <i>squarrosa</i> , and <i>Gilia leptomeria</i> . Elev. 525 feet.	Low to moderate; suitable habitat potentially present in survey area.	May - June

Scientific name (Common Name)	State Status ^{1/}	Habitat Characteristics/ Identifying Features ^{2/}	Potential to Occur in Survey Area	Survey Period
<i>Cryptantha leucophaea</i> (gray cryptantha)	T	Sandy substrates, especially sand dunes that have not been completely stabilized. Appears to be restricted to areas where there is still some wind-derived movement of open sand. Associated species include: <i>Purshia tridentata</i> , <i>Artemisia tridentata</i> , <i>Hesperostipa comata</i> , <i>Achnatherum hymenoides</i> , <i>Poa secunda</i> , <i>Oenothera pallida</i> , <i>Eriogonum niveum</i> , <i>Penstemon attenuates</i> , and <i>Astragalus succumbens</i> . Elev. 300-2,500 feet.	Low; limited suitable habitat likely present in survey area.	May - June
<i>Cryptantha scoparia</i> (desert cryptantha)	S	Dry areas with full sun and little competing vegetation. In Washington, grows on south-facing slopes and ridges between small canyons with fine, dry silt and talus. Sites may be a little more alkaline than surrounding areas. Associated species include: <i>Artemisia tridentata</i> , <i>Krascheninnikovia lanata</i> , <i>Eriogonum niveum</i> , <i>Eriophyllum lanatum</i> , <i>Epilobium minutum</i> , <i>Bromus hordeaceus</i> , <i>Bromus tectorum</i> , and <i>Pseudoroegneria spicata</i> . Elev. 1,200 - 2,100 feet.	Low; limited suitable habitat likely present in survey area.	April - June
<i>Cryptantha spiculifera</i> (Snake River cryptantha)	S	Sandy knolls and badlands and talus at low elevations; dry, open, flat or sloping areas in stable or stony soils. Associated species include: <i>Artemisia rigida</i> , <i>A. tridentata</i> , <i>Ericameria nauseosa</i> , <i>Eriogonum sphaerocephalum</i> , <i>Salvia dorrii</i> , <i>Lupinus sericeus</i> , <i>Pseudoroegneria spicata</i> , and <i>Poa secunda</i> . Elev. 450 to 3,500 feet.	Low; limited suitable habitat likely present in survey area.	May - July
<i>Cuscuta denticulata</i> (desert dodder)	T	Parasitic on a variety of native shrubs in desert areas, including sagebrush (<i>Artemisia</i> spp.), rabbitbrush (<i>Chrysothamnus/Ericameria</i> spp.). Associated species include: <i>Artemisia tridentata</i> , <i>Poa secunda</i> , <i>Achnatherum hymenoides</i> , <i>Bromus tectorum</i> , <i>Astragalus caricinus</i> , <i>Erigeron poliospermus</i> , <i>Cymopterus terebinthinus</i> , and <i>Helianthus cusickii</i> . Elev. 880 - 1,089 feet.	Unlikely; known occurrences in Benton County are historical occurrences.	July - August
<i>Eleocharis coloradoensis</i> (dwarf spike-rush)	X	Fresh to brackish bare wet soil, inland. Fresh or brackish drying lake and pond margins, stream beds, flood plains, vernal pools, irrigation ditches, tidal wetlands. Elev. 0 - 6,900 feet.	Unlikely; species is believed to be extirpated in Washington.	Spring - fall
<i>Eremogone franklinii</i> var. <i>thompsonii</i> (Thompson's sandwort)	S	Sand dunes, scabland, and sagebrush slopes. Associated species include: <i>Purshia tridentata</i> , <i>Poa canbyi</i> and other bunchgrasses.	Low; limited suitable habitat likely present in survey area.	May - June
<i>Eremothera minor</i> (small-flower evening-primrose)	S	Gravelly basalt slopes, sandy and alkaline soils, and dry rocky hillsides; often with considerable cover of bare soil. Associated species include: <i>Artemisia tridentata</i> , <i>Ericameria nauseosa</i> , <i>Purshia tridentata</i> , <i>Bromus tectorum</i> , and <i>Poa secunda</i> . Elev. 460 - 1,140 feet.	Low; limited suitable habitat likely present within survey area.	May - early June
<i>Eremothera pygmaea</i> (dwarf evening-primrose)	S	Sagebrush steppe, on unstable soil or gravel in steep talus, dry washes, banks, and roadcuts. Associated species include: <i>Artemisia tridentata</i> , <i>Bromus tectorum</i> , <i>Eriogonum</i> spp., <i>Gilia minutiflora</i> , <i>Mentzelia</i> spp., <i>Cryptantha</i> spp., <i>Salsola tragus</i> , and <i>Neoholmgrenia (Camissonia) andina</i> . Elev. 450 - 2,050 feet.	Low; limited suitable habitat likely present within survey area.	June - August

Scientific name (Common Name)	State Status ^{1/}	Habitat Characteristics/ Identifying Features ^{2/}	Potential to Occur in Survey Area	Survey Period
<i>Erythranthe suksdorfii</i> (Suksdorf's monkeyflower)	S	Open, moist, or rather dry places, from the valleys and foothills to moderate or occasionally high elevations in the mountains. Occurs in seasonally moist swales, drainages, or vernal pools in shrub-steppe vegetation. Microhabitats are often disturbed by small erosive events (i.e., slumps, slides, bioturbation, and frost boils). Associated species include: <i>Juniperus communis</i> , <i>Philadelphus lewisii</i> , <i>Artemisia tridentata</i> , <i>Eriogonum</i> sp., <i>Bromus tectorum</i> , <i>Poa secunda</i> , <i>Camissonia hilgardii</i> , <i>Collomia linearis</i> , <i>Draba verna</i> , <i>Erythranthe floribunda</i> , <i>E. breviflora</i> , <i>Plectritis macrocera</i> , <i>Cryptantha ambigua</i> , <i>Microsteris gracilis</i> , and <i>Ranunculus testiculatus</i> . Elev. 430 to 7,100 feet.	Unlikely; suitable habitat unlikely to occur within survey area.	mid-April – approx. June
<i>Hypericum majus</i> (Canadian St. John's-wort)	S	Along ponds, lakesides, riparian habitats, or other low, wet places (FACW species). In Washington, it occurs in habitats that are completely submerged during portions of the growing season or periodically inundated from water controlled by hydroelectric dams. Associated species include: <i>Equisetum</i> spp., <i>Juncus bufonius</i> , <i>J. tenuis</i> , <i>J. articulatus</i> , and <i>Carex</i> spp. Elev. 50 - 2,340 feet.	Unlikely; suitable habitat unlikely to occur within survey area.	July - September
<i>Leymus flavescens</i> (yellow wildrye)	S	Occurs in sandy soils throughout its range. In Montana it is found in sand-deposition areas of sand dunes, where it is associated with <i>Hesperostipa comata</i> and <i>Elymus caninus</i> . The species has also been found on sandy roadsides.	Unlikely; known occurrence in Benton County is a historical occurrence.	June - July
<i>Lipocarpa aristulata</i> (awned halfchaff sedge)	T	Wet soil and mud, often comprised of fine sand and silt, in bottomlands, sandbars, beaches, shorelines, stream banks, ponds, and ditches. In WA, grows along shorelines and islands below high water at elevations up to 500 feet. Associated species include: <i>Eleocharis</i> spp., <i>Juncus</i> spp., <i>Ammannia robusta</i> , <i>Rotala ramoiior</i> , <i>Cyperus</i> spp., <i>Limosella</i> spp., <i>Lindernia dubia</i> , and <i>Rorippa columbiae</i> .	Unlikely; suitable habitat unlikely to occur within survey area.	Late-summer – early-fall
<i>Loeflingia squarrosa</i> (spreading pygmyleaf)	T	Low swales and shallow vernal pools in sandy and silty areas. The Washington populations were found during an unusually wet year in swales and vernal wet areas with a great diversity of annuals in an otherwise arid environment. Associated species include: <i>Artemisia tridentata</i> , <i>Poa secunda</i> , <i>Greeneocharis circumscissa</i> , <i>Erythranthe suksdorfii</i> , <i>Holosteum umbellatum</i> , <i>Microsteris gracilis</i> , <i>Gnaphalium palustre</i> , <i>Epilobium minutum</i> , <i>Gilia sinuata</i> , and <i>Juncus bufonius</i> . Elev. 430 - 580 feet.	Unlikely; suitable habitat unlikely to occur within survey area.	May
<i>Lomatium tuberosum</i> (Hoover's desert-parsley)	S	Loose basalt talus in sagebrush steppe, typically on east- to north-facing slopes. Sometimes in channels of open ridgetops and talus on south- to southwest-facing slopes in the western portion of its distribution. Associated species include: <i>Artemisia rigida</i> , <i>Poa secunda</i> , <i>Pseudoroegneria spicata</i> , and <i>Delphinium nuttalianum</i> . Elev. 460 - 4,000 feet.	Low; limited suitable habitat likely present within survey area.	Early-March – mid-April

Scientific name (Common Name)	State Status ^{1/}	Habitat Characteristics/ Identifying Features ^{2/}	Potential to Occur in Survey Area	Survey Period
<i>Micromonolepis pusilla</i> (red poverty-weed)	T	Desert regions, in saline or alkaline clay soils, salt-encrusted soils, or edges of alkaline ponds. This species is adapted to extreme conditions. In some sites it is limited to growing directly beneath greasewood shrubs, due to cattle trampling and soil compaction between the shrubs. Associated species include: <i>Sarcobatus vermiculatus</i> , <i>Suaeda depressa</i> , <i>Bromus tectorum</i> , and <i>Phacelia tetramera</i> . Elev. 1,950 - 2,210 feet.	Unlikely; suitable habitat unlikely to occur within survey area and known occurrence in Benton County is historical occurrence.	April - June
<i>Mimetanthe pilosa</i> (false monkeyflower)	S	Moist, sandy or gravelly soils, especially by small streams, seeps, springs, and disturbed areas. Elev. 1,000-4,500 feet.	Unlikely; known occurrence in Benton County is a historical occurrence.	April - August
<i>Myosurus alopecuroides</i> (foxtail mouse-tail)	T	Obligate vernal pool species; found on hard, bare, desiccated clay in sparsely vegetated areas of shallow pools. Associated species include: <i>Deschampsia danthonioides</i> , <i>Myosurus minimus</i> , <i>Navarretia leucocephala</i> , <i>Plagiobothrys</i> spp., and <i>Polygonum polygaloides</i> ssp. <i>confertiflorum</i> . Elev. 250 to 2,500 feet.	Unlikely; suitable habitat unlikely to occur within survey area.	May - June
<i>Nicotiana attenuata</i> (coyote tobacco)	S	Dry, sandy bottom lands, dry rocky washes, and in other dry open places; Elev. 320 to 2,640 feet. Associated species: <i>Artemisia tridentata</i> , <i>Ericameria</i> spp., <i>Bromus tectorum</i> , <i>Leymus cinereus</i> , <i>Centaurea diffusa</i> , <i>Verbascum thapsus</i> , <i>Solanum triflorum</i> , <i>Achillea millefolium</i> , and <i>Mentzelia laevicaulis</i> .	Low to moderate; suitable habitat is potentially present in survey area.	June - September
<i>Oenothera cespitosa</i> ssp. <i>cespitosa</i> (cespitose evening-primrose)	S	Open sagebrush desert; on loose talus slopes, steep, sandy or gravelly slopes, road cuts, and dry hills; as well as along the flat river terrace of the Columbia River. It occurs within general areas dominated by <i>Artemisia tridentata</i> or <i>Artemisia rigida</i> . Other associated species include: <i>Ericameria nauseosa</i> , <i>Eriogonum douglasii</i> and <i>E. niveum</i> , <i>Poa secunda</i> , <i>Achnatherum thurberianum</i> , <i>A. hymenoides</i> , <i>Hesperostipa comata</i> , <i>Koeleria macrantha</i> , <i>Astragalus purshii</i> , <i>A. succumbens</i> , <i>Balsamorhiza careyana</i> , <i>Phacelia hastata</i> , and <i>Pteryxia terebinthina</i> . Elev. 410 to 1,800 feet.	Moderate; suitable habitat potentially present in survey area.	Late-April – mid-June
<i>Rorippa columbiae</i> (Columbia yellowcress)	T	Riverbanks, permanent lakes, snow-fed lakes, and streams, internally-drained lakes with extended periods of dryness, wet meadows, and ditches. All known sites are inundated for at least part of the year. Soil types include clay, sand, gravel, sandy silt, cobblestones, and rocks. All sites in Washington occur along the Columbia River, in the lowest vegetated riparian zone.	Unlikely; suitable habitat unlikely to occur within survey area.	April - October
<i>Rotala ramosior</i> (lowland toothcup)	S	Damp areas in fine sand and silt, wet, swampy places, mudflats, lakes and pond margins, and along free-flowing river reaches. Found in riparian wetlands growing below high water, often in a community of small emergent annuals. Elev. 200 to 2,260 feet. Associated species include: <i>Salix exigua</i> , <i>Ammannia robusta</i> , <i>Juncus</i> spp., <i>Eleocharis acicularis</i> , <i>Limosella acaulis</i> , <i>Lindneria dubia</i> , and <i>Cyperus acuminatus</i> . Elev. 200 to 2,259 feet.	Unlikely; suitable habitat unlikely to occur within survey area.	June - August

Scientific name (Common Name)	State Status ^{1/}	Habitat Characteristics/ Identifying Features ^{2/}	Potential to Occur in Survey Area	Survey Period
<i>Sabulina nuttallii</i> var. <i>fragilis</i> (Nuttall's sandwort)	T	Open, gravelly benches, dry rocky areas, or limestone talus from open sagebrush hills to alpine slopes. In Washington this taxon has been found on desert ridges of raised basalt, talus, outcrops, and in rocky to gravelly or sandy soil. Associated species include: <i>Purshia tridentata</i> , <i>Grayia spinosa</i> , <i>Salvia dorrii</i> , <i>Pseudoroegneria spicata</i> , <i>Ericameria nauseosa</i> , <i>Eriogonum microthecum</i> , <i>Balsamorhiza careyana</i> , and <i>Lomatium macrocarpum</i> .	Unlikely; suitable habitat unlikely to occur within survey area.	May - August
<i>Texosporium sancti-jacobi</i> (woven-spore lichen)	T	Arid to semi-arid shrub steppe, grassland or savannah communities up to 3,300 feet in elevation. On flat to gentle north-facing slopes. Soils are non-saline and noncalcareous. Most common on decomposing bunchgrass clumps that are impregnated with soil, but elevated above the surrounding surface. Also found on old, decaying mammal scat. Associated species: <i>Artemisia tridentata</i> , <i>Purshia tridentata</i> , <i>Poa secunda</i> , <i>Festuca idahoensis</i> , <i>Pseudoroegneria spicata</i> , the lichens <i>Megaspore verrucosa</i> , <i>Trapeliopsis</i> spp., <i>Cladonia</i> spp., and the moss <i>Encalypta raptocarpa</i> .	Low to moderate; suitable habitat potentially occurs within survey area.	April - June

Notes:

1/ State Status: WNHP (2019) provides the following explanation of state status:

E = Endangered, in danger of becoming extinct or extirpated from Washington

T = Threatened, likely to become Endangered in Washington

S = Sensitive, vulnerable or declining and could become Endangered or Threatened in Washington

X = Possibly extinct or extirpated from Washington State (includes state historical species).

No federally listed species have the potential to occur in survey area.

2/ Sources: Burke Museum of Natural History and Culture 2020; Camp and Gamon 2011; Hitchcock and Cronquist 2018; WNHP 2019, 2020.

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ATTACHMENT B
VASCULAR PLANTS OBSERVED WITHIN THE
SURVEY AREA

Scientific Name	Common Name	Family	Type	Non-native	Noxious Weed Class Benton County / Washington State	Synonyms / Notes
<i>Achillea millefolium</i>	common yarrow	Asteraceae	forb			
<i>Agoseris grandiflora</i>	bigflower agoseris	Asteraceae	forb			
<i>Agoseris heterophylla</i>	annual agoseris	Asteraceae	forb			
<i>Agropyron cristatum</i>	crested wheatgrass	Poaceae	grass	x		
<i>Allium acuminatum</i>	tapertip onion	Amaryllidaceae	forb			
<i>Ambrosia acanthicarpa</i>	bur ragweed	Asteraceae	forb			
<i>Amsinckia lycopsoides</i>	tarweed fiddleneck, bugloss fiddleneck	Boraginaceae	forb			
<i>Amsinckia tessellata</i>	bristly fiddleneck, tessellate fiddleneck	Boraginaceae	forb			
<i>Antennaria dimorpha</i>	low pussytoes	Asteraceae	forb			
<i>Artemisia tridentata</i>	big sagebrush	Asteraceae	shrub			
<i>Astragalus caricinus</i>	buckwheat milkvetch	Fabaceae	forb			
<i>Astragalus purshii</i>	woollypod milkvetch, rabbit eggs milk-vetch	Fabaceae	forb			
<i>Astragalus spaldingii</i>	Spalding's milkvetch	Fabaceae	forb			
<i>Astragalus succumbens</i>	crouching milkvetch, Columbia milkvetch	Fabaceae	forb			
<i>Balsamorhiza careyana</i>	Carey's balsamroot	Asteraceae	forb			
<i>Balsamorhiza rosea</i>	rosy balsamroot	Asteraceae	forb			
<i>Bassia scoparia</i>	red belvedere, mock cypress, kochia	Amaranthaceae	forb	x	Class B / Class B	<i>Kochia scoparia</i>
<i>Bromus arvensis</i>	field brome/Japanese brome	Poaceae	grass	x		<i>Bromus japonicus</i>
<i>Bromus hordeaceus</i>	soft brome	Poaceae	grass	x		<i>Bromus mollis</i>
<i>Bromus tectorum</i>	cheatgrass	Poaceae	grass	x		
<i>Calochortus macrocarpus</i> var. <i>macrocarpus</i>	sagebrush mariposa lily	Liliaceae	forb			
<i>Centaurea solstitialis</i>	yellow starthistle	Asteraceae	forb	x	Class B / Class B	
<i>Centaurea</i> sp.	knapweed	Asteraceae	forb	x	Class B / Class B	likely diffuse knapweed
<i>Ceratocephala testiculata</i>	burr buttercup	Ranunculaceae	forb	x		
<i>Chaenactis douglasii</i>	Douglas' dustymaiden, dusty maidens	Asteraceae	forb			
<i>Chondrilla juncea</i>	rush skeletonweed	Asteraceae	forb	x	Class B / Class B	
<i>Chorispora tenella</i>	crossflower, blue mustard	Brassicaceae	forb	x		
<i>Chrysothamnus viscidiflorus</i>	yellow rabbitbrush, green rabbitbrush	Asteraceae	shrub			
<i>Comandra umbellata</i>	bastard toadflax	Santalaceae	forb			
<i>Conyza canadensis</i>	horseweed, Canadian fleabane	Asteraceae	forb			
<i>Crepis atriobarba</i>	slender hawksbeard	Asteraceae	forb			
<i>Crepis intermedia</i>	intermediate hawksbeard, limestone hawksbeard	Asteraceae	forb			
<i>Cymopterus terebinthinus</i>	turpentine spring parsley, turpentine wavewing	Apiaceae	forb			<i>Pteryxia terebinthina</i>
<i>Descurainia pinnata</i>	western tansymustard	Brassicaceae	forb			
<i>Dieteria canescens</i>	hoary-aster	Asteraceae	forb			<i>Machaeranthera canescens</i>
<i>Draba verna</i>	spring whitlow-grass	Brassicaceae	forb	x		
<i>Elymus elymoides</i>	squirreltail	Poaceae	grass			
<i>Epilobium brachycarpum</i>	tall annual willowherb	Onagraceae	forb			
<i>Ericameria nauseosa</i>	rubber rabbitbrush, gray rabbitbrush	Asteraceae	shrub			
<i>Erigeron filifolius</i>	threadleaf fleabane	Asteraceae	forb			
<i>Erigeron poliospermus</i>	cushion fleabane, hairy-seeded daisy fleabane	Asteraceae	forb			
<i>Erigeron pumilus</i>	shaggy fleabane	Asteraceae	forb			
<i>Eriogonum niveum</i>	snow buckwheat	Polygonaceae	forb			
<i>Eriogonum sphaerocephalum</i> var. <i>sphaerocephalum</i>	rock buckwheat	Polygonaceae	forb			
<i>Eriophyllum lanatum</i> var. <i>integrifolium</i>	Oregon sunshine	Asteraceae	forb			
<i>Erodium cicutarium</i>	redstem stork's bill, crane's-bill	Geraniaceae	forb	x		
<i>Hesperostipa comata</i>	needle-and-thread grass	Poaceae	grass			
<i>Holosteum umbellatum</i>	jagged chickweed	Caryophyllaceae	forb	x		
<i>Hordeum murinum</i>	mouse barley	Poaceae	grass	x		
<i>Lactuca serriola</i>	prickly lettuce	Asteraceae	forb	x		
<i>Lagophylla ramosissima</i>	slender hareleaf, branched lagophylla	Asteraceae	forb			
<i>Leymus cinereus</i>	basin wildrye	Poaceae	grass			<i>Elymus cinereus</i>
<i>Linum lewisii</i> var. <i>lewisii</i>	wild blue flax, prairie flax	Linaceae	forb			
<i>Lithospermum ruderales</i>	western gromwell, western stoneseed	Boraginaceae	forb			

Scientific Name	Common Name	Family	Type	Non-native	Noxious Weed Class Benton County / Washington State	Synonyms / Notes
<i>Lomatium</i> sp.	desert-parsley, biscuit-root	Apiaceae	forb			
<i>Lupinus leucophyllus</i>	velvet lupine	Fabaceae	forb			
<i>Lupinus sulphureus</i> var. <i>subsaccatus</i>	sulphur lupine, Bingen lupine	Fabaceae	forb			
<i>Madia</i> sp.	tarweed	Asteraceae	forb			
<i>Nesotus stenophyllus</i>	narrowleaf goldenweed	Asteraceae	forb/sub-shrub			<i>Haplopappus stenophyllus</i>
<i>Onopordum acanthium</i>	Scotch thistle	Asteraceae	forb	x	Class B / Class B	
<i>Phlox longifolia</i>	long-leaf phlox	Polemoniaceae	forb			
<i>Phlox</i> sp.	phlox	Polemoniaceae	forb			
<i>Plantago patagonica</i>	woolly plantain, indianwheat plantain	Plantaginaceae	forb			
<i>Poa ampla</i>	big bluegrass	Poaceae	grass			cultivar of <i>Poa secunda</i>
<i>Poa bulbosa</i>	bulbous bluegrass	Poaceae	grass	x		
<i>Poa secunda</i>	Sandberg bluegrass	Poaceae	grass			
<i>Polygonum aviculare</i>	prostrate knotweed	Polygonaceae	forb	x		
<i>Pseudognaphalium</i> sp.	cudweed	Asteraceae	forb			
<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass	Poaceae	grass			
<i>Salsola tragus</i>	prickly Russian thistle	Chenopodiaceae	forb	x		<i>Salsola kali</i>
<i>Secale cereale</i>	cereal rye	Poaceae	grass	x	Class C / Class C	
<i>Sisymbrium altissimum</i>	tall tumblemustard	Brassicaceae	forb	x		
<i>Stephanomeria tenuifolia</i>	wire lettuce, narrowleaf wirelettuce	Asteraceae	forb			
<i>Taraxacum officinale</i>	common dandelion	Asteraceae	forb	x		
<i>Tetradymia canescens</i>	gray horsebrush, spineless horsebrush	Asteraceae	shrub			
<i>Tragopogon dubius</i>	yellow salsify	Asteraceae	forb	x		
<i>Triticum aestivum</i>	wheat	Poaceae	grass	x		
<i>Vulpia microstachys</i>	small fescue	Poaceae	grass			

ATTACHMENT C

REPRESENTATIVE HABITAT PHOTOGRAPHS



Photo 1. Active wheat field within area previously mapped as eastside (interior) grassland



Photo 2. Dwarf-shrub steppe habitat dominated by rock buckwheat (*Eriogonum sphaerocephalum*) and Sandberg bluegrass (*Poa secunda*) in northwestern corner of survey area



Photo 3. Non-native grassland dominated by cereal rye (*Secale cereale*)



Photo 4. Planted grassland with bluebunch wheatgrass (*Pseudoroegneria spicata*), crested wheatgrass (*Agropyron cristatum*), and abundant cheatgrass (*Bromus tectorum*)



Photo 5. Planted grassland dominated by big bluegrass (*Poa ampla*) and bluebunch wheatgrass



Photo 6. Rabbitbrush shrubland with high cover of rubber rabbitbrush (*Ericameria nauseosa*) and non-native grassland habitat dominated by cereal rye

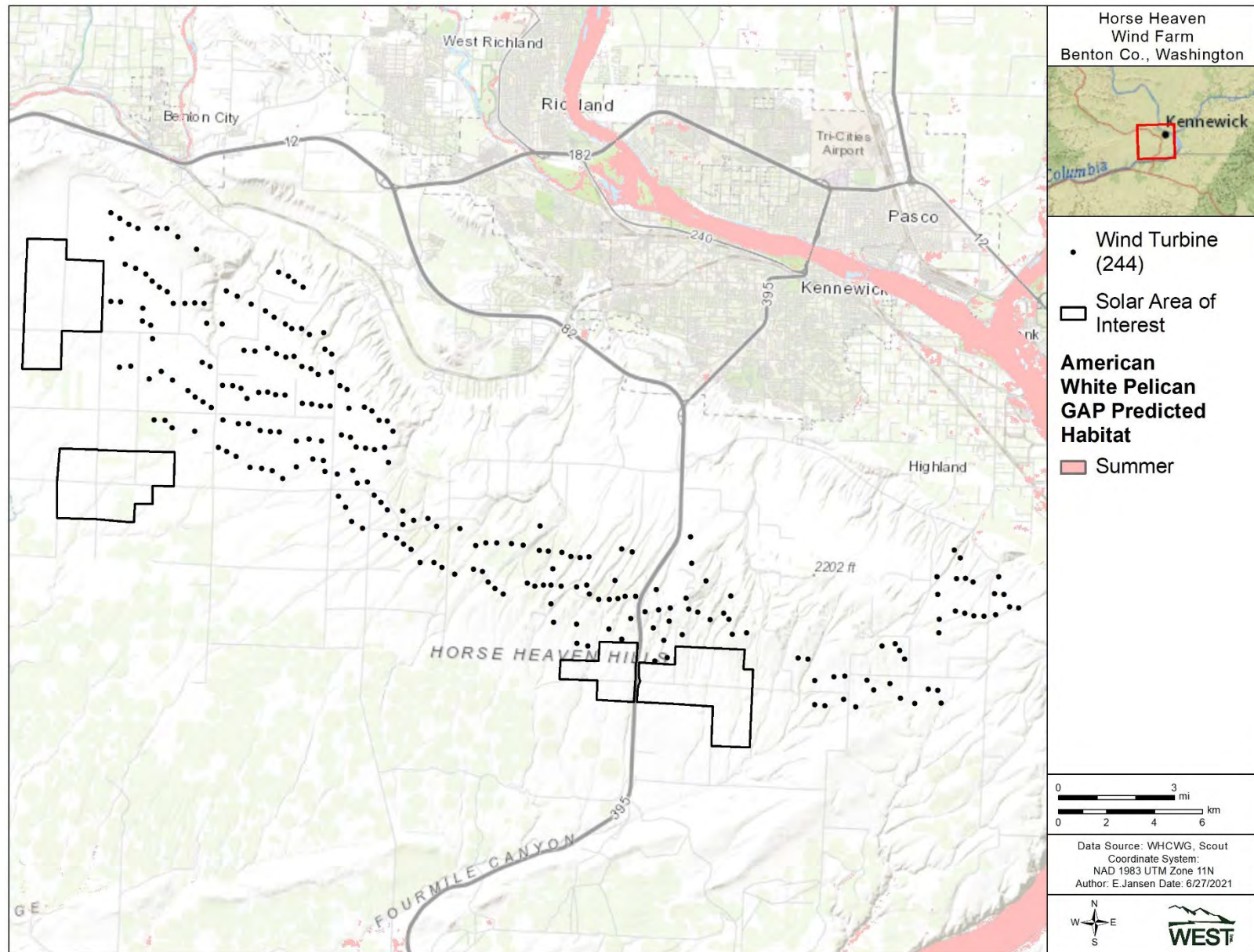


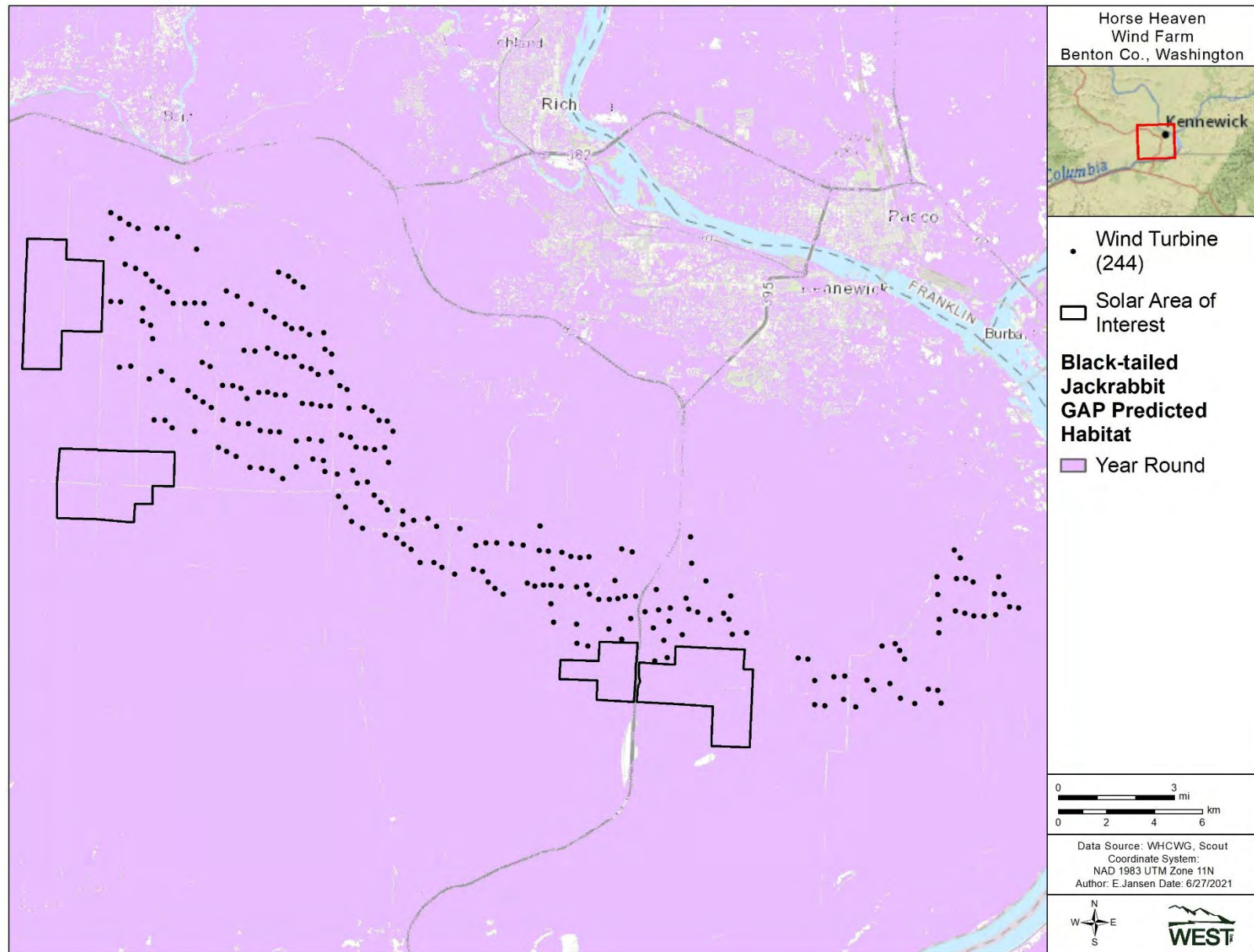
Photo 7. Sagebrush shrub-steppe habitat with high cover of cheatgrass and yellow salsify (*Tragopogon dubius*) in understory

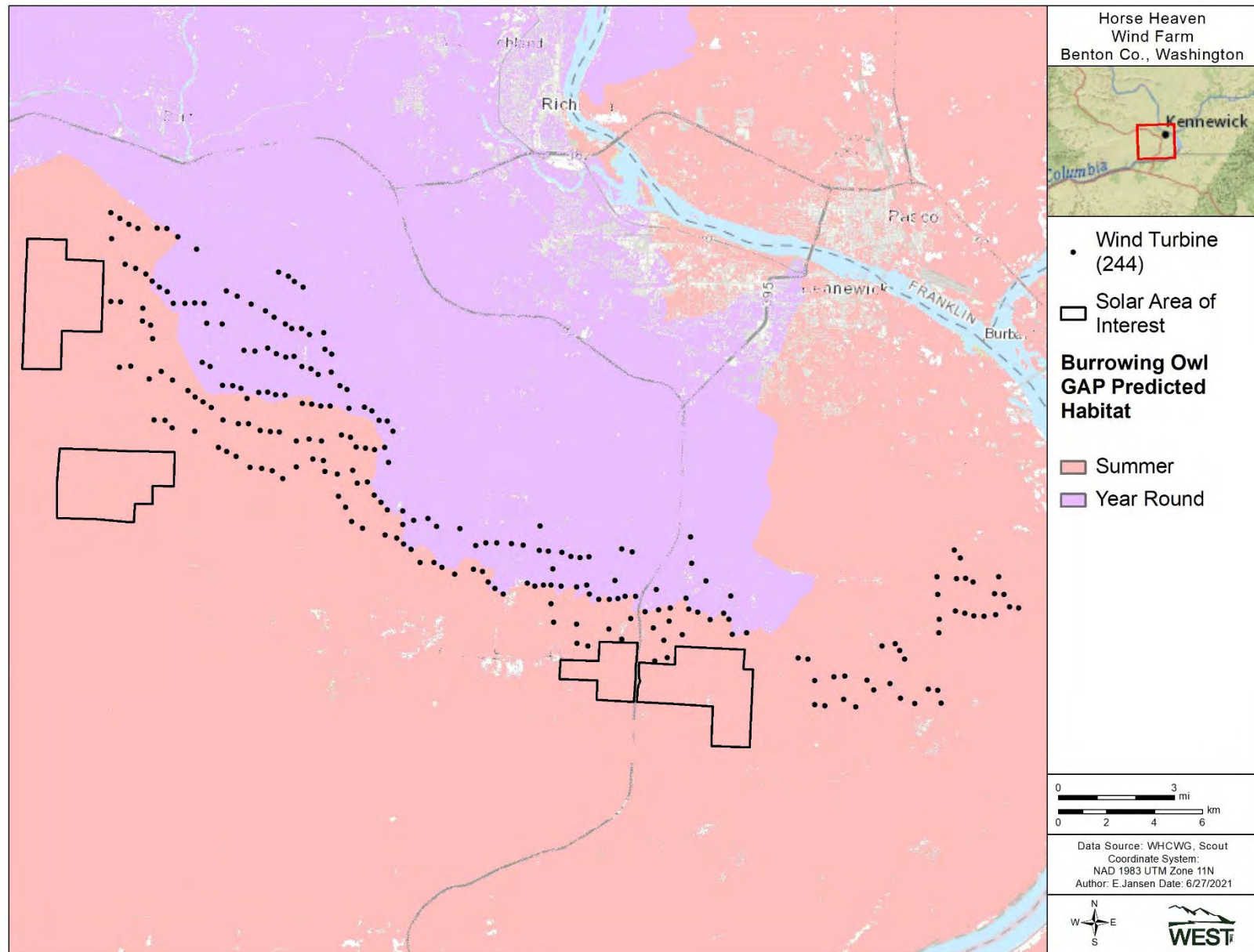


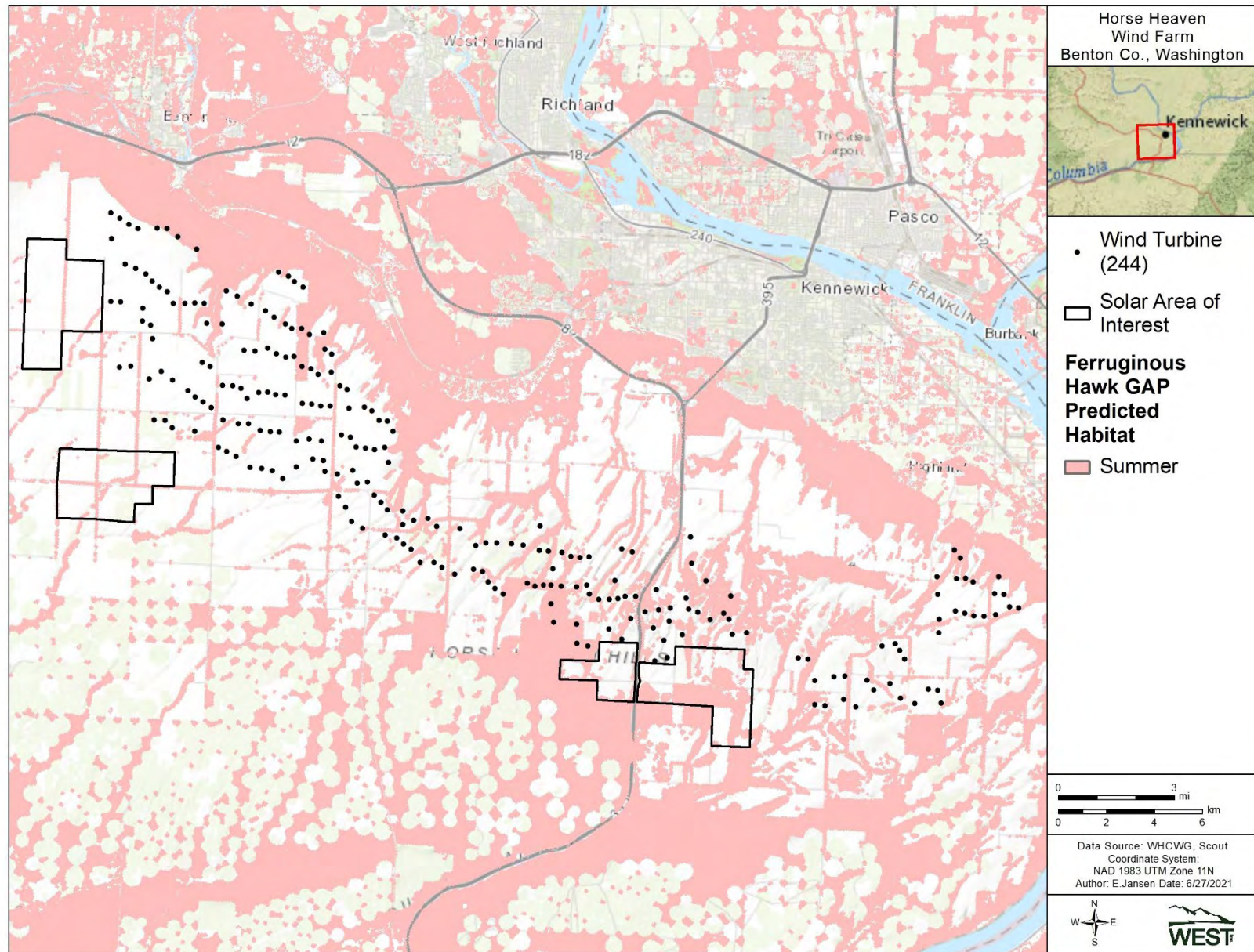
Photo 8. Sagebrush shrub-steppe habitat with big sagebrush (*Artemisia tridentata*), bluebunch wheatgrass, Sandberg bluegrass, and cheatgrass

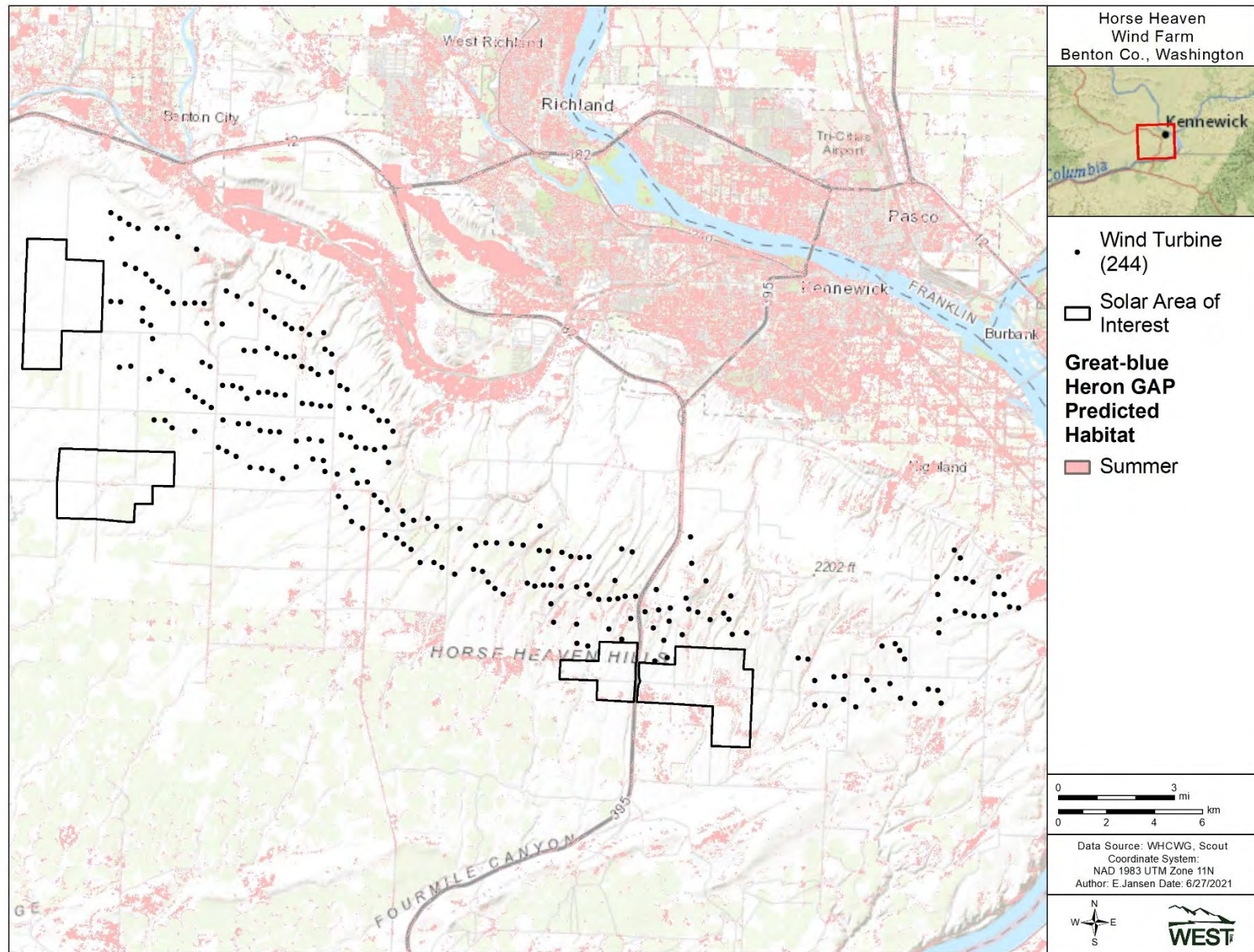
Wildlife GAP Predicted Habitat Maps (6/29/2021)

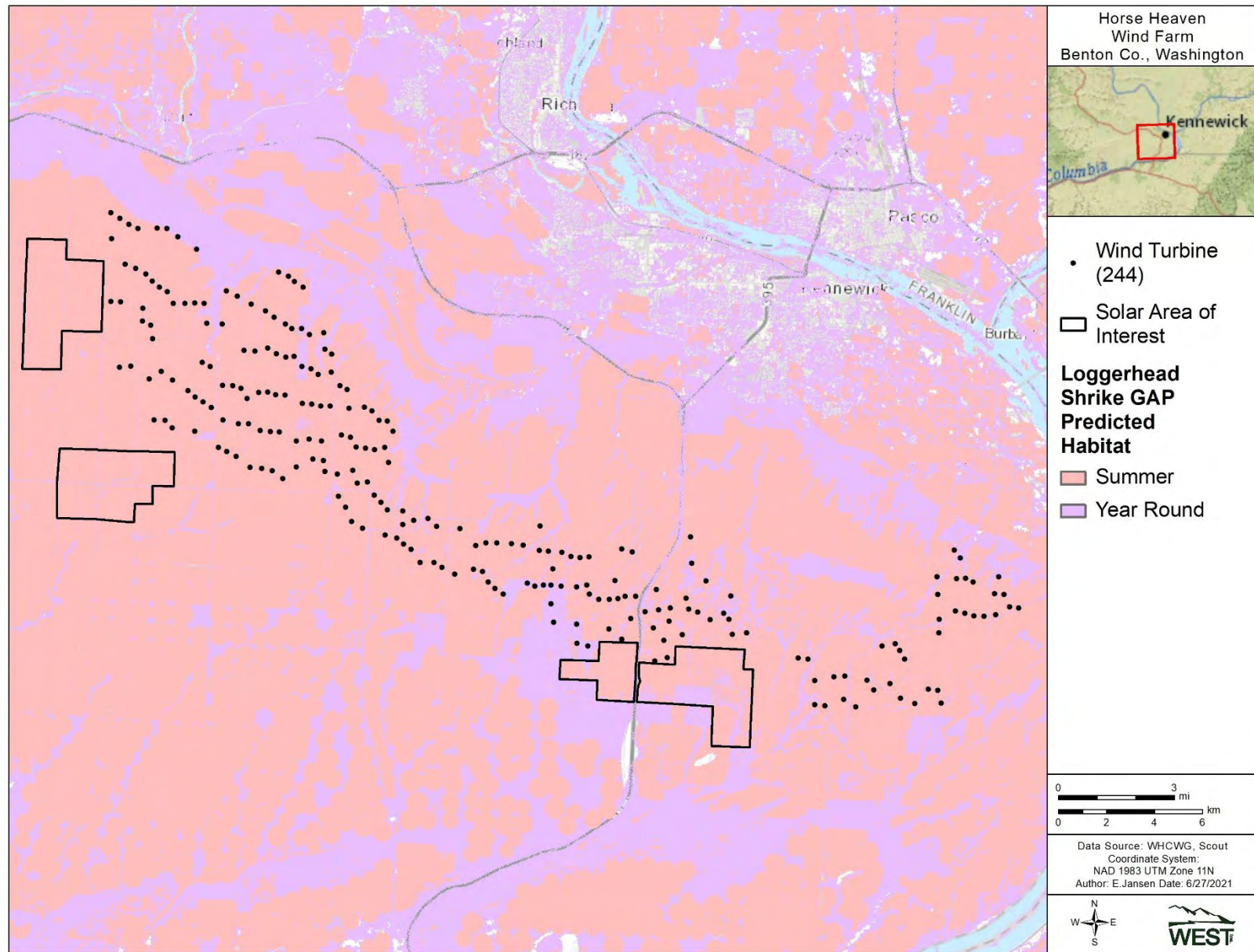


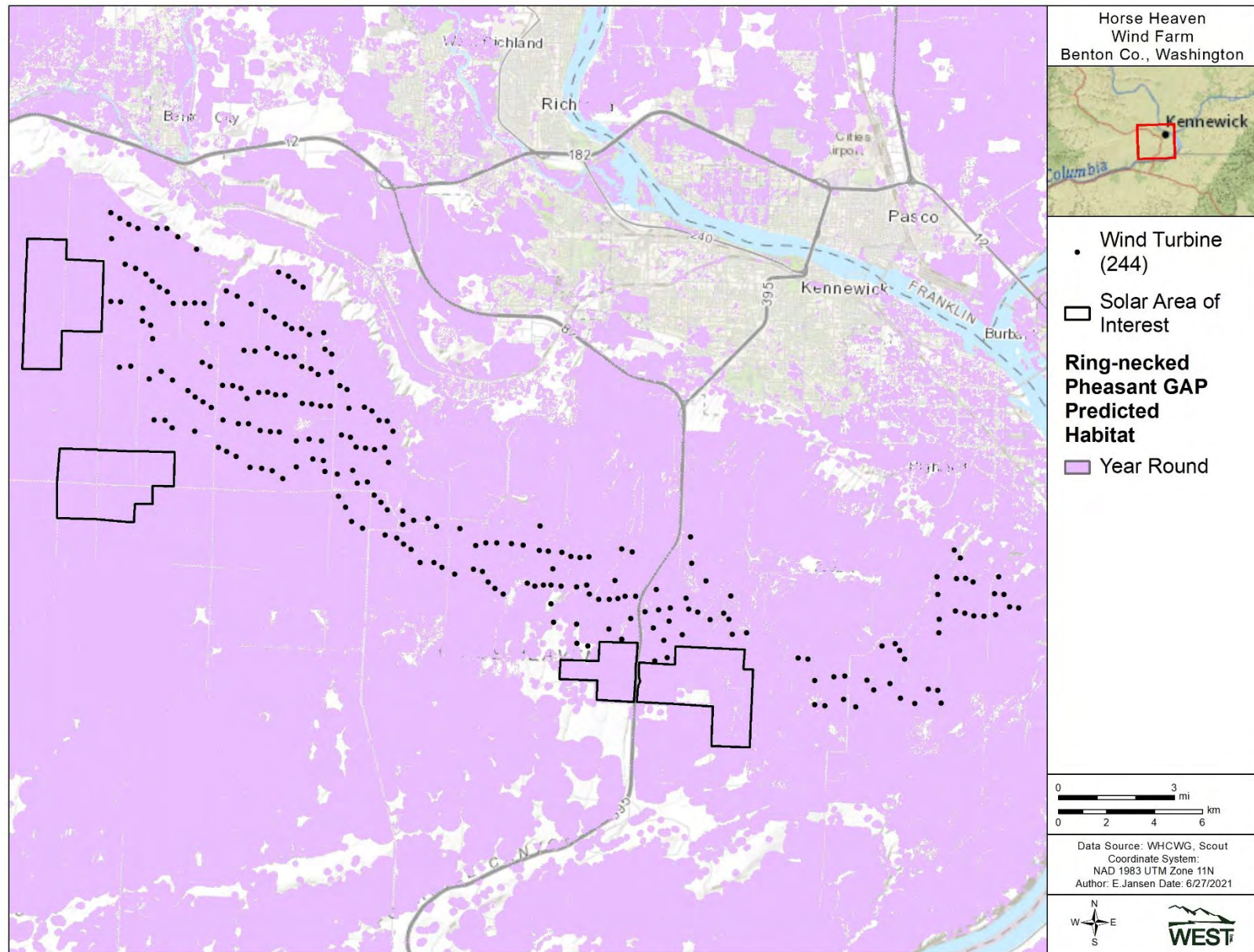


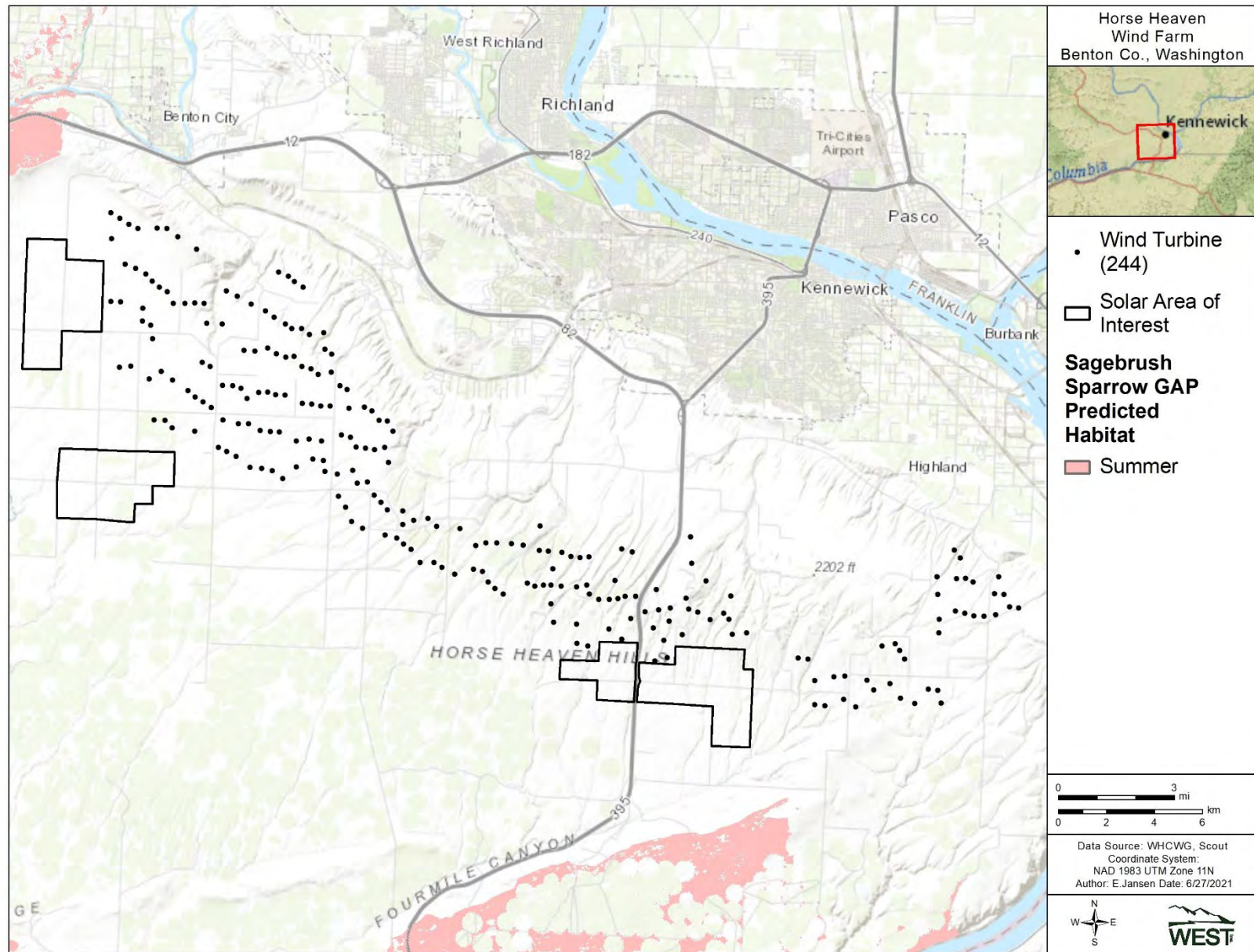


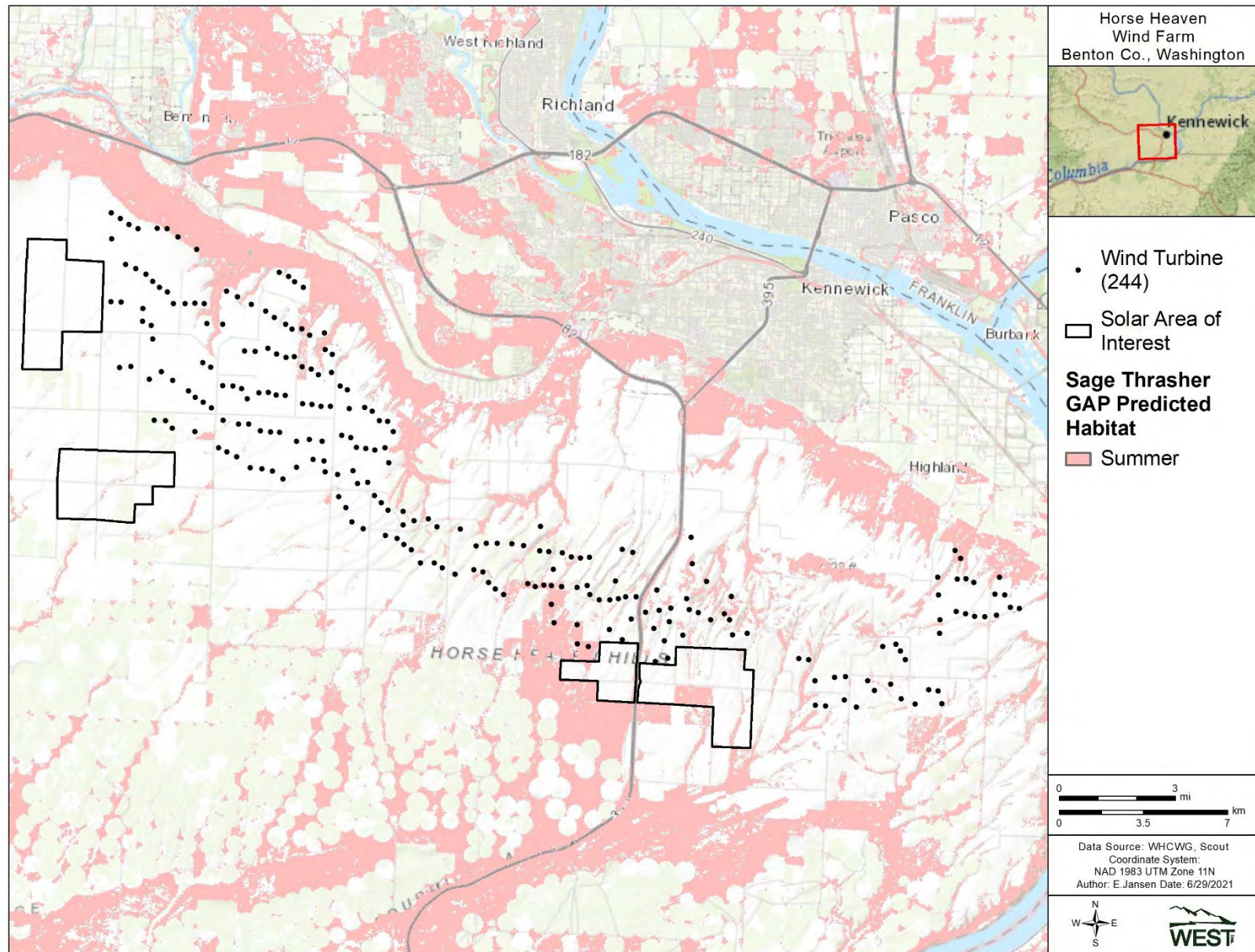


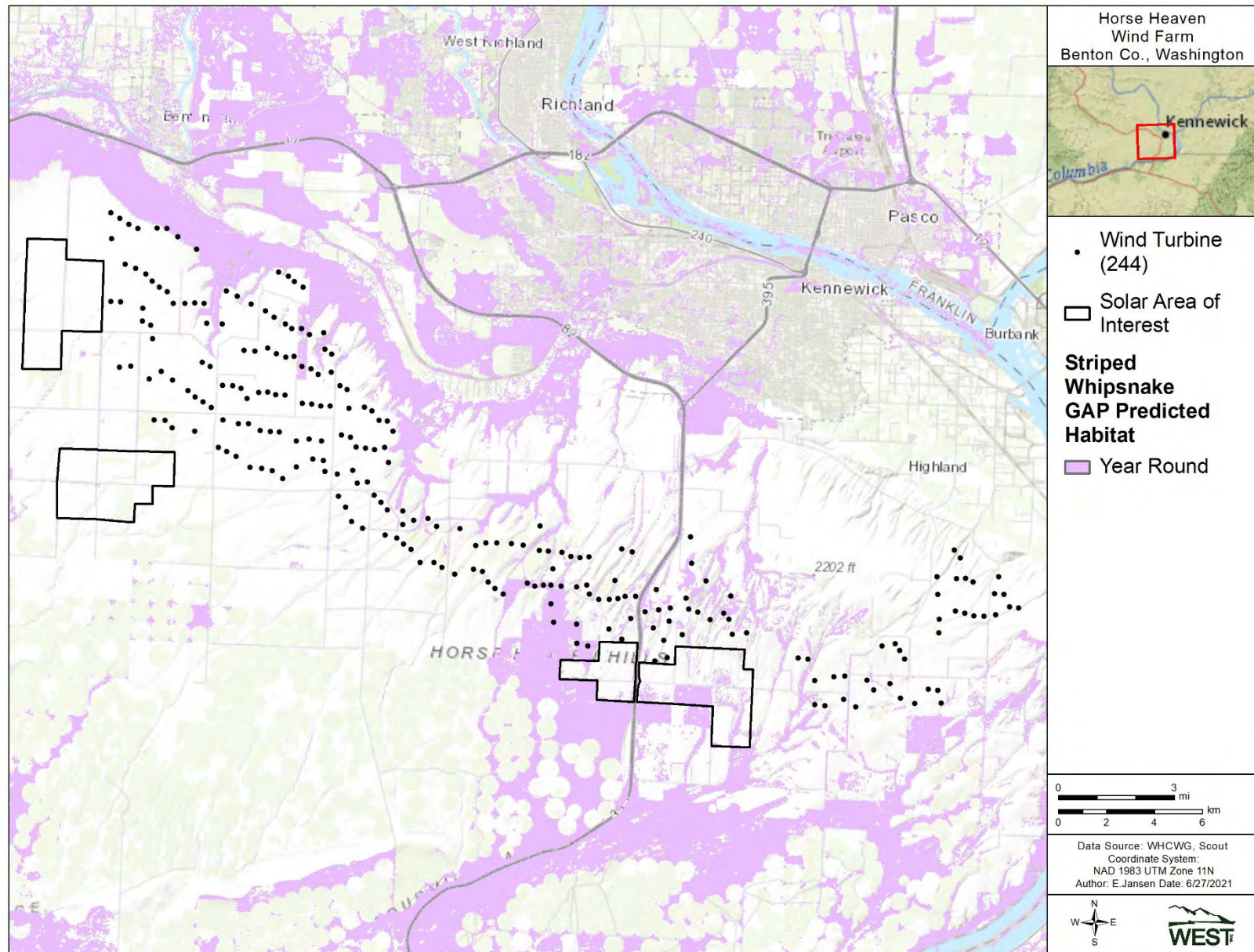


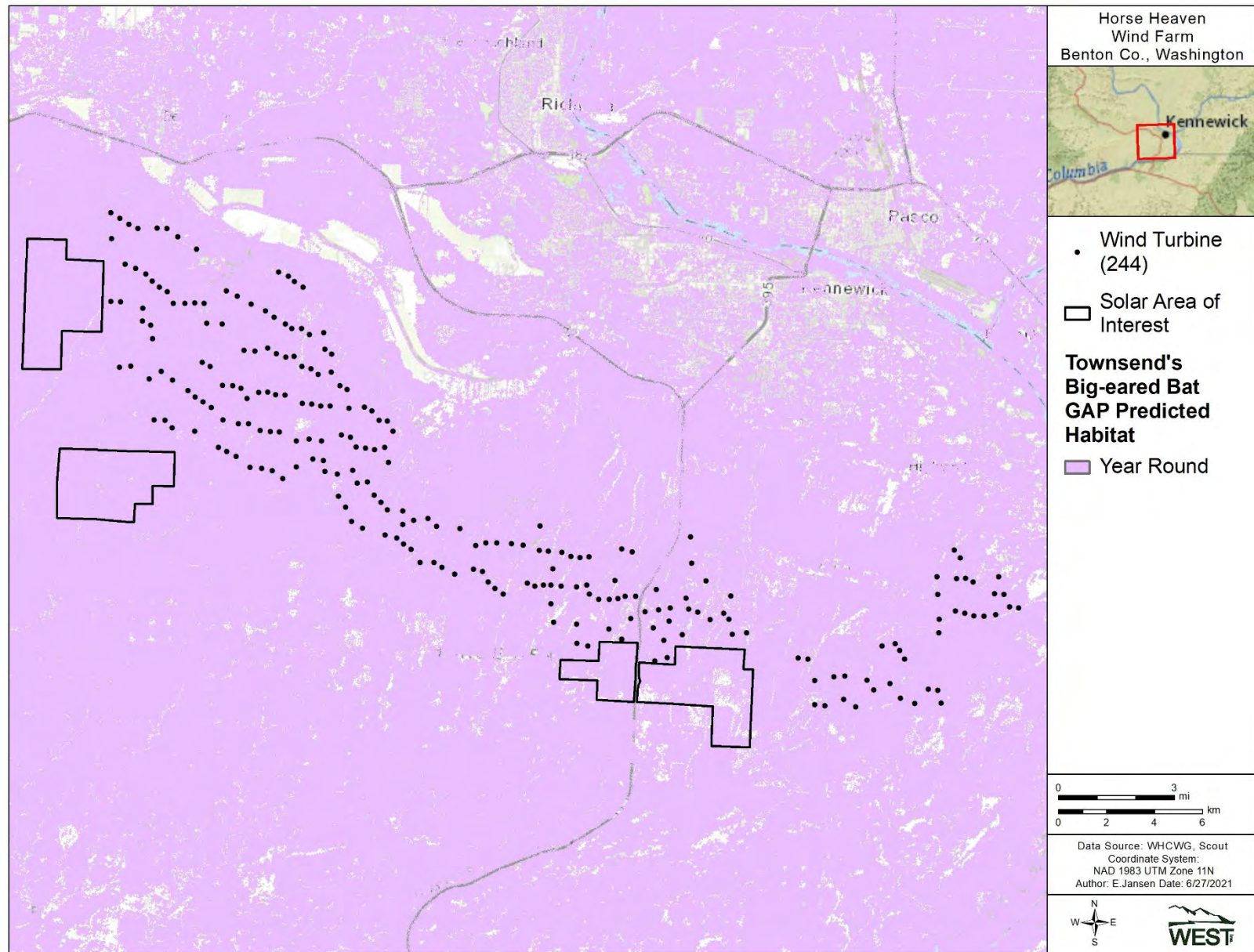


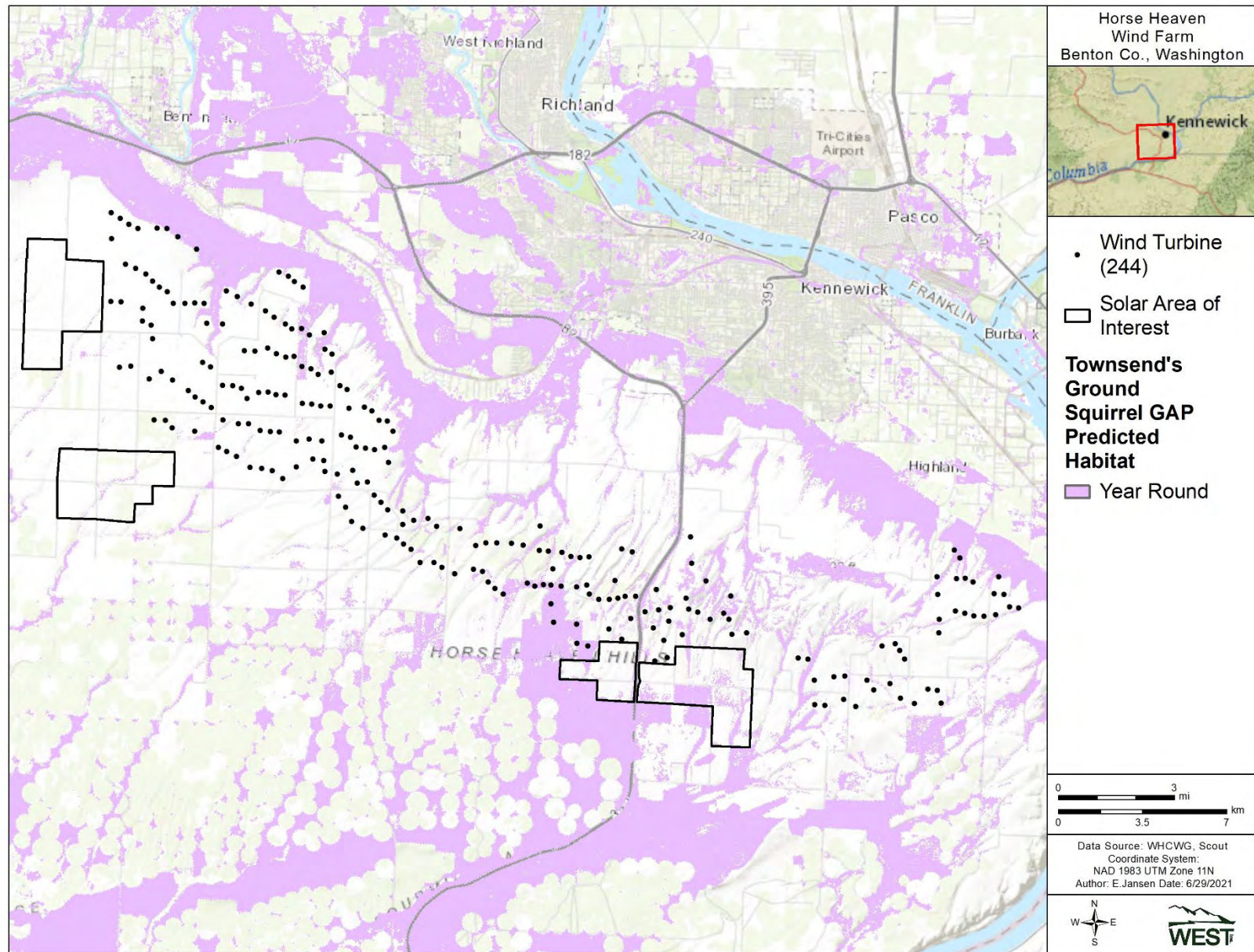


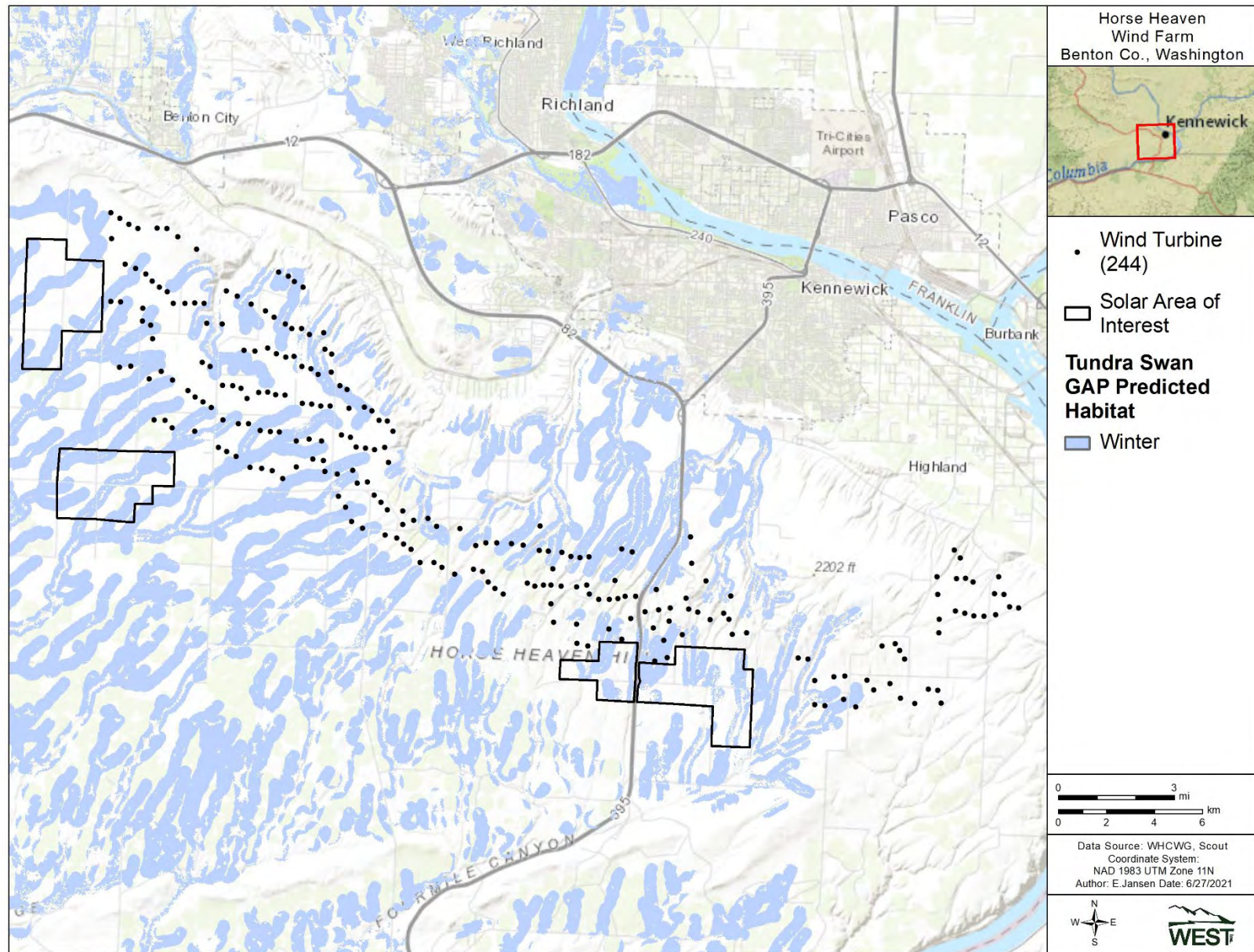


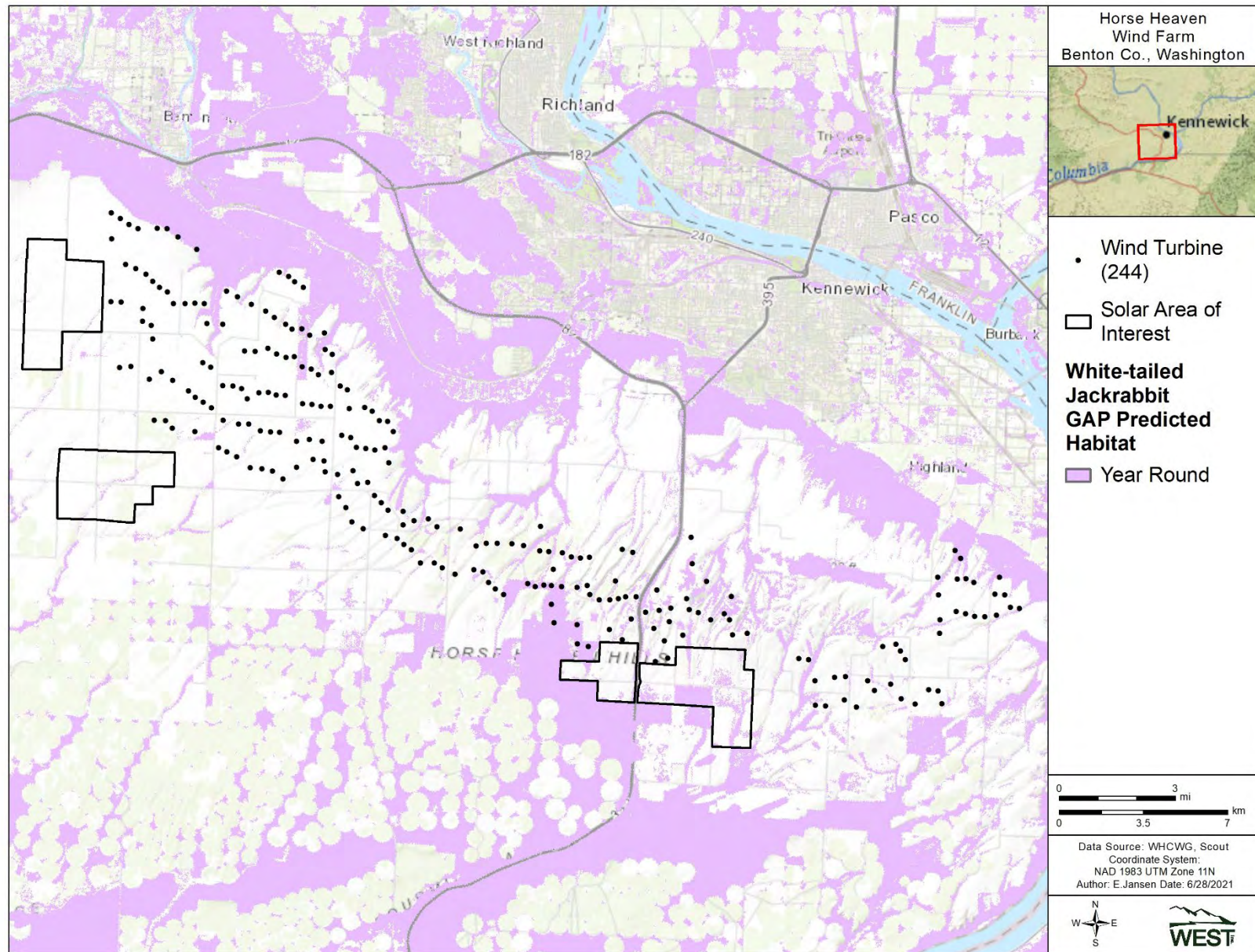












2021 Botany and Habitat Survey Report for Horse Heaven Wind Farm

Benton County, Washington

Prepared for
Horse Heaven Wind Farm, LLC

Prepared by



19803 North Creek Parkway
Bothell, WA 98011

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ACRONYMS AND ABBREVIATIONS

CRP	Conservation Reserve Program
GPS	Global Positioning System
IPaC	Information for Planning and Consultation
NHD	National Hydrography Dataset
NWI	National Wetlands Inventory
PHS	Priority Habitat and Species
Project	Horse Heaven Wind Farm
Tetra Tech	Tetra Tech, Inc.
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WDFW	Washington Department of Fish and Wildlife
WNHP	Washington Natural Heritage Program

1 INTRODUCTION

This report presents the methods and results for the 2021 botanical and habitat surveys conducted by Tetra Tech, Inc. (Tetra Tech) for the Horse Heaven Wind Farm (Project). The Project is located within Benton County, approximately 2.5 miles south of Benton City and 6 miles south of Kennewick, Washington (Figure 1). In 2020, Tetra Tech conducted botanical and habitat surveys in locations associated with 44 proposed wind turbine generators preliminarily identified as occurring within native habitat (Tetra Tech 2021). The purpose of the 2021 botanical and habitat surveys was to document the presence of special status vascular plant and noxious weed species and verify, map, and characterize habitat within portions of the Project Wind Energy Micrositing Corridor and Solar Siting Areas not completed in 2020 (Figure 2).

2 METHODS

2.1 Survey Area

The 2021 Survey Area consisted of portions of the Project Wind Energy Micrositing Corridor and Solar Siting Areas that were not surveyed in 2020 (Figure 2). At the time of the surveys, access was not permitted to two parcels totaling 604 acres within the southwestern Solar Siting Area. With the exception of these two parcels, all portions of the Wind Energy Micrositing Corridor and Solar Siting Areas not completed in 2020 were surveyed in 2021. The 2021 Survey Area consisted of 18,338 acres. Although the parcels where access was not permitted were not traversed on foot during surveys (or considered part of the 2021 Survey Area), they were viewed from public roads and adjacent accessible parcels to the extent possible.

2.2 Background Review

2.2.1 *Special Status Plant Species*

Prior to conducting field surveys, Tetra Tech conducted a pre-field review of existing information on special status plant species with the potential to occur in Benton County and within the 2021 Survey Area. For purposes of this report, the term “special status plant” includes federally-listed endangered, threatened, or candidate vascular plant species and state endangered, threatened, and sensitive vascular plant species as defined by the Washington Natural Heritage Program (WNHP). Specific sources of information that were reviewed prior to conducting field surveys include the following:

- U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) query for Benton County (USFWS 2021a);
- Washington Natural Heritage Rare Vascular and Nonvascular Species, County Lists (WNHP 2021a);
- Washington Vascular Plant Species of Special Concern (WNHP 2019);
- WNHP Element Occurrence database of rare and imperiled species and plant communities (WNHP 2021b);
- Online Field Guide to the Rare Plants of Washington (WNHP 2021c);
- USFWS National Wetlands Inventory (NWI; USFWS 2021b); and
- U.S. Geological Survey (USGS) National Hydrography Dataset (NHD; USGS 2021)

Based on review of the above sources, Tetra Tech compiled a list of special status vascular plant species known to occur or with the potential to occur in the 2021 Survey Area (Attachment A). Each of the species identified as potentially occurring within the 2021 Survey Area was assigned a “likelihood of occurrence” (i.e., highly unlikely, low, moderate) based on the proximity of known occurrences, whether the known occurrence is a historical occurrence, and the likelihood of suitable habitat occurring within the 2021 Survey Area (Attachment A). Tetra Tech also reviewed aerial imagery of the 2021 Survey Area to identify potential habitat for special status plant species within the 2021 Survey Area.

Prior to conducting field surveys, Tetra Tech reviewed existing literature, herbarium records, and other sources to generate fact sheets or “field guides” for each special status plant species with the potential to occur within the 2021 Survey Area. These fact sheets were used by surveyors in the field and included:

- Photographs of each species and its habitat;
- Information detailing habitat associations;
- Range and flowering period;
- Identifying features; and
- Characteristics distinguishing the target species from similar species within its range.

2.2.2 Noxious Weeds

Prior to field surveys, Tetra Tech reviewed lists of species designated as noxious weeds in Washington State and Benton County (BCNWCB 2020; WSNWCB 2021). Additionally, existing literature and other sources were reviewed to familiarize surveyors with identification of designated noxious weeds that would potentially be encountered within the 2021 Survey Area.

2.2.3 Habitat

Prior to conducting field surveys, Tetra Tech conducted a desktop review to preliminarily identify habitat types within the 2021 Survey Area. Sources reviewed for the preliminary habitat classification included the following:

- National Land Cover Database land cover data (Homer et al. 2020);
- Site Characterization Study Report, Badger Canyon Wind Project (Chatfield and Thompson 2018a);
- Site Characterization Study Report, Four Mile Wind Project (Chatfield and Thompson 2018b);
- Results of the 2018 vegetation and land cover mapping for the Badger Canyon Wind Project (Chatfield and Brown 2018a);
- Results of the 2018 vegetation and land cover mapping for the Four Mile Wind Project (Chatfield and Brown 2018b);
- Wildlife Survey Report for the Horse Heaven Wind Project (Jansen and Brown 2018);
- Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species (PHS) database (WDFW 2021);
- USFWS NWI (USFWS 2021b);
- USGS NHD (USGS 2021);
- Management recommendations for Washington’s priority habitats (Azerrad et al. 2011);
- Washington Large Fires 1973-2020 (DNR 2021); and
- SAGEMAP Sagebrush Habitat (USGS 2011).

Based on review of the above sources, preliminary habitat boundaries within the 2021 Survey Area were delineated. These preliminary habitat boundaries were uploaded to Samsung Galaxy tablets using ArcGIS Collector mapping software for field verification of habitat types during field surveys.

2.3 Field Surveys

Field surveys were conducted May 31–June 4, 2021. The survey dates were chosen as they coincide with the identification period for the majority of special status plant species with the potential to occur within the 2021 Survey Area.

2.3.1 Special Status Plant Survey Methods

Special status vascular plant field surveys were conducted using the focused intuitive controlled survey method, a standard and commonly accepted survey protocol (USFS and BLM 1998). This method incorporates meandering transects that traverse the survey area and that target the full array of major vegetation types (with the exception of agricultural fields as they do not support special status plant species), aspects, topographical features, habitats, and substrate types. The distribution of survey effort is based on habitat conditions observed in the field and surveyor experience and knowledge of rare plant species and their habitats. Areas that provide marginal potential habitat for rare plant species (e.g., areas dominated by non-native species) are surveyed with less intensity than areas of high-potential habitat for special status plant species (e.g., intact shrub-steppe habitat). While traversing the 2021 Survey Area, the surveyors searched for special status vascular plant species, and when the surveyors arrived at an area of high-potential habitat for special status species, they conducted a complete survey for the special status species. Complete surveys include an examination of 100 percent of the habitat.

During surveys, Tetra Tech maintained a running list of vascular plant species encountered within the 2021 Survey Area and made informal collections of unknown species for later identification. Identification was verified by the use of appropriate plant keys, in particular, *Flora of the Pacific Northwest* (Hitchcock and Cronquist 2018).

2.3.2 Noxious Weeds

Noxious weed surveys were conducted concurrently with special status plant and habitat surveys. Tetra Tech recorded observations of state- and county-designated noxious weeds. When a noxious weed was encountered in the 2021 Survey Area, the location was recorded with a global positioning system (GPS) point and the species, estimated size of the infestation (<0.1 acre; 0.1–1.0 acre; 1.0–5.0 acres), and relative abundance (sparse; common; high cover) was recorded.

2.3.3 Habitat

Tetra Tech conducted habitat surveys concurrently with special status and noxious weed surveys. Surveys consisted of a combination of roadside and pedestrian (i.e., walking) surveys. Where accessible by roads, agricultural and disturbed/developed lands were typically documented from the roadside, and the type of agriculture (e.g., wheat) or disturbance (e.g., cell tower) and status of each agricultural field (e.g., fallow, active) were noted. For non-agricultural lands and vegetated portions of disturbed or developed lands, biologists conducted pedestrian surveys that consisted of walking meandering transects throughout the area. Field surveys were conducted by a team of two biologists familiar with eastern Washington Columbia Plateau Ecoregion habitats, WDFW priority habitats (WDFW 2008), and the WDFW Wind Power Guidelines habitat categories¹ (WDFW 2009).

¹ The WDFW Wind Power Guidelines (WDFW 2009) provide specific management recommendations, alternatives for site assessment, and mitigation options and construction alternatives for avoiding impacts to Washington's wildlife resources and habitat for proposed wind power projects. Currently, there are no similar guidelines for solar power projects.

During field surveys, habitat types within the 2021 Survey Area were documented, mapped, and characterized. In general, habitat types were adapted from habitat descriptions in the WDFW Wind Power Guidelines (WDFW 2009) and *Wildlife-habitat Relationships in Oregon and Washington* (Johnson and O'Neil 2001). Preliminary habitat classifications identified during the desktop review (see Section 2.2.3) were revised either by modifying habitat boundaries in the field utilizing the tablets and ArcGIS Collector mapping software and/or drawing revised boundaries (based on field data collection and observations described below) in Google Earth that were then digitized following the field surveys.

To help characterize and map habitat types, biologists collected GPS habitat points. Information collected at these habitat points included the percent cover, using Daubenmire cover classes (NRCS and BLM 1996), of the following:

- Total vegetation cover
- Total tree and shrub cover
- Total cover of native and non-native grasses
- Total cover of non-native species
- Total cover of annual and perennial forbs
- Cover of standing dead shrubs or trees
- Cover of litter, rock, and bare ground
- Percent cover of dominant tree, shrub, and grass species

In addition, a list of dominant forbs, as well as observed disturbances (e.g., grazing), and a general assessment of habitat quality (e.g., poor, moderate, high) were also recorded at each habitat point and a photo of the habitat was taken. In addition to walking meandering transects, the biologists scanned the adjacent landscape from vantage points that allowed views across the landscape to help map habitat boundaries.

3 RESULTS

3.1 Background Review

3.1.1 *Special Status Plants*

Based on the background review, one federally listed threatened vascular plant species, the Umtanum desert buckwheat (*Eriogonum codium*), is known to occur within Benton County (USFWS 2021a). However, this species has a highly restricted distribution, and the entire known population occurs in a 1.9-acre area on the eastern end of Umtanum Ridge within the Hanford Reach National Monument, which is more than 25 miles north of the Project Lease Boundary (USFWS 2019). Additionally, the approximately 5 acres of designated critical habitat for Umtanum desert buckwheat is restricted to this region along Umtanum Ridge (i.e., outside the Project Lease Boundary).

Including Umtanum desert buckwheat, which in addition to being federally listed as threatened is also considered a state endangered species, 29 state endangered, threatened, or sensitive vascular plant species are known or have the potential to occur in Benton County (WNHP 2021a). Attachment A provides the list of the 29 special status plant species known or potentially occurring in Benton County, as well as their state and federal status, preferred habitat, likelihood of occurring in the 2021 Survey Area, and recommended survey period. As noted in Attachment A, one state threatened vascular plant species, grey

cryptantha (*Cryptantha leucophaea*), has been documented within 5 miles of the eastern border of the Project Lease Boundary (WNHP 2021b); however, this occurrence is across the Columbia River from the Project Lease Boundary.

During the background review, one special status lichen species, woven-spore lichen (*Texosporium sancti-jacobi*), was also identified as having the potential to occur in the 2021 Survey Area (WNHP 2021a). This species is listed as threatened in the state by the WNHP. Woven spore-lichen has been documented at four separate locations within approximately 3 miles of the Project Lease Boundary, with the closest occurrence approximately 0.4 mile to the north (WNHP 2021b).

3.1.2 Noxious Weeds

Based on the background review, 155 species are currently designated as noxious weeds in Washington State, and 124 species are currently designated as noxious weeds in Benton County (BCNWCB 2020; WSNWCB 2021). Per the WSNWCB (2021), the following are the definitions for each class of noxious weed:

- **Class A Weeds:** Non-native species whose distribution in Washington is still limited. Preventing new infestations and eradicating existing infestations are the highest priority. Eradication of all Class A plants is required by law.
- **Class B Weeds:** Non-native species presently limited to portions of the State. Species are designated for required control in regions where they are not yet widespread. Preventing new infestations in these areas is a high priority. In regions where a Class B species is already abundant, control is decided at the local level, with containment as the primary goal.
- **Class C Weeds:** Noxious weeds that are typically widespread in Washington or are of special interest to the state's agricultural industry. The Class C status allows county weed boards to require control if locally desired, or they may choose to provide education or technical consultation.

3.1.3 Habitat

Existing habitat conditions within the Survey Area are influenced by existing and past land uses, as well as historic fires that have affected the region. Therefore, a background review was conducted to determine the known extent of existing habitat conditions and historic fires within the area that have been recorded in public databases.

The WDFW PHS query identified one priority habitat, shrub-steppe, within and adjacent to much of the northern edge of the Project Lease Boundary and within portions of the 2021 Survey Area. SAGEMAP data identified sagebrush habitat as present scattered throughout the 2021 Survey Area (USGS 2011). The NHD maps 40.4 miles of intermittent streams within the 2021 Survey Area (USGS 2021). Desktop review of NWI data identified 0.25 acre of freshwater emergent wetlands and 96.3 acres of riverine wetlands within the 2021 Survey Area (USFWS 2021b). Nine fires were identified as overlapping the Project Lease Boundary between 1973 and 2020, eight of which overlap a portion of the 2021 Survey Area (Figure 3; DNR 2021).

3.2 Field Surveys

3.2.1 Special Status Plants

No special status vascular plant species were observed within the 2021 Survey Area during surveys conducted in 2021. In addition, very little suitable habitat for special status vascular plant species was observed (Attachment A). The list of vascular plant species observed within the 2021 Survey Area is provided as Attachment B.

Although field surveys in 2020 and 2021 were focused on special status vascular plants, a habitat suitability assessment for woven-spore lichen was conducted to identify potential suitable habitat at the Project for this species. The habitat suitability assessment is provided in Attachment C. Based on this assessment, approximately 18.9 acres within the Wind Energy Micrositing Corridor and Solar Siting Areas may provide suitable habitat for woven-spore lichen.

3.2.2 Noxious Weeds

Tetra Tech recorded six state- and county-designated noxious weed species during field surveys. Table 1 lists the noxious weed species observed, their noxious weed designation, and the frequency of observations. Figure 4 shows the locations of noxious weeds observed during field surveys.

Table 1. Noxious Weeds Observed During 2021 Botanical Field Surveys

Scientific Name	Common Name	State and County Class ¹	Frequency
<i>Bassia (Kochia) scoparia</i>	kochia	B	Abundant. Frequently observed throughout the 2021 Survey Area.
<i>Centaurea</i> sp. ²	knapweed	B	Commonly observed in central portion of 2021 Survey Area. Also observed in several locations in eastern and western portion of 2021 Survey Area.
<i>Chondrilla juncea</i>	rush skeletonweed	B	Commonly observed throughout 2021 Survey Area.
<i>Convolvulus arvensis</i>	field bindweed	C	Observed in two locations in eastern portion of 2021 Survey Area.
<i>Onopordum acanthium</i>	Scotch thistle	B	Observed in five locations in central-eastern portion of 2021 Survey Area.
<i>Secale cereale</i>	cereal rye	C	Abundant. Frequently observed throughout 2021 Survey Area.

Notes:

¹ Definitions for weed classes are provided in Section 3.1.2.

² Individuals observed were not flowering at the time of surveys. Based on observations of rosettes and leaves, individuals and populations are believed to be either diffuse knapweed (*Centaurea diffusa*) or spotted knapweed (*Centaurea stoebe*) which are both designated Class B weeds.

Two noxious weed species were abundant throughout the 2021 Survey Area: kochia and cereal rye. Kochia was frequently observed along roadsides and along the edges of agricultural fields throughout the 2021 Survey Area. Although a few small (<0.1 acre) infestations of kochia were observed, most infestations were larger than 0.1 acre and many were larger than 1 acre. Large (greater than 1 acre), dense patches of cereal rye were frequently observed throughout the 2021 Survey Area. This noxious weed was often observed on hillslopes adjacent to agricultural fields or drainages and formed almost a complete monoculture in many the locations where it was observed.

Both knapweed and rush skeletonweed were commonly observed in the 2021 Survey Area. Knapweed was primarily observed in the central portion of the 2021 Survey Area. Patches ranged from small (<0.1 acre) to large (1-5 acres) patches that consisted of sparse, scattered individuals to areas with a high cover of knapweed. The knapweed individuals were not flowering at the time of the field surveys; however, based on the rosettes and leaf characteristics, it is assumed that individuals observed were either diffuse knapweed or spotted knapweed. Tetra Tech documented rush skeletonweed in scattered locations throughout much of the 2021 Survey Area, with the exception of the northwest portion (Figure 4). Although most patches of rush skeletonweed were either small (<0.1 acre) or medium (0.1-1 acre) in size, several larger infestations (1-5 acres) were observed scattered throughout the central portion of the 2021 Survey Area. Typically, observations of rush skeletonweed consisted of small patches or individuals scattered throughout the area, instead of occurring in dense populations.

Scotch thistle was observed in five locations in the 2021 Survey Area: all in the central-eastern portion of the 2021 Survey Area (Figure 4). Three of the five infestations were between approximately 0.1 and 1 acre in size with many Scotch thistle plants, while two infestations were small (<0.1 acre) and consisted of just a few plants. Two small (<0.1 acre) infestations of field bindweed were observed: one in the northeastern portion and one in the central-eastern portion of the 2021 Survey Area (Figure 4).

Cereal rye is a Class C noxious weed, indicating that it is either widespread in the state or is of interest to the state's agricultural industry. The other four species observed are Class B noxious weeds, meaning that they are designated for required control in regions where they are not yet widespread and preventing new infestations in these areas is a high priority. In regions where these species are already abundant, control is decided at the local level, with containment as the primary goal (WSNWCB 2021).

3.2.3 *Habitat*

The following seven habitat types were field mapped within the 2021 Survey Area:

- Agricultural land
- Developed/disturbed
- Eastside (interior) grassland
- Non-native grassland
- Planted grassland
- Rabbitbrush shrubland
- Sagebrush shrub-steppe

Table 2 lists the acres of each habitat type found within the 2021 Survey Area, and Figure 5 displays the locations of habitat types mapped within the 2021 Survey Area. Each of these habitat types is briefly described below. Representative photos of habitat types observed during field surveys are provided in Attachment D. As noted in Section 2.1, access to two parcels totaling 604 acres within the southwestern Solar Siting Area was not permitted during the 2021 surveys. While these areas were not traversed on foot or considered part of the 2021 Survey Area, they were viewed from adjacent accessible parcels and public roads to the extent possible. Of these 604 acres, it was determined that approximately 595 acres (99 percent) consisted of cultivated agricultural land. Based on a desktop review of the areas that were not able to be viewed from adjacent parcels or public roads, the remaining approximately 9 acres (1 percent) was determined to potentially consist of non-native grassland (6 acres) and sagebrush shrub-steppe (3 acres).

In general, vegetation within the majority of the 2021 Survey Area has been heavily modified due to historic and current agriculture and grazing activity. Non-native invasive grasses and forbs, such as bulbous bluegrass, cereal rye, cheatgrass, prickly lettuce, Russian thistle, tall tumbled mustard, and yellow salsify, are prevalent throughout the 2021 Survey Area.

Table 2. Habitat Types Mapped within the 2021 Survey Area

Habitat Type	Acres in Survey Area (Percent of Survey Area)	Common Plant Species Observed ¹
Agricultural land	15,273 (83%)	Wheat or fallow wheat fields. In addition to wheat, several non-native grasses and forbs were observed in agricultural fields, including: <u>Grasses:</u> cereal rye (<i>Secale cereale</i>), cheatgrass (<i>Bromus tectorum</i>) <u>Forbs:</u> kochia (<i>Bassia [Kochia] scoparia</i>), prickly lettuce (<i>Lactuca serriola</i>), Russian thistle (<i>Salsola tragus</i>)
Developed/disturbed	221 (1%)	No to limited vegetation observed. Where vegetation exists, species are similar to those listed under the non-native grassland habitat type.
Eastside (interior) grassland ²	174 (1%)	<u>Shrubs:</u> green rabbitbrush (<i>Chrysothamnus viscidiflorus</i>), rubber rabbitbrush (<i>Ericameria nauseosa</i>) <u>Grasses:</u> bluebunch wheatgrass (<i>Pseudoroegneria spicata</i>), bulbous bluegrass (<i>Poa bulbosa</i>), cheatgrass, cereal rye, Great Basin wildrye (<i>Leymus cinereus</i>), needle-and-thread (<i>Hesperostipa comata</i>), Sandberg bluegrass (<i>Poa secunda</i> ssp. <i>secunda</i>) <u>Forbs:</u> Carey's balsamroot (<i>Balsamorhiza careyana</i>), common stork's bill (<i>Erodium cicutarium</i>), fiddleneck (<i>Amsinckia</i> spp.), lupine (<i>Lupinus</i> spp.), prickly lettuce, shaggy fleabane (<i>Erigeron pumilus</i>), Spalding's milkvetch (<i>Astragalus spaldingii</i>), tall tumbledustard, triternate biscuit-root (<i>Lomatium triternatum</i>), wild blue flax (<i>Linum lewisii</i> var. <i>lewisii</i>), woolly plantain (<i>Plantago patagonica</i>), woollypod milkvetch (<i>Astragalus purshii</i>), yarrow (<i>Achillea millefolium</i>), yellow salsify (<i>Tragopogon dubius</i>)
Non-native grassland	929 (5%)	<u>Shrubs:</u> rubber rabbitbrush (only occasionally observed, and when observed was very sparse) <u>Grasses:</u> bulbous bluegrass, cereal rye, cheatgrass <u>Forbs:</u> fiddleneck, kochia, prickly lettuce, Russian thistle, tall tumbledustard, yarrow, yellow salsify
Planted grassland	602 (3%)	<u>Shrubs:</u> rubber rabbitbrush <u>Grasses:</u> big bluegrass (<i>Poa secunda</i> ssp. <i>juncifolia</i>), bluebunch wheatgrass, cereal rye, cheatgrass, crested wheatgrass (<i>Agropyron cristatum</i>) <u>Forbs:</u> bigflower agoseris (<i>Agoseris grandiflora</i>), yarrow, hawksbeard (<i>Crepis</i> spp.), hoary-aster (<i>Dieteria canescens</i>), shaggy fleabane, prickly lettuce, tall tumbledustard, yellow salsify
Rabbitbrush shrubland	980 (5%)	<u>Shrubs:</u> green rabbitbrush, rubber rabbitbrush <u>Grasses:</u> big bluegrass, bluebunch wheatgrass, bulbous bluegrass, cereal rye, cheatgrass, crested wheatgrass, Idaho fescue (<i>Festuca idahoensis</i>), needle-and-thread <u>Forbs:</u> Carey's balsamroot, fiddleneck, hoary-aster, lupine, knapweed, prickly lettuce, shaggy fleabane, tall tumbledustard, threadleaf fleabane (<i>Erigeron filifolius</i>), woolly plantain, yarrow, yellow salsify
Sagebrush shrub-steppe ²	161 (1%)	<u>Shrubs:</u> big sagebrush (<i>Artemisia tridentata</i>), green rabbitbrush, rubber rabbitbrush <u>Grasses:</u> bluebunch wheatgrass, bulbous bluegrass, cereal rye, cheatgrass, needle-and-thread, Sandberg bluegrass <u>Forbs:</u> Carey's balsamroot, common stork's bill, desert parsley (<i>Lomatium</i> sp.), fiddleneck, hoary-aster, long-leaf phlox (<i>Phlox longifolia</i>), low pussytoes (<i>Antennaria dimorpha</i>), lupine, milkvetch (<i>Astragalus purshii</i> , <i>A. spaldingii</i>), prickly lettuce, Russian thistle, sagebrush mariposa lily (<i>Calochortus macrocarpus</i> var. <i>macrocarpus</i>), shaggy fleabane, tall tumbledustard, wild blue flax, woolly plantain, yarrow, yellow salsify
Total	18,338 (100%)^{3,4}	

Notes:

¹ Species in **bold** are non-native.

² Listed as a priority habitat by the WDFW (WDFW 2008).

³ Totals may not sum exactly due to rounding.

⁴ Total does not include the 604 acres of the western solar siting areas where access was not permitted during 2021 surveys.

3.2.3.1 *Agricultural Land*

Areas mapped as agricultural land within the 2021 Survey Area consisted of active wheat fields and fallow wheat fields (i.e., fields in active rotation but not planted during the current season). The vast majority of the 2021 Survey Area was mapped as agricultural land (Table 2; Figure 5).

3.2.3.2 *Developed/Disturbed*

Developed/disturbed areas mapped within the 2021 Survey Area primarily included roads, structures and other disturbed areas associated with agricultural production, gravel piles for road repair and construction, and cell towers. The majority of the areas mapped as developed/disturbed were unvegetated or sparsely vegetated. Where present, vegetation within developed/disturbed areas was dominated by non-native invasive species such as cereal rye, cheatgrass, kochia, and prickly lettuce.

3.2.3.3 *Eastside (Interior) Grassland*

Eastside (interior) grassland habitat was mapped in three locations within the 2021 Survey Area. The largest of these locations was associated with the Solar Siting Area in the southeastern portion of the 2021 Survey Area. Dominant species observed in this location included the native grass needle-and-thread and the native forbs yarrow, shaggy fleabane, and lupine, as well as the non-native grasses and forbs: bulbous bluegrass, cereal rye, cheatgrass, prickly lettuce, yellow salsify, and common stork's-bill. Although rubber rabbitbrush and green rabbitbrush were observed in this area, the cover of these species was less than 5 percent. This area of eastside (interior) grassland is degraded due to the high cover of non-native species and heavy cattle grazing.

The other two locations were mapped in the central portion of the 2021 Survey Area. One of these locations consisted of a small area dominated by Great Basin wildrye along an ephemeral drainage (Attachment D, Photo 6). This area was also highly degraded due to the high cover of non-native species including cereal rye, cheatgrass, and tall tumblemustard. The third location was located on steep hillslopes along Badger Canyon. The 2018 Locust Grove Fire was mapped as overlapping a portion of this area (Figure 3; DNR 2021). Dominant species observed in this area included the native grasses and forbs: bluebunch wheatgrass and Sandberg bluegrass, Carey's balsamroot, lupine, yarrow, and Spalding's milkvetch and the non-native grasses and forbs: cheatgrass and tall tumblemustard. Although traces of rabbitbrush were observed in this area, no shrubs or seedlings of sagebrush (*Artemisia* spp.), including burned or dead sagebrush, were observed in this area (Attachment D, Photo 7). The habitat quality on the east side of Badger Canyon was higher (lower cover of non-native species, less signs of cattle grazing) than on the west side of the canyon.

3.2.3.4 *Non-native Grassland*

Non-native grassland habitat was commonly observed in the 2021 Survey Area. This habitat type was often observed on hillslopes and adjacent draws; however, it was also found adjacent to agricultural fields or in other flat areas where formerly planted and/or native grassland is now dominated by non-native grass and forb species. The majority of areas mapped as non-native grassland habitat consisted of vast areas dominated by dense cover of cereal rye (Attachment D, Photos 2, 3, and 8). As noted in Section 3.2.2, cereal rye is listed as a Class C noxious weed in Washington State and Benton County. Other common species observed in this habitat type include cheatgrass, prickly lettuce, tall tumblemustard, and yellow salsify. Although native forbs including yarrow, hoary-aster, and slender hareleaf (*Lagophylla ramosissima*) were occasionally observed in this habitat type, they typically represented only a small percent cover of the overall vegetative cover.

3.2.3.5 *Planted Grassland*

Within the 2021 Survey Area, the planted grassland habitat type consists of former agricultural lands or other disturbed areas (e.g., disturbed from wildfire) that have been planted with non-native grasses, native grasses and/or native shrubs. These areas may have been or may currently be enrolled in the Conservation Reserve Program (CRP) but their current legal status is unknown.

Areas mapped as planted grassland include areas planted with the non-native perennial grass crested wheatgrass, as well as areas planted primarily with the native perennial grasses bluebunch wheatgrass and big bluegrass. Rabbitbrush, primarily rubber rabbitbrush, was also commonly observed in this habitat type. Areas mapped as planted grassland typically contained less than approximately 10 percent cover of rabbitbrush. However, small (less than 1 acre) dense patches of rabbitbrush occur in this habitat type. Areas where high cover of rabbitbrush was observed were mapped as the rabbitbrush shrubland habitat type (see Section 3.2.3.6).

The quality of planted grassland habitat type within the 2021 Survey Area varied, with some areas of planted grassland habitat containing a higher predominance of native species such as bluebunch wheatgrass, big bluegrass, yarrow, and large-flowered agoseris and lower cover of non-native invasive species (Attachment D, Photo 10). Other areas of planted grassland habitat contain a high predominance of non-native species including the planted perennial grass crested wheatgrass and/or higher cover of non-native invasive species such as cheatgrass, cereal rye, prickly lettuce, and yellow salsify (Attachment D, Photo 11). In the western portion of the Survey Area, several areas mapped as planted grassland habitat consisted of dead and dying planted grasses (Attachment D, Photo 12). In general, planted grassland habitat contained a low diversity of forb species.

3.2.3.6 *Rabbitbrush Shrubland*

Rabbitbrush shrubland habitat was primarily mapped in the central and eastern portions of the 2021 Survey Area (Figure 5). Similar to the planted grassland habitat type, this habitat type was often observed in former agricultural lands or other disturbed areas (e.g., disturbed from wildfire) that appear to have been planted with non-native grasses, native grasses, and/or native shrubs (Attachment D, Photo 13). These areas may have been or may currently be enrolled in the CRP, but their current status is unknown. It is unknown whether rabbitbrush was planted in these areas or has established naturally. Rubber rabbitbrush is an early seral species that readily colonizes disturbed sites, such as areas disturbed by overgrazing or fire or abandoned agricultural lands (Faber-Langendoen et al. 2013; Tirmenstein 1999; USDA 2017). Within the 2021 Survey Area, rabbitbrush shrubland was also observed on hillslopes that are too steep for agricultural cultivation (Attachment D, Photos 14 and 15). Rabbitbrush may have colonized some of these hillslopes following past wildfires.

Shrub cover in the rabbitbrush shrubland habitat type ranged between approximately 10 to 80 percent cover, but was typically greater than 25 percent. Rubber rabbitbrush was the dominant shrub species observed, although green rabbitbrush and occasionally spineless horsebrush was also observed in this habitat type. Other common species observed in rabbitbrush shrubland habitat included the native grasses big bluegrass and bluebunch wheatgrass and the non-native grasses crested wheatgrass, cheatgrass, and cereal rye. Common forbs observed included the native forbs hoary-aster (*Dieteria canescens*), shaggy fleabane, and yarrow and the non-native forbs prickly lettuce, tall tumbled mustard, and yellow salsify.

3.2.3.7 *Sagebrush Shrub-steppe*

Sagebrush shrub-steppe habitat was mapped in scattered locations within the 2021 Survey Area; however, it was most prevalent in the eastern portion of the survey area (Figure 5). In general, sagebrush shrub-

steppe habitat within the 2021 Survey Area was restricted to hillslopes and drainages that are too steep for agricultural production (Attachment D, Photo 16). The vast majority of sagebrush shrub-steppe habitat within the 2021 Survey Area was fragmented and highly degraded due to high cover of non-native grass and forb species and/or grazing (Attachment D, Photo 17). In a few areas mapped as sagebrush shrub-steppe, evidence of past wildfires was noted by the presence of dead shrubs (Attachment D, Photo 18).

Shrub cover in sagebrush shrub-steppe habitat type ranged between approximately 5 and 75 percent cover, but was typically less than 40 percent. The dominant shrub species in this habitat type was big sagebrush. Other shrub species commonly observed include rubber rabbitbrush and green rabbitbrush; and spineless horsebrush (*Tetradymia canescens*) and threetip sagebrush (*Artemisia tripartita*) were also observed in a few locations. Cover and diversity of grasses and forbs was variable within this habitat type; however, cover of non-native grasses including cereal rye, cheatgrass, and bulbous bluegrass was typically high. Other grasses and forbs commonly observed in sagebrush shrub-steppe habitat include the native grasses and forbs: bluebunch wheatgrass, needle-and-thread, Sandberg bluegrass, Carey's balsamroot, yarrow, long-leaf phlox, lupine, shaggy fleabane, woolly plantain, and Spalding's milkvetch, and the non-native forbs: redstem stork's bill, prickly lettuce, Russian thistle, tall tumbled mustard, and yellow salsify.

4 CONCLUSIONS

Tetra Tech did not document any special status plant species within the 2021 Survey Area. Five noxious weed species were documented, several of which were abundant within the 2021 Survey Area.

Seven habitat types were mapped and characterized within the 2021 Survey Area. The vast majority (approximately 83 percent) of the 2021 Survey Area was found to consist of agricultural land. Developed/disturbed and non-native grassland accounted for approximately 6 percent of the 2021 Survey Area and eastside (interior) grassland, planted grassland, rabbitbrush shrubland, and sagebrush shrub-steppe accounted for the remaining approximately 10 percent of the 2021 Survey Area. As noted in Sections 2.1 and 3.2.3, access to two parcels totaling 604 acres within the southwestern Solar Siting Area was not permitted during the 2021 surveys. While these areas were not traversed on foot during surveys or considered part of the 2021 Survey Area, they were viewed from adjacent accessible parcels and public roads to the extent possible. Of these 604 acres, it was determined that approximately 99 percent (595 acres) of this area consists of agricultural land. In general, habitat in the vast majority of the 2021 Survey Area has been heavily modified and degraded due to historic and current agriculture and grazing activity, wildfires, and the presence of non-native, invasive plant species.

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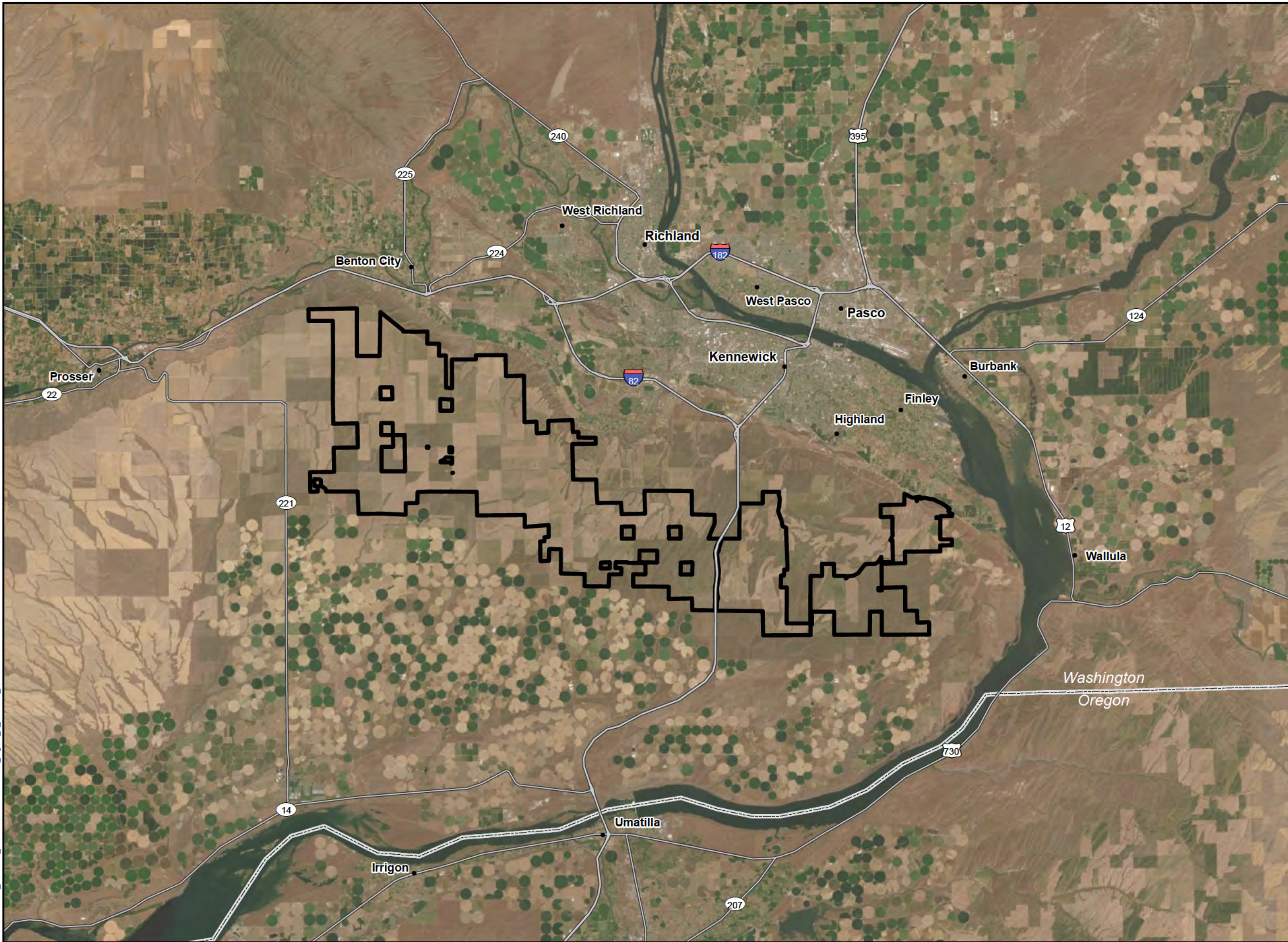
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FIGURES

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Horse Heaven Wind Project



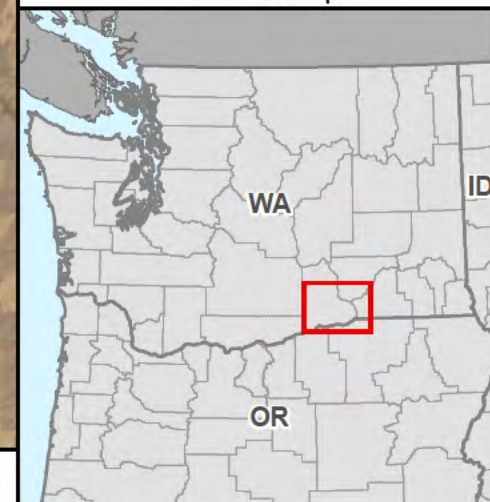
Figure 1
Project Location

BENTON COUNTY, WA

 Project Lease Boundary
(12/01/20)



Reference Map



1:250,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet

0 2.5 5 10 Miles

NOT FOR CONSTRUCTION

Horse Heaven
Wind Project



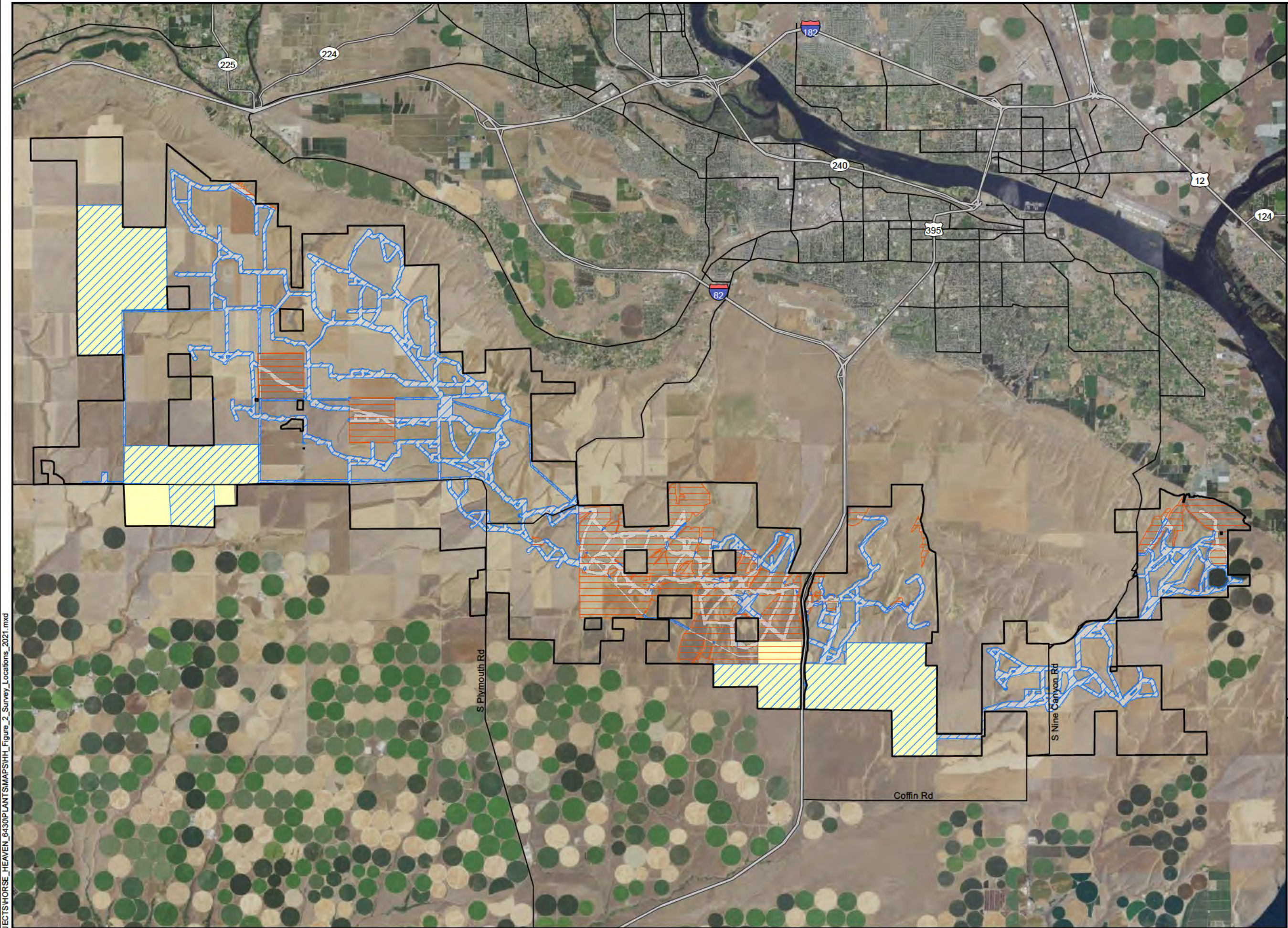
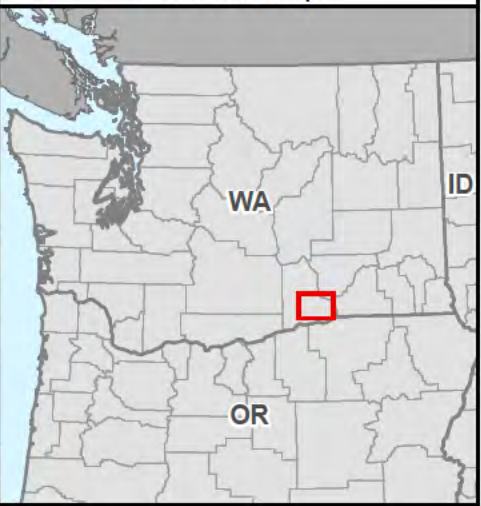
Figure 2
2020 and 2021 Survey Area

BENTON COUNTY, WA

- Project Lease Boundary (12/01/20)
- 2021 Survey Area
- 2020 Survey Area (Tetra Tech 2021)
- Wind Energy Micrositing Corridor (12/03/20)
- Solar Siting Area



Reference Map



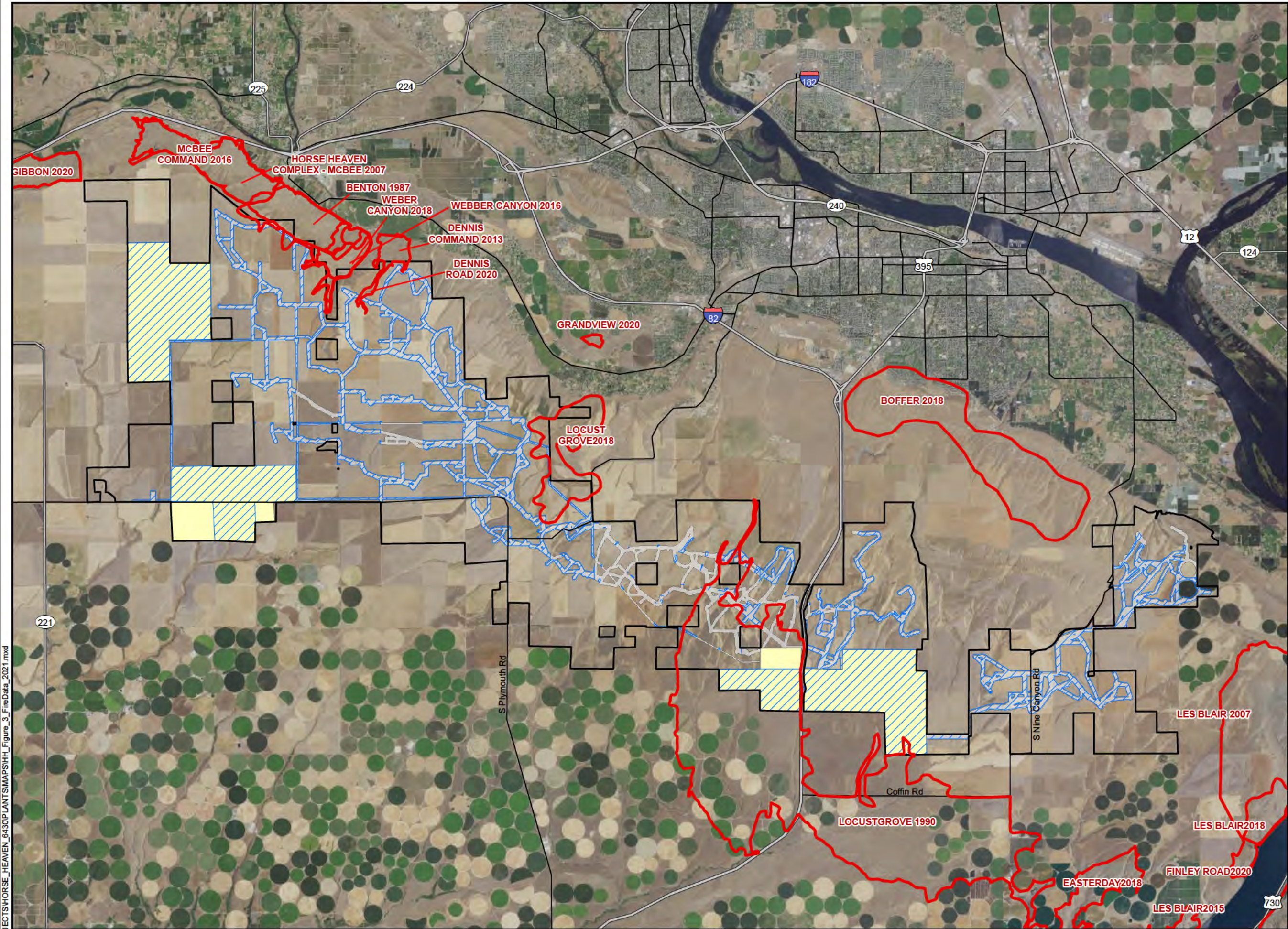
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1:130,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet

0 1 2 4 Miles

NOT FOR CONSTRUCTION



Horse Heaven
Wind Project



Figure 3
Fire Data

BENTON COUNTY, WA

- Project Lease Boundary (12/01/20)
- 2021 Survey Area
- Washington Large Fires 1973-2020 (DNR 2021)
- Wind Energy Micrositing Corridor (12/03/20)
- Solar Siting Area



Reference Map



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1:140,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet

0 1 2 4 Miles

NOT FOR CONSTRUCTION

Horse Heaven
Wind Project



Figure 4a
Noxious Weeds

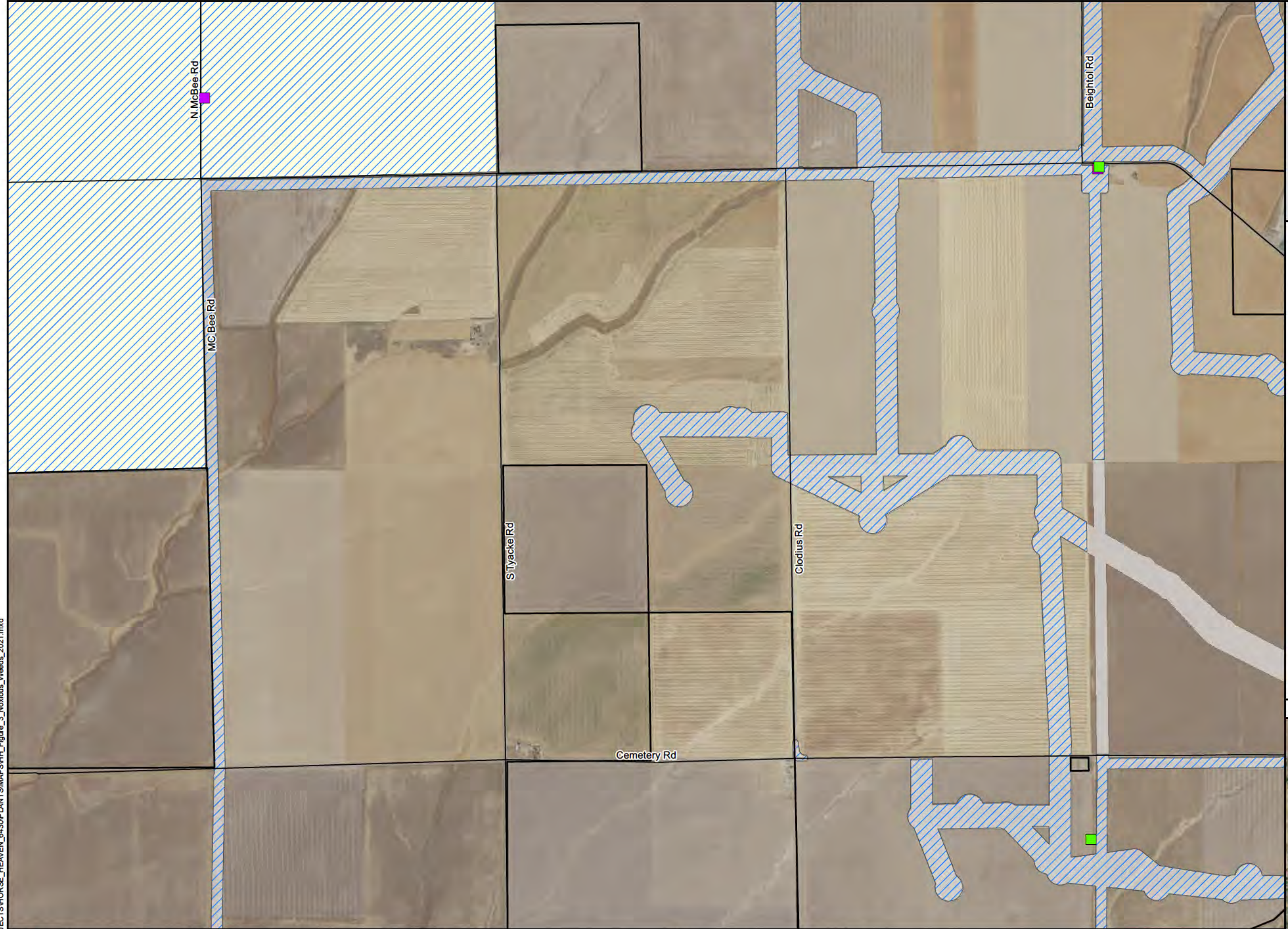
BENTON COUNTY, WA

- Project Lease Boundary (12/01/20)
- 2021 Survey Area
- Micrositing Corridor (12/03/20)
- Solar Siting Area

- Noxious Weed
- Kochia scoparia* (kochia)
 - Secale cereale* (cereal rye)



Reference Map



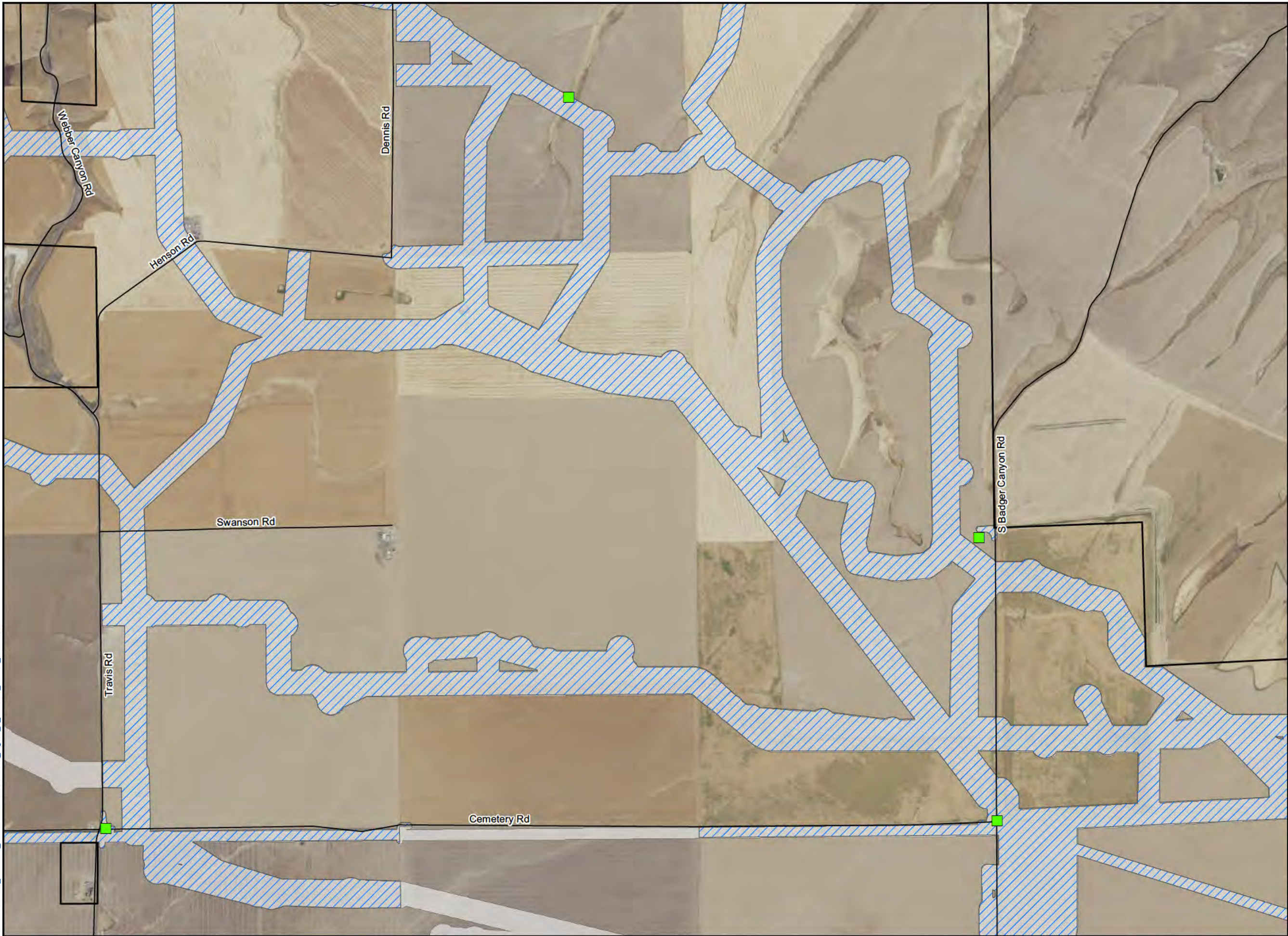
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Horse Heaven
Wind Project



Figure 4b
Noxious Weeds

BENTON COUNTY, WA

- Project Lease Boundary (12/01/20)
- 2021 Survey Area
- Micrositing Corridor (12/03/20)
- Solar Siting Area
- Noxious Weed
 - Kochia scoparia (kochia)



Reference Map



1:20,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet

0 1,000 2,000 4,000 Feet

NOT FOR CONSTRUCTION

Horse Heaven
Wind Project



Figure 4c
Noxious Weeds

BENTON COUNTY, WA

- Project Lease Boundary (12/01/20)
- 2021 Survey Area
- Micrositing Corridor (12/03/20)
- Solar Siting Area

- Noxious Weed
- Centaurea diffusa* (diffuse knapweed)
 - Chondrilla juncea* (rush skeleton weed)
 - Kochia scoparia* (kochia)
 - Secale cereale* (cereal rye)



Reference Map



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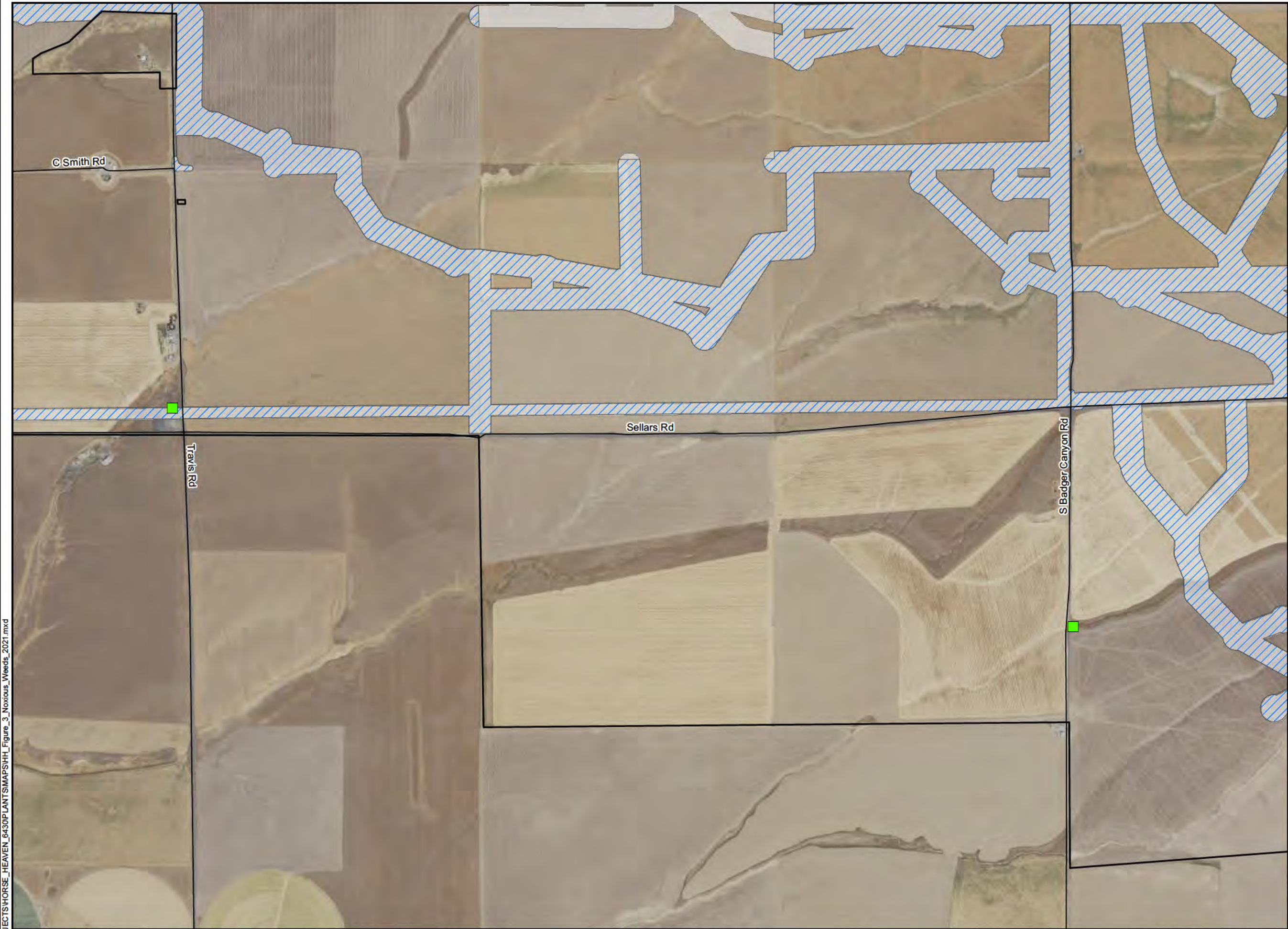


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Horse Heaven
Wind Project



Figure 4d
Noxious Weeds

BENTON COUNTY, WA

- Project Lease Boundary (12/01/20)
- 2021 Survey Area
- Micrositing Corridor (12/03/20)
- Solar Siting Area
- Noxious Weed
 - Kochia scoparia* (kochia)



Reference Map



1:20,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet

0 1,000 2,000 4,000 Feet

NOT FOR CONSTRUCTION

Horse Heaven
Wind Project



Figure 4e
Noxious Weeds

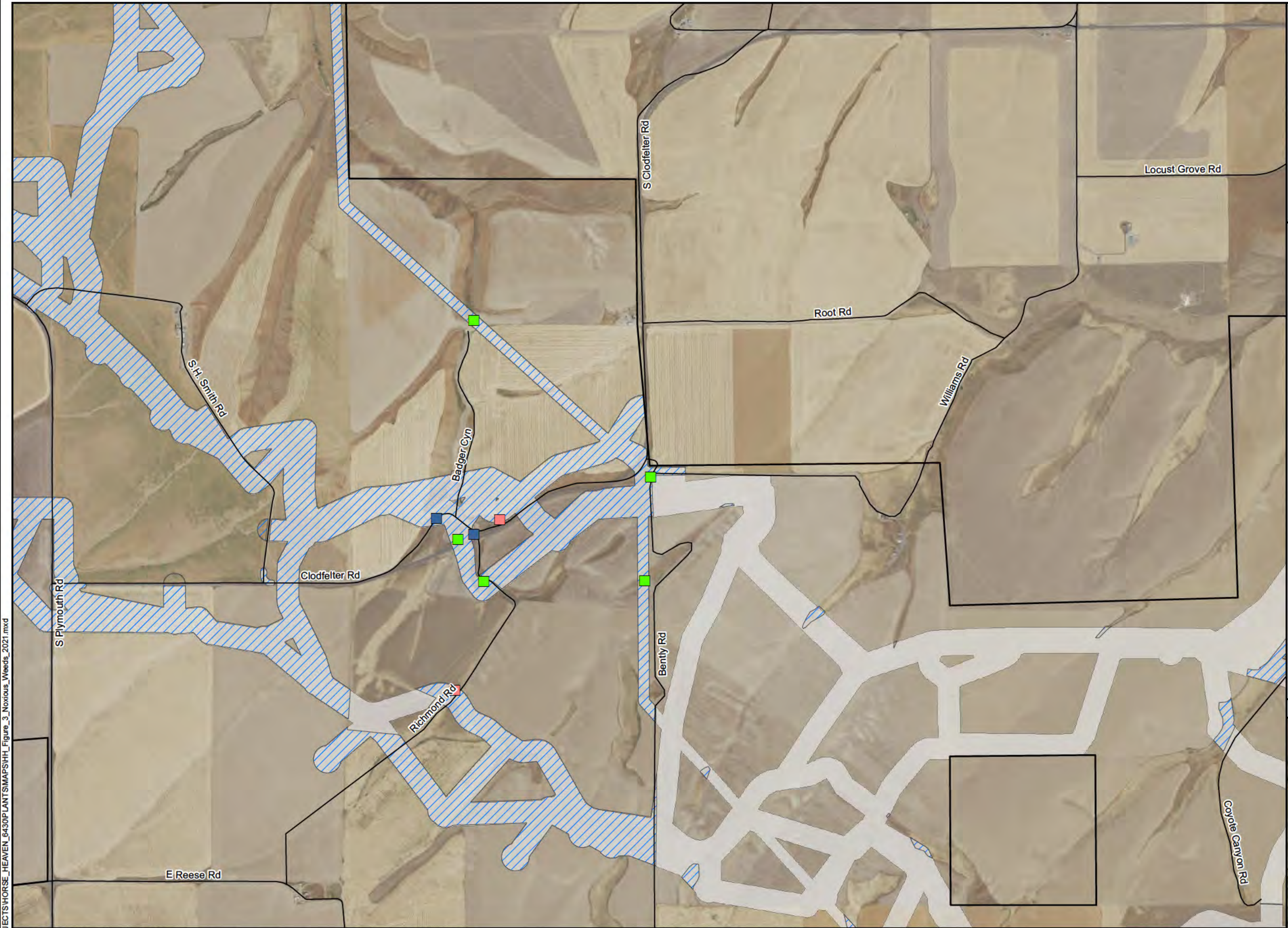
BENTON COUNTY, WA

- Project Lease Boundary (12/01/20)
- 2021 Survey Area
- Micrositing Corridor (12/03/20)
- Solar Siting Area

- Noxious Weed
- Centaurea diffusa* (diffuse knapweed)
 - Chondrilla juncea* (rush skeleton weed)
 - Kochia scoparia* (kochia)



Reference Map



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Horse Heaven
Wind Project



Figure 4f
Noxious Weeds

BENTON COUNTY, WA

- Project Lease Boundary (12/01/20)
- 2021 Survey Area
- Micrositing Corridor (12/03/20)
- Solar Siting Area

Noxious Weed

- Centaurea diffusa* (diffuse knapweed)
- Chondrilla juncea* (rush skeleton weed)
- Kochia scoparia* (kochia)
- Onopordum acanthium* (Scotch thistle)
- Secale cereale* (cereal rye)



Reference Map



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1:20,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet

0 1,000 2,000 4,000 Feet

NOT FOR CONSTRUCTION

Horse Heaven
Wind Project



Figure 4g
Noxious Weeds

BENTON COUNTY, WA

- Project Lease Boundary (12/01/20)
- 2021 Survey Area
- Micrositing Corridor (12/03/20)
- Solar Siting Area

Noxious Weed

- Centaurea diffusa* (diffuse knapweed)
- Chondrilla juncea* (rush skeleton weed)
- Kochia scoparia* (kochia)
- Onopordum acanthium* (Scotch thistle)
- Secale cereale* (cereal rye)



Reference Map



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1:20,000 NAD 1983 StatePlane Washington South FIPS 4602 Feet

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NOT FOR CONSTRUCTION

Horse Heaven
Wind Project



Figure 4h
Noxious Weeds

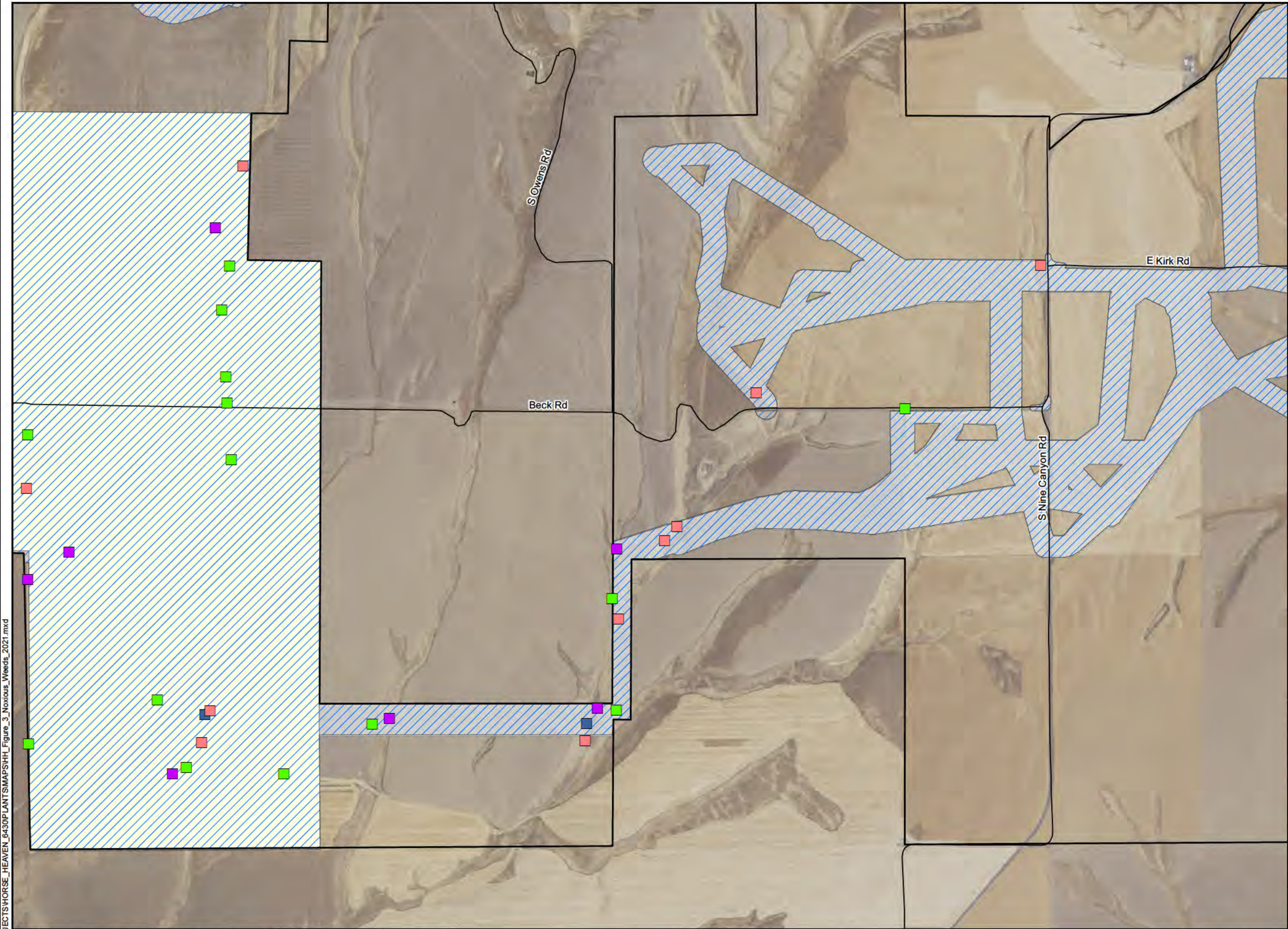
BENTON COUNTY, WA

- Project Lease Boundary
(12/01/20)
- 2021 Survey Area
- Micrositing Corridor
(12/03/20)
- Solar Siting Area

- Noxious Weed
- Centaurea diffusa* (diffuse knapweed)
 - Chondrilla juncea* (rush skeleton weed)
 - Kochia scoparia* (kochia)
 - Secale cereale* (cereal rye)



Reference Map



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Horse Heaven
Wind Project



Figure 4i
Noxious Weeds

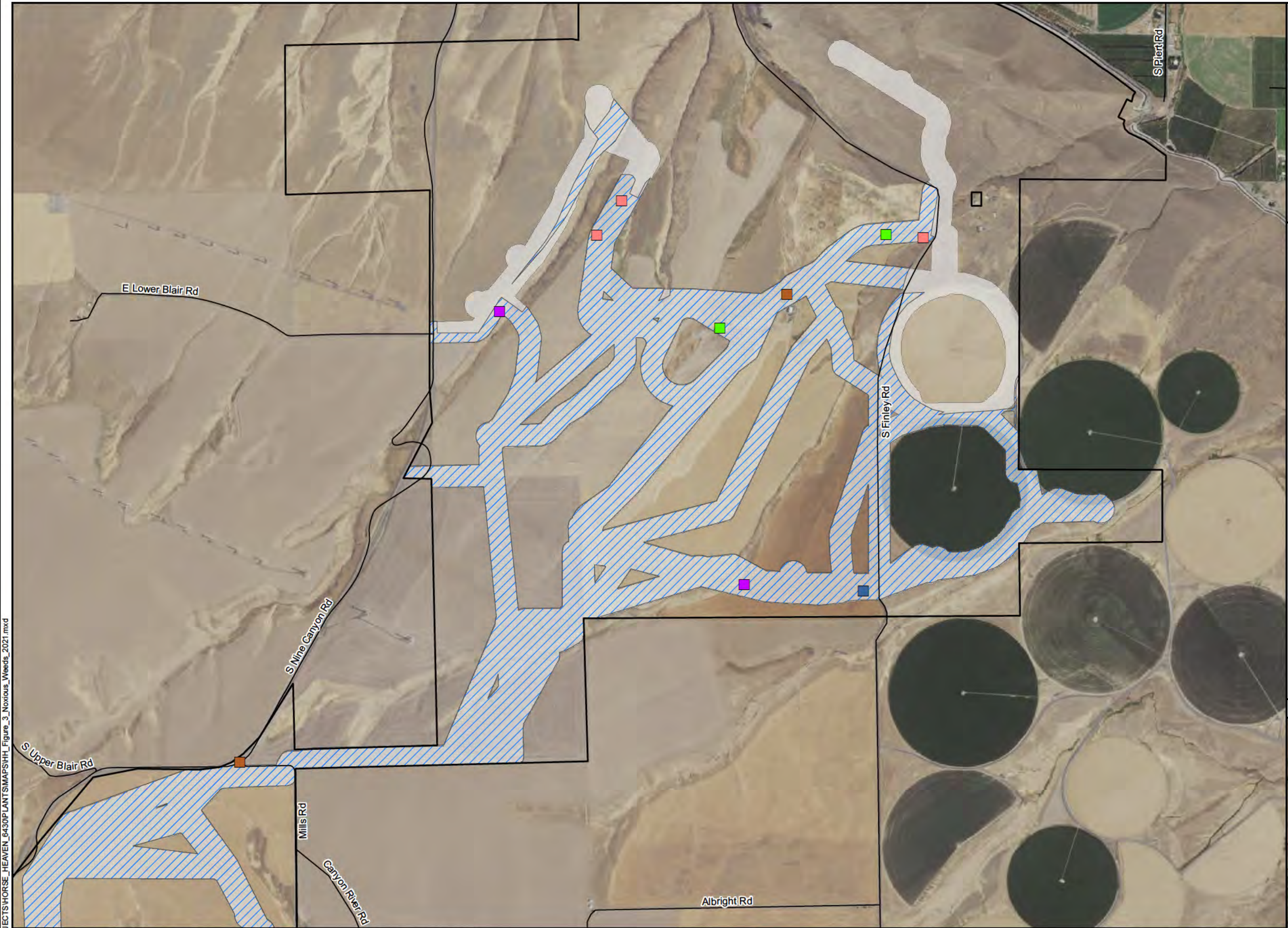
BENTON COUNTY, WA

- Project Lease Boundary (12/01/20)
- 2021 Survey Area
- Micrositing Corridor (12/03/20)
- Solar Siting Area

- Noxious Weed
- Centaurea diffusa* (diffuse knapweed)
 - Chondrilla juncea* (rush skeleton weed)
 - Convolvulus arvensis* (field bindweed)
 - Kochia scoparia* (kochia)
 - Secale cereale* (cereal rye)



Reference Map



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Horse Heaven Wind Project



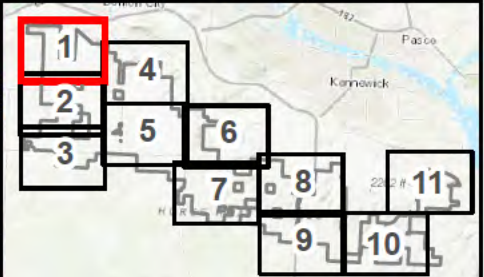
Figure 5a
Habitat Mapping

BENTON COUNTY, WA

- Project Lease Boundary
- 2021 Survey Area
- Wind Energy Micrositing Corridor
- Solar Siting Area

- Habitat Types
- Agricultural land
 - Developed/disturbed
 - Non-native Grassland
 - Planted Grassland

Reference Map



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1:24,000 WGS 1984 UTM Zone 11N

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NOT FOR CONSTRUCTION



Horse Heaven Wind Project



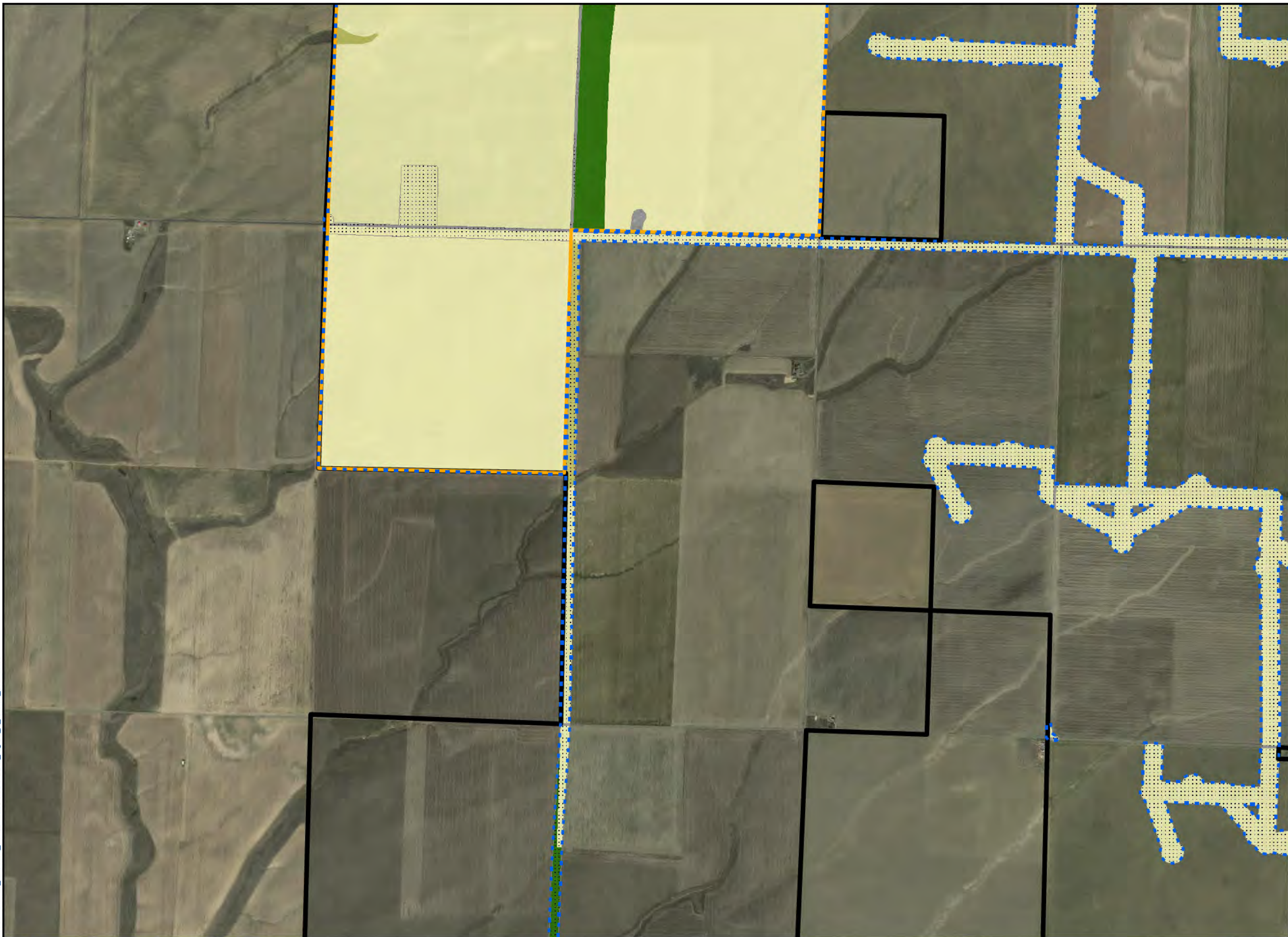
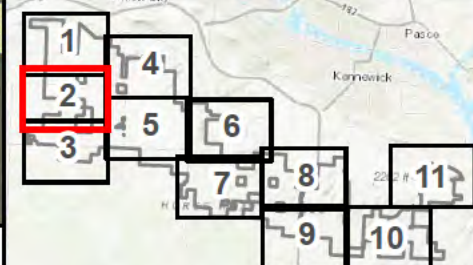
Figure 5b
Habitat Mapping

BENTON COUNTY, WA

- Project Lease Boundary
- 2021 Survey Area
- Wind Energy Micrositing Corridor
- Solar Siting Area

- Habitat Types**
- Agricultural land
 - Developed/disturbed
 - Non-native Grassland
 - Planted Grassland

Reference Map



1:24,000 WGS 1984 UTM Zone 11N

0 0.25 0.5 1 1.5 2 Miles

NOT FOR CONSTRUCTION



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Horse Heaven
Wind Project



Figure 5c
Habitat Mapping

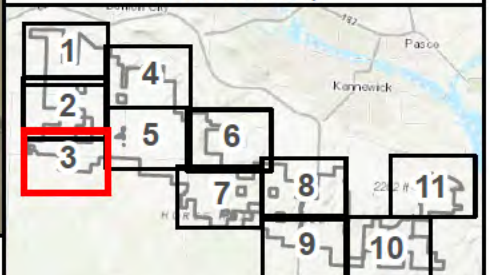
BENTON COUNTY, WA

- Project Lease Boundary
- 2021 Survey Area
- Wind Energy Micrositing Corridor
- Solar Siting Area

Habitat Types

- Agricultural land
- Developed/disturbed
- Non-native Grassland
- Planted Grassland
- Sagebrush Shrub-steppe

Reference Map



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1:24,000 WGS 1984 UTM Zone 11N

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NOT FOR CONSTRUCTION



Horse Heaven
Wind Project



Figure 5d
Habitat Mapping

BENTON COUNTY, WA

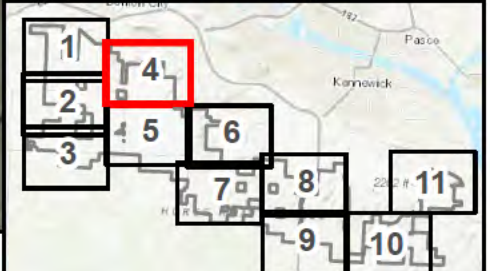
- Project Lease Boundary
- 2021 Survey Area
- Wind Energy Micrositing Corridor

Habitat Types

- Agricultural land
- Developed/disturbed
- Non-native Grassland
- Sagebrush Shrub-steppe

HH-West Intermediate Substation (Alternate)

Reference Map



1:24,000 WGS 1984 UTM Zone 11N

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NOT FOR CONSTRUCTION



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Horse Heaven Wind Project



Figure 5e
Habitat Mapping

BENTON COUNTY, WA

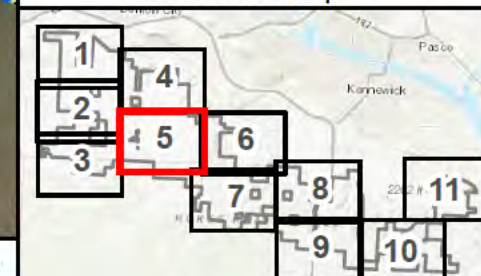
- Project Lease Boundary
- 2021 Survey Area
- Wind Energy Micrositing Corridor
- Solar Siting Area

Habitat Types

- Agricultural land
- Developed/disturbed
- Non-native Grassland
- Planted Grassland
- Sagebrush Shrub-steppe

HH-West Intermediate Substation (Primary)

Reference Map



1:24,000 WGS 1984 UTM Zone 11N

0 0.25 0.5 1 1.5 2 Miles

NOT FOR CONSTRUCTION



Horse Heaven Wind Project



Figure 5f
Habitat Mapping

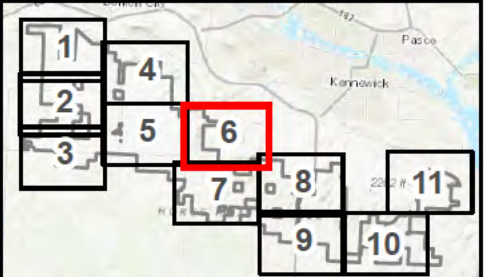
BENTON COUNTY, WA

- Project Lease Boundary
- 2021 Survey Area
- Wind Energy Micrositing Corridor

Habitat Types

- Agricultural land
- Developed/disturbed
- Eastside (Interior) Grasslands
- Non-native Grassland
- Rabbitbrush Shrubland
- Sagebrush Shrub-steppe

Reference Map



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1:24,000 WGS 1984 UTM Zone 11N

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NOT FOR CONSTRUCTION



Horse Heaven Wind Project



Figure 5g
Habitat Mapping

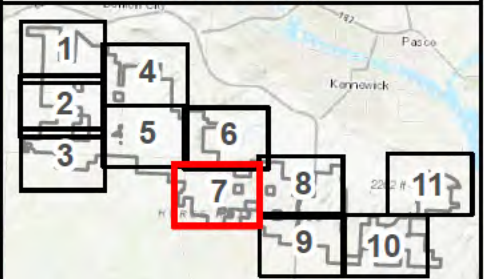
BENTON COUNTY, WA

- Project Lease Boundary
- 2021 Survey Area
- Wind Energy Micrositing Corridor

Habitat Types

- Agricultural land
- Developed/disturbed
- Eastside (Interior) Grasslands
- Non-native Grassland
- Planted Grassland
- Rabbitbrush Shrubland
- Sagebrush Shrub-steppe

Reference Map



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Horse Heaven Wind Project



Figure 5h
Habitat Mapping

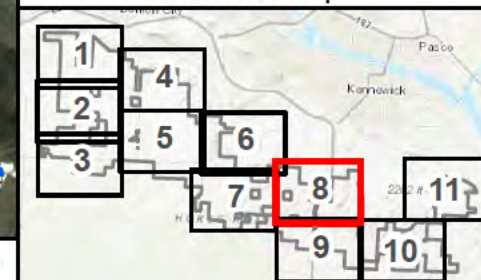
BENTON COUNTY, WA

- Project Lease Boundary
- 2021 Survey Area
- Wind Energy Micrositing Corridor

Habitat Types

- Agricultural land
- Developed/disturbed
- Non-native Grassland
- Planted Grassland
- Rabbitbrush Shrubland
- Sagebrush Shrub-steppe

Reference Map



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1:24,000 WGS 1984 UTM Zone 11N

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Horse Heaven Wind Project



Figure 5i
Habitat Mapping

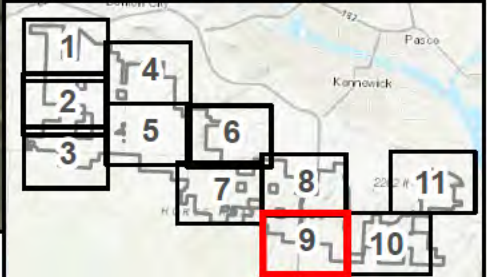
BENTON COUNTY, WA

- Project Lease Boundary
- 2021 Survey Area
- Wind Energy Micrositing Corridor
- Solar Siting Area

Habitat Types

- Agricultural land
- Developed/disturbed
- Eastside (Interior) Grasslands
- Non-native Grassland
- Planted Grassland
- Rabbitbrush Shrubland
- Sagebrush Shrub-steppe

Reference Map



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Horse Heaven Wind Project



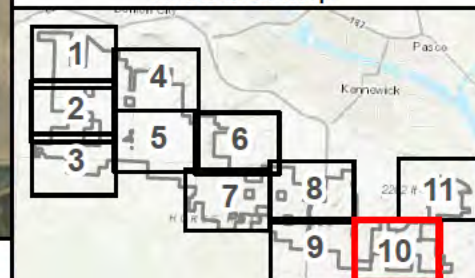
Figure 5j
Habitat Mapping

BENTON COUNTY, WA

- Project Lease Boundary
- 2021 Survey Area
- Wind Energy Micrositing Corridor
- Solar Siting Area

- Habitat Types**
- Agricultural land
 - Developed/disturbed
 - Non-native Grassland
 - Planted Grassland
 - Rabbitbrush Shrubland
 - Sagebrush Shrub-steppe

Reference Map



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1:24,000 WGS 1984 UTM Zone 11N

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NOT FOR CONSTRUCTION



Horse Heaven
Wind Project



Figure 5k
Habitat Mapping

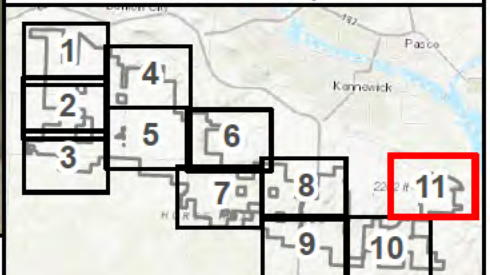
BENTON COUNTY, WA

- Project Lease Boundary
- 2021 Survey Area
- Wind Energy Micrositing Corridor

Habitat Types

- Agricultural land
- Developed/disturbed
- Non-native Grassland
- Planted Grassland
- Rabbitbrush Shrubland
- Sagebrush Shrub-steppe

Reference Map



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1:24,000 WGS 1984 UTM Zone 11N

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**ATTACHMENT A
SPECIAL STATUS PLANT SPECIES
WITH POTENTIAL TO OCCUR WITHIN THE 2021
SURVEY AREA**

Table A-1. Special Status Plant Species with Potential to Occur within the 2021 Survey Area¹

Scientific name (Common Name)	State Status / Federal Status ²	Habitat Characteristics/ Identifying Features ³	Survey Period ⁴	Likelihood of Occurrence Based on Background Review	Suitable Habitat Present Based on Field Surveys
<i>Aliciella leptomeria</i> (Great Basin gilia)	T / --	Open habitats in semiarid regions, on dry bluffs or in sandy swales. Substrates are often hard, gravelly or sandy, fine reddish to blackish basalt soils, or fine non-basalt gravel with caliche fragments. Associated species include: <i>Artemisia tridentata</i> , <i>Grayia spinosa</i> , and <i>Gilia sinuata</i> . Elev. 470–1,140 feet.	April–June	Low; limited suitable habitat likely present in 2021 Survey Area.	Limited suitable habitat present
<i>Ammania robusta</i> (grand redstem)	T / --	Shoreline and islands along the Columbia River, in riparian mudflats dominated by annual species. Also known from lakeshores in the channeled scablands. Sites are inundated until midsummer and periodically throughout the growing season, depending on upstream management of the river. Associated species include <i>Rotala ramosior</i> , <i>Eleocharis acicularis</i> , <i>Cyperus</i> spp., <i>Limosella aquatica</i> , <i>Lindernia dubia</i> , and occasionally <i>Rorippa columbiae</i> .	May–June	Highly unlikely; suitable habitat unlikely to occur within 2021 Survey Area.	No suitable habitat present
<i>Astragalus columbianus</i> (Columbian milkvetch)	S / --	Shrub-steppe habitats on sandy or gravelly loams, silts, rocky silt loams, and lithosols. Associated species include: <i>Artemisia tridentata</i> , <i>A. rigida</i> , <i>Pseudoroegneria spicata</i> , <i>Astragalus caricinus</i> , <i>A. purshii</i> , <i>A. speirocarpus</i> , and <i>A. succumbens</i> . Elev. 420–2,320 feet.	Mid-April–mid-June	Low to moderate; suitable habitat potentially present in 2021 Survey Area.	Limited suitable habitat present
<i>Astragalus kentrophyta</i> var. <i>douglasii</i> (thistle milkvetch)	X / --	On sandy ground, dunes, or eroded riverbanks at low elevations. Not seen since 1883; this taxon is likely extinct.	June	Highly unlikely; species is believed to be extirpated in Washington.	No suitable habitat present
<i>Astragalus misellus</i> var. <i>pauper</i> (pauper milkvetch)	S / --	Open ridgetops and upper slopes, rarely middle and lower slopes, along western margin of the Columbia Basin province. In <i>Artemisia tridentata</i> / <i>Pseudoroegneria spicata</i> vegetation community. Associated species include: <i>Artemisia rigida</i> , <i>A. tridentata</i> , <i>Crepis atriobarba</i> , <i>C. occidentalis</i> , <i>Eriogonum sphaerocephalum</i> , <i>Pseudoroegneria spicata</i> , <i>Poa secunda</i> , <i>Astragalus purshii</i> , <i>Erigeron linearis</i> , <i>Lomatium macrocarpum</i> , <i>Phlox longifolia</i> , and <i>P. hoodii</i> . Elev. 500–3,280 feet.	April–June	Highly unlikely; known occurrences in Benton County are historical occurrences. ⁵	Very limited suitable habitat present

Scientific name (Common Name)	State Status / Federal Status ²	Habitat Characteristics/ Identifying Features ³	Survey Period ⁴	Likelihood of Occurrence Based on Background Review	Suitable Habitat Present Based on Field Surveys
<i>Calyptridium roseum</i> (rosy pussypaws)	T / --	Sagebrush desert to arid montane forest, in sandy to gravelly soils. In Washington, grows in very dry shrub-steppe, in low swales in dark sandy soil. In spring, the swale microsites may be moister than the surrounding habitat. Associated species include: <i>Artemisia tridentata</i> , <i>Bromus tectorum</i> , <i>Poa secunda</i> , <i>Greeneocharis circumscissa</i> , <i>Holosteum umbellatum</i> , <i>Draba verna</i> , <i>Erythranthe suksdorfii</i> , <i>Microsteris gracilis</i> , <i>Loeflingia squarrosa</i> subsp. <i>squarrosa</i> , and <i>Gilia leptomeria</i> . Elev. 525 feet.	May–June	Low to moderate; suitable habitat potentially present in 2021 Survey Area.	Limited suitable habitat present
<i>Cryptantha leucophaea</i> (gray cryptantha)	T / --	Sandy substrates, especially sand dunes that have not been completely stabilized. Appears to be restricted to areas where there is still some wind-derived movement of open sand. Associated species include: <i>Purshia tridentata</i> , <i>Artemisia tridentata</i> , <i>Hesperostipa comata</i> , <i>Achnatherum hymenoides</i> , <i>Poa secunda</i> , <i>Oenothera pallida</i> , <i>Eriogonum niveum</i> , <i>Penstemon attenuatus</i> , and <i>Astragalus succumbens</i> . Elev. 300–2,500 feet.	May–June	Low; limited suitable habitat likely present in 2021 Survey Area.	Very limited suitable habitat present
<i>Cryptantha scoparia</i> (desert cryptantha)	S / --	Dry areas with full sun and little competing vegetation. In Washington, grows on south-facing slopes and ridges between small canyons with fine, dry silt and talus. Sites may be a little more alkaline than surrounding areas. Associated species include: <i>Artemisia tridentata</i> , <i>Krascheninnikovia lanata</i> , <i>Eriogonum niveum</i> , <i>Eriophyllum lanatum</i> , <i>Epilobium minutum</i> , <i>Bromus hordeaceus</i> , <i>Bromus tectorum</i> , and <i>Pseudoroegneria spicata</i> . Elev. 1,200–2,100 feet.	April–June	Low; limited suitable habitat likely present in 2021 Survey Area.	No suitable habitat present
<i>Cryptantha spiculifera</i> (Snake River cryptantha)	S / --	Sandy knolls and badlands and talus at low elevations; dry, open, flat or sloping areas in stable or stony soils. Associated species include: <i>Artemisia rigida</i> , <i>A. tridentata</i> , <i>Ericameria nauseosa</i> , <i>Eriogonum sphaerocephalum</i> , <i>Salvia dorrii</i> , <i>Lupinus sericeus</i> , <i>Pseudoroegneria spicata</i> , and <i>Poa secunda</i> . Elev. 450–3,500 feet.	May–July	Low; limited suitable habitat likely present in 2021 Survey Area.	Very limited suitable habitat present
<i>Cuscuta denticulata</i> (desert dodder)	T / --	Parasitic on a variety of native shrubs in desert areas, including sagebrush (<i>Artemisia</i> spp.), rabbitbrush (<i>Chrysothamnus/Ericameria</i> spp.). Associated species include: <i>Artemisia tridentata</i> , <i>Poa secunda</i> , <i>Achnatherum hymenoides</i> , <i>Bromus tectorum</i> , <i>Astragalus carcinus</i> , <i>Erigeron poliospermus</i> , <i>Cymopterus terebinthinus</i> , and <i>Helianthus cusickii</i> . Elev. 880–1,089 feet.	July– August	Highly unlikely; known occurrences in Benton County are historical occurrences ⁵ .	Limited suitable habitat present

Scientific name (Common Name)	State Status / Federal Status ²	Habitat Characteristics/ Identifying Features ³	Survey Period ⁴	Likelihood of Occurrence Based on Background Review	Suitable Habitat Present Based on Field Surveys
<i>Eleocharis coloradoensis</i> (dwarf spike-rush)	X / --	Fresh to brackish bare wet soil, inland. Fresh or brackish drying lake and pond margins, stream beds, flood plains, vernal pools, irrigation ditches, tidal wetlands. Elev. 0–6,900 feet.	Spring–fall	Highly unlikely; species is believed to be extirpated in Washington.	No suitable habitat present
<i>Eremogone franklinii</i> var. <i>thompsonii</i> (Thompson's sandwort)	S / --	Sand dunes, scabland, and sagebrush slopes. Associated species include: <i>Purshia tridentata</i> , <i>Poa canbyi</i> and other bunchgrasses.	May–June	Low; limited suitable habitat likely present in 2021 Survey Area.	Very limited suitable habitat present
<i>Eremothera minor</i> (small-flower evening-primrose)	S / --	Gravelly basalt slopes, sandy and alkaline soils, and dry rocky hillsides; often with considerable cover of bare soil. Associated species include: <i>Artemisia tridentata</i> , <i>Ericameria nauseosa</i> , <i>Purshia tridentata</i> , <i>Bromus tectorum</i> , and <i>Poa secunda</i> . Elev. 460–1,140 feet.	May–early June	Low; limited suitable habitat likely present within 2021 Survey Area.	Very limited suitable habitat present
<i>Eremothera pygmaea</i> (dwarf evening-primrose)	S / --	Sagebrush steppe, on unstable soil or gravel in steep talus, dry washes, banks, and roadcuts. Associated species include: <i>Artemisia tridentata</i> , <i>Bromus tectorum</i> , <i>Eriogonum</i> spp., <i>Gilia minutiflora</i> , <i>Mentzelia</i> spp., <i>Cryptantha</i> spp., <i>Salsola tragus</i> , and <i>Neoholmgrenia</i> (<i>Camissonia</i>) <i>andina</i> . Elev. 450–2,050 feet.	Flowers April–June; Fruits June–August	Low; limited suitable habitat likely present within 2021 Survey Area.	Very limited suitable habitat present
<i>Eriogonum codium</i> (Umtanum desert buckwheat)	E / T	Known from one population on flat to gently sloping microsities near the top of a steep, north-facing basalt ridge overlooking the Columbia River. Overall vegetation cover is low. Associated species include: <i>Grayia spinosa</i> , <i>Salvia dorrii</i> , <i>Bromus tectorum</i> , <i>Camissonia minor</i> , <i>Cryptantha pterocarya</i> , and <i>Phacelia linearis</i> . Elev. 1,120–1,300 feet.	May–August	Highly unlikely, only known population is located more than 25 miles north of 2021 Survey Area.	No suitable habitat present
<i>Erythranthe suksdorfii</i> (Suksdorf's monkeyflower)	S / --	Open, moist, or rather dry places, from the valleys and foothills to moderate or occasionally high elevations in the mountains. Occurs in seasonally moist swales, drainages, or vernal pools in shrub-steppe vegetation. Microhabitats are often disturbed by small erosive events (i.e., slumps, slides, bioturbation, and frost boils). Associated species include: <i>Juniperus communis</i> , <i>Philadelphus lewisii</i> , <i>Artemisia tridentata</i> , <i>Eriogonum</i> sp., <i>Bromus tectorum</i> , <i>Poa secunda</i> , <i>Camissonia hilgardii</i> , <i>Collomia linearis</i> , <i>Draba verna</i> , <i>Erythranthe floribunda</i> , <i>E. breviflora</i> , <i>Plectritis macrocera</i> , <i>Cryptantha ambigua</i> , <i>Microsteris gracilis</i> , and <i>Ranunculus testiculatus</i> . Elev. 430–7,100 feet.	mid-April–approx. June	Low; limited suitable habitat likely to occur within 2021 Survey Area.	No suitable habitat present

Scientific name (Common Name)	State Status / Federal Status ²	Habitat Characteristics/ Identifying Features ³	Survey Period ⁴	Likelihood of Occurrence Based on Background Review	Suitable Habitat Present Based on Field Surveys
<i>Hypericum majus</i> (Canadian St. John's-wort)	S / --	Along ponds, lakesides, riparian habitats, or other low, wet places (FACW species). In Washington, it occurs in habitats that are completely submerged during portions of the growing season or periodically inundated from water controlled by hydroelectric dams. Associated species include: <i>Equisetum</i> spp., <i>Juncus bufonius</i> , <i>J. tenuis</i> , <i>J. articulatus</i> , and <i>Carex</i> spp. Elev. 50–2,340 feet.	July– September	Highly unlikely; suitable habitat unlikely to occur within 2021 Survey Area.	No suitable habitat present
<i>Leymus flavescens</i> (yellow wildrye)	S / --	Occurs in sandy soils throughout its range. In Montana it is found in sand-deposition areas of sand dunes, where it is associated with <i>Hesperostipa comata</i> and <i>Elymus caninus</i> . The species has also been found on sandy roadsides.	June–July	Highly unlikely; known occurrence in Benton County is a historical occurrence ⁵ .	No suitable habitat present
<i>Lipocarpus aristulata</i> (awned halfchaff sedge)	T / --	Wet soil and mud, often comprised of fine sand and silt, in bottomlands, sandbars, beaches, shorelines, stream banks, ponds, and ditches. In WA, grows along shorelines and islands below high water at elevations up to 500 feet. Associated species include: <i>Eleocharis</i> spp., <i>Juncus</i> spp., <i>Ammannia robusta</i> , <i>Rotala ramosior</i> , <i>Cyperus</i> spp., <i>Limosella</i> spp., <i>Lindernia dubia</i> , and <i>Rorippa columbiana</i> .	June– August	Highly unlikely; suitable habitat unlikely to occur within 2021 Survey Area.	No suitable habitat present
<i>Loeflingia squarrosa</i> (spreading pygmyleaf)	T / --	Low swales and shallow vernal pools in sandy and silty areas. The Washington populations were found during an unusually wet year in swales and vernal wet areas with a great diversity of annuals in an otherwise arid environment. Associated species include: <i>Artemisia tridentata</i> , <i>Poa secunda</i> , <i>Greeneocharis circumscissa</i> , <i>Erythranthe suksdorfii</i> , <i>Holosteum umbellatum</i> , <i>Microsteris gracilis</i> , <i>Gnaphalium palustre</i> , <i>Epilobium minutum</i> , <i>Gilia sinuata</i> , and <i>Juncus bufonius</i> . Elev. 430–580 feet.	May	Highly unlikely; suitable habitat unlikely to occur within 2021 Survey Area.	No suitable habitat present
<i>Lomatium tuberosum</i> (Hoover's desert- parsley)	S / --	Loose basalt talus in sagebrush steppe, typically on east- to north-facing slopes. Sometimes in channels of open ridgetops and talus on south- to southwest-facing slopes in the western portion of its distribution. Associated species include: <i>Artemisia rigida</i> , <i>Poa secunda</i> , <i>Pseudoroegneria spicata</i> , and <i>Delphinium nuttallianum</i> . Elev. 460–4,000 feet.	Early March– mid-April	Low; limited suitable habitat likely present within 2021 Survey Area.	No suitable habitat present

Scientific name (Common Name)	State Status / Federal Status ²	Habitat Characteristics/ Identifying Features ³	Survey Period ⁴	Likelihood of Occurrence Based on Background Review	Suitable Habitat Present Based on Field Surveys
<i>Micromonolepis pusilla</i> (red poverty-weed)	T / --	Desert regions, in saline or alkaline clay soils, salt-encrusted soils, or edges of alkaline ponds. This species is adapted to extreme conditions. In some sites it is limited to growing directly beneath greasewood shrubs, due to cattle trampling and soil compaction between the shrubs. Associated species include: <i>Sarcobatus vermiculatus</i> , <i>Suaeda depressa</i> , <i>Bromus tectorum</i> , and <i>Phacelia tetramera</i> . Elev. 1,950–2,210 feet.	April–June	Highly unlikely; suitable habitat unlikely to occur within survey area and known occurrence in Benton County is historical occurrence ⁵ .	No suitable habitat present
<i>Mimetanthe pilosa</i> (false monkeyflower)	S / --	Moist, sandy or gravelly soils, especially by small streams, seeps, springs, and disturbed areas. Elev. 1,000–4,500 feet.	May–July	Highly unlikely; known occurrence in Benton County is a historical occurrence ⁵ .	No suitable habitat present
<i>Myosurus alopecuroides</i> (foxtail mouseltail)	T / --	Obligate vernal pool species; found on hard, bare, desiccated clay in sparsely vegetated areas of shallow pools. Associated species include: <i>Deschampsia danthonioides</i> , <i>Myosurus minimus</i> , <i>Navarretia leucocephala</i> , <i>Plagiobothrys</i> spp., and <i>Polygonum polygaloides</i> ssp. <i>confertiflorum</i> . Elev. 250–2,500 feet.	March–June	Highly unlikely; suitable habitat unlikely to occur within 2021 Survey Area.	No suitable habitat present
<i>Nicotiana attenuata</i> (coyote tobacco)	S / --	Dry, sandy bottom lands, dry rocky washes, and in other dry open places; Elev. 320 to 2,640 feet. Associated species: <i>Artemisia tridentata</i> , <i>Ericameria</i> spp., <i>Bromus tectorum</i> , <i>Leymus cinereus</i> , <i>Centaurea diffusa</i> , <i>Verbascum thapsus</i> , <i>Solanum triflorum</i> , <i>Achillea millefolium</i> , and <i>Mentzelia laevicaulis</i> .	June–September	Low; limited suitable habitat likely to occur in 2021 Survey Area.	Very limited suitable habitat present
<i>Oenothera cespitosa</i> ssp. <i>cespitosa</i> (cespitose evening-primrose)	S / --	Open sagebrush desert; on loose talus slopes, steep, sandy or gravelly slopes, road cuts, and dry hills; as well as along the flat river terrace of the Columbia River. It occurs within general areas dominated by <i>Artemisia tridentata</i> or <i>Artemisia rigida</i> . Other associated species include: <i>Ericameria nauseosa</i> , <i>Eriogonum douglasii</i> and <i>E. niveum</i> , <i>Poa secunda</i> , <i>Achnatherum thurberianum</i> , <i>A. hymenoides</i> , <i>Hesperostipa comata</i> , <i>Koeleria macrantha</i> , <i>Astragalus purshii</i> , <i>A. succumbens</i> , <i>Balsamorhiza careyana</i> , <i>Phacelia hastata</i> , and <i>Cymopterus terebinthina</i> . Elev. 410–1,800 feet.	Late-April–mid-June	Moderate; suitable habitat potentially present in 2021 Survey Area.	Limited suitable habitat present

Scientific name (Common Name)	State Status / Federal Status ²	Habitat Characteristics/ Identifying Features ³	Survey Period ⁴	Likelihood of Occurrence Based on Background Review	Suitable Habitat Present Based on Field Surveys
<i>Rorippa columbiae</i> (Columbia yellowcress)	T / --	Riverbanks, permanent lakes, snow-fed lakes, and streams, internally-drained lakes with extended periods of dryness, wet meadows, and ditches. All known sites are inundated for at least part of the year. Soil types include clay, sand, gravel, sandy silt, cobblestones, and rocks. All sites in Washington occur along the Columbia River, in the lowest vegetated riparian zone.	April– October	Highly unlikely; suitable habitat unlikely to occur within 2021 Survey Area.	No suitable habitat present
<i>Rotala ramosior</i> (lowland toothcup)	S / --	Damp areas in fine sand and silt, wet, swampy places, mudflats, lakes and pond margins, and along free-flowing river reaches. Found in riparian wetlands growing below high water, often in a community of small emergent annuals. Elev. 200 to 2,260 feet. Associated species include: <i>Salix exigua</i> , <i>Ammannia robusta</i> , <i>Juncus</i> spp., <i>Eleocharis acicularis</i> , <i>Limosella acaulis</i> , <i>Lindernia dubia</i> , and <i>Cyperus acuminatus</i> . Elev. 200–2,259 feet.	June– August	Highly unlikely; suitable habitat unlikely to occur within 2021 Survey Area.	No suitable habitat present
<i>Sabulina nuttallii</i> var. <i>fragilis</i> (Nuttall's sandwort)	T / --	Open, gravelly benches, dry rocky areas, or limestone talus from open sagebrush hills to alpine slopes. In Washington this taxon has been found on desert ridges of raised basalt, talus, outcrops, and in rocky to gravelly or sandy soil. Associated species include: <i>Purshia tridentata</i> , <i>Grayia spinosa</i> , <i>Salvia dorrii</i> , <i>Pseudoroegneria spicata</i> , <i>Ericameria nauseosa</i> , <i>Eriogonum microthecum</i> , <i>Balsamorhiza careyana</i> , and <i>Lomatium macrocarpum</i> .	May– August	Highly unlikely; suitable habitat unlikely to occur within 2021 Survey Area.	No suitable habitat present

Notes:

¹ Table based on the WNHP's Rare Vascular and Nonvascular Species List for Benton County (WNHP 2021a)

² State Status: WNHP (2019) provides the following explanation of state status:

E = Endangered, in danger of becoming extinct or extirpated from Washington

T = Threatened, likely to become Endangered in Washington

S = Sensitive, vulnerable or declining and could become Endangered or Threatened in Washington

X = Possibly extinct or extirpated from Washington State (includes state historical species).

Federal status: T = Listed threatened.

³ Sources: Burke Museum of Natural History and Culture 2021; Hitchcock and Cronquist 2018; WNHP 2019, 2021b.

⁴ Sources: Burke Museum of Natural History and Culture 2021; WNHP 2021b.

⁵ Historical occurrence is one that has not been reconfirmed for 40 or more years, or the species is extirpated from the county (WNHP 2021a).

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ATTACHMENT B
VASCULAR PLANTS OBSERVED WITHIN THE
2021 SURVEY AREA

Scientific Name	Common Name	Family	Type	Non-native	Noxious Weed Class Benton County / Washington State	Synonyms / Notes
<i>Achillea millefolium</i>	common yarrow	Asteraceae	forb			
<i>Achnatherum hymenoides</i>	Indian rice grass	Poaceae	grass			
<i>Agoseris grandiflora</i>	bigflower agoseris	Asteraceae	forb			
<i>Agoseris heterophylla</i>	annual agoseris	Asteraceae	forb			
<i>Agropyron cristatum</i>	crested wheatgrass	Poaceae	grass	x		
<i>Allium acuminatum</i>	tapertip onion	Amaryllidaceae	forb			
<i>Amaranthus blitoides</i>	matweed, prostrate pigweed	Amaranthaceae	forb	x		
<i>Ambrosia acanthicarpa</i>	bur ragweed	Asteraceae	forb			
<i>Amsinckia lycopsoides</i>	tarweed fiddleneck, bugloss fiddleneck	Boraginaceae	forb			
<i>Amsinckia tessellata</i>	bristly fiddleneck, tessellate fiddleneck	Boraginaceae	forb			
<i>Antennaria dimorpha</i>	low pussytoes	Asteraceae	forb			
<i>Artemisia dracunculus</i>	dragon sawewort, tarragon, dragon wormwood	Asteraceae	forb			
<i>Artemisia tridentata</i>	big sagebrush	Asteraceae	shrub			
<i>Artemisia tripartita</i>	threetip sagebrush	Asteraceae	shrub			
<i>Astragalus purshii</i>	woollypod milkvetch, Pursh's milk-vetch	Fabaceae	forb			
<i>Astragalus spaldingii</i>	Spalding's milkvetch	Fabaceae	forb			
<i>Balsamorhiza careyana</i>	Carey's balsamroot	Asteraceae	forb			
<i>Bassia scoparia</i>	red belvedere, mock cypress, kochia	Amaranthaceae	forb	x	Class B / Class B	<i>Kochia scoparia</i>
<i>Bromus arvensis</i>	field brome/Japanese brome	Poaceae	grass	x		<i>Bromus japonicus</i>
<i>Bromus hordeaceus</i>	soft brome	Poaceae	grass	x		<i>Bromus mollis</i>
<i>Bromus tectorum</i>	cheatgrass	Poaceae	grass	x		
<i>Calochortus macrocarpus</i> var. <i>macrocarpus</i>	sagebrush mariposa lily	Liliaceae	forb			
<i>Centaurea</i> sp.	knapweed	Asteraceae	forb	x	Class B / Class B	likely diffuse knapweed
<i>Ceratocephala testiculata</i>	burr buttercup	Ranunculaceae	forb	x		
<i>Chaenactis douglasii</i>	Douglas' dustymaiden, dusty maidens	Asteraceae	forb			
<i>Chenopodium leptophyllum</i>	narrowleaf goosefoot	Amaranthaceae	forb			
<i>Chondrilla juncea</i>	rush skeletonweed	Asteraceae	forb	x	Class B / Class B	
<i>Chorispora tenella</i>	crossflower, blue mustard	Brassicaceae	forb	x		
<i>Chrysothamnus viscidiflorus</i>	yellow rabbitbrush, green rabbitbrush	Asteraceae	shrub			
<i>Convolvulus arvensis</i>	field bindweed	Convolvulaceae	forb	x	Class C / Class C	
<i>Conyza canadensis</i>	horseweed, Canadian fleabane	Asteraceae	forb			
<i>Crepis atriobarba</i>	slender hawksbeard	Asteraceae	forb			
<i>Crepis intermedia</i>	intermediate hawksbeard, limestone hawksbeard	Asteraceae	forb			
<i>Cymopterus terebinthinus</i>	turpentine spring parsley, turpentine wavewing	Apiaceae	forb			<i>Pteryxia terebinthina</i>
<i>Descurainia pinnata</i>	western tansymustard	Brassicaceae	forb			
<i>Descurainia sophia</i>	flixweed	Brassicaceae	forb	x		
<i>Dieteria canescens</i>	hoary-aster	Asteraceae	forb			<i>Machaeranthera canescens</i>
<i>Draba verna</i>	spring whitlow-grass	Brassicaceae	forb	x		
<i>Elymus elymoides</i>	squirreltail	Poaceae	grass			
<i>Epilobium brachycarpum</i>	tall annual willowherb	Onagraceae	forb			
<i>Ericameria nauseosa</i>	rubber rabbitbrush, gray rabbitbrush	Asteraceae	shrub			
<i>Erigeron filifolius</i>	threadleaf fleabane	Asteraceae	forb			
<i>Erigeron linearis</i>	desert yellow daisy, lineleaf fleabane	Asteraceae	forb			
<i>Erigeron pumilus</i>	shaggy fleabane	Asteraceae	forb			
<i>Eriophyllum lanatum</i> var. <i>integrifolium</i>	Oregon sunshine	Asteraceae	forb			
<i>Erodium cicutarium</i>	redstem, common stork's bill, crane's-bill	Geraniaceae	forb	x		
<i>Grayia spinosa</i>	spiny hopsage	Amaranthaceae	shrub			
<i>Hesperostipa comata</i>	needle-and-thread grass	Poaceae	grass			
<i>Heterotheca villosa</i>	hairy goldaster	Asteraceae	forb			
<i>Holosteum umbellatum</i>	jagged chickweed	Caryophyllaceae	forb	x		
<i>Hordeum murinum</i>	mouse barley	Poaceae	grass	x		
<i>Lactuca serriola</i>	prickly lettuce	Asteraceae	forb	x		
<i>Lagophylla ramosissima</i>	slender hareleaf, branched lagophylla	Asteraceae	forb			
<i>Lappula longispina</i>	long-spined stickseed	Boraginaceae	forb	x		

Scientific Name	Common Name	Family	Type	Non-native	Noxious Weed Class Benton County / Washington State	Synonyms / Notes
<i>Leymus cinereus</i>	basin wildrye	Poaceae	grass			<i>Elymus cinereus</i>
<i>Linum lewisii</i> var. <i>lewisii</i>	wild blue flax, prairie flax	Linaceae	forb			
<i>Lithospermum ruderale</i>	western gromwell, western stoneseed	Boraginaceae	forb			
<i>Lomatium macrocarpum</i>	large-fruit desert-parsley, bigseed lomatium	Apiaceae	forb			
<i>Lomatium papilioniferum</i>	butterfly bearing biscuit-root	Apiaceae	forb			<i>Lomatium grayi</i>
<i>Lomatium triternatum</i>	triternate biscuit-root	Apiaceae	forb			
<i>Lupinus leucophyllus</i>	velvet lupine	Fabaceae	forb			
<i>Lupinus sulphureus</i> var. <i>subsaccatus</i>	sulphur lupine, Bingen lupine	Fabaceae	forb			
<i>Madia</i> sp.	tarweed	Asteraceae	forb			
<i>Mentzelia albicaulis</i>	white-stem blazingstar	Loasaceae	forb			
<i>Onopordum acanthium</i>	Scotch thistle	Asteraceae	forb	x	Class B / Class B	
<i>Phacelia linearis</i>	thread-leaf phacelia, thread-leaf scorpion-weed	Hydrophyllaceae	forb			
<i>Phlox longifolia</i>	long-leaf phlox	Polemoniaceae	forb			
<i>Phlox</i> sp.	phlox	Polemoniaceae	forb			
<i>Plantago patagonica</i>	woolly plantain, indianwheat plantain	Plantaginaceae	forb			
<i>Poa bulbosa</i>	bulbous bluegrass	Poaceae	grass	x		
<i>Poa secunda</i> ssp. <i>juncifolia</i>	big bluegrass, Nevada bluegrass, alkali bluegrass	Poaceae	grass			<i>Poa ampla</i>
<i>Poa secunda</i> ssp. <i>secunda</i>	Sandberg bluegrass, curly bluegrass	Poaceae	grass			
<i>Polygonum aviculare</i>	prostrate knotweed	Polygonaceae	forb	x		
<i>Polypogon monspeliensis</i>	annual rabbit's-foot grass	Poaceae	grass	x		
<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass	Poaceae	grass			
<i>Robinia pseudoacacia</i>	black locust	Fabaceae	tree	x		
<i>Salsola tragus</i>	prickly Russian thistle	Chenopodiaceae	forb	x		<i>Salsola kali</i>
<i>Secale cereale</i>	cereal rye	Poaceae	grass	x	Class C / Class C	
<i>Sisymbrium altissimum</i>	tall tumbled mustard	Brassicaceae	forb	x		
<i>Stephanomeria tenuifolia</i>	wire lettuce, narrowleaf wirelettuce	Asteraceae	forb			
<i>Taraxacum officinale</i>	common dandelion	Asteraceae	forb	x		
<i>Tetradymia canescens</i>	gray horsebrush, spineless horsebrush	Asteraceae	shrub			
<i>Tragopogon dubius</i>	yellow salsify	Asteraceae	forb	x		
<i>Triticum aestivum</i>	wheat	Poaceae	grass	x		
<i>Verbena bracteata</i>	carpet vervain	Verbenaceae	forb			
<i>Vulpia bromoides</i>	brome fescue	Poaceae	grass	x		
<i>Vulpia microstachys</i>	small fescue	Poaceae	grass			

ATTACHMENT C WOVEN-SPORE LICHEN HABITAT SUITABILITY ASSESSMENT

1 INTRODUCTION

Based on review of the Washington Natural Heritage Program (WNHP) data (WNHP 2021a, 2021b), one special status non-vascular species, woven-spore lichen (*Texosporium sancti-jacobi*), was identified as occurring in Benton County and potentially within the Project Lease Boundary. In Washington, this species has been assigned the rank of threatened by the WNHP (WNHP 2021a). Woven spore-lichen has been documented at four separate locations within approximately 3 miles of the Project Lease Boundary, with the closest occurrence approximately 0.4 mile to the north. Field surveys for woven-spore lichen have not been conducted for the Project. In lieu of field surveys, this habitat suitability assessment was conducted to identify potentially suitable habitat at the Project for this species.

2 BACKGROUND

Woven spore lichen is a crustose lichen in the Caliciaceae (pin lichen) family of the Fungi Kingdom. It is identified by its whitish-margined apothecia (spore-bearing structure or fruiting body) and dark olive, loose spore mass (WNHP 2021c). In Washington, this species is currently known from Benton, Klickitat, Lincoln, and Yakima counties (Stone et al. 2018).

Habitat for this species includes arid to semiarid shrub-steppe, grassland, biscuit scabland, or savannah communities up to 3,300 feet in elevation (WNHP 2021c). Woven-spore lichen is typically found in areas of non-saline and noncalcerous soils on flat to gentle slopes, although it has also been found on slopes of up to 15 percent (Root and McCune 2012; Stone et al. 2018; WNHP 2021c). Most sites where it is found are relatively undisturbed and dominated by native plants, including sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), Idaho fescue (*Festuca idahoensis*), and bluebunch wheatgrass (*Pseudoroegneria spicata*) and are influenced by moisture from a river or lake (Root and McCune 2012; Stone et al. 2018; WNHP 2021c). It is often found on decomposing bunchgrass clumps that are impregnated with soil but elevated above the surrounding surface, on well-developed pinnacles of soil, or on old, decaying mammal scat (Stone et al. 2018; WNHP 2021c).

In 2018, surveys for woven-spore lichen were conducted for the Bureau of Land Management (BLM) in various locations on BLM-managed land in Lincoln, Grant, Yakima, and Benton counties (Stone et al. 2018). These surveys included BLM-managed land in the Horse Heaven Hills. During these surveys, woven-spore lichen was found in the Horse Heaven Hills in areas dominated by native bunchgrasses including bluebunch wheatgrass (*Pseudoroegneria spicata*) and Sandberg bluegrass (*Poa secunda* ssp. *secunda*) and lacking a shrub component (Stone et al. 2018). Although the areas where woven-spore lichen was most observed to be most abundant during these surveys had high cover of native plants, some areas had significant cover of invasive annual *Bromus* species and other non-native species (Stone et al. 2018). However, the ability to tolerate invasive grasses may be restricted to relatively moist habitats, such as those in proximity to rivers (Root and McCune 2012; Stone et al. 2018).

Woven-spore lichen appears to be intolerant of disturbance such as livestock grazing, and fire generally eliminates the species (McCune and Rosentreter 1992; Stone et al. 2018; WNHP 2021c). Vegetation communities where this species is typically found are considered late-successional due to the lack of disturbance for 20 years or more (McCune and Rosentreter 1992).

3 METHODS – HABITAT SUITABILITY ASSESSMENT

Based on the habitat requirements noted above and the results of habitat and botanical field surveys conducted in 2020 (Tetra Tech 2021) and 2021 (this report), Tetra Tech performed a habitat suitability assessment to determine whether potential suitable habitat for woven-spore lichen may occur within the Project Wind Energy Micrositing Corridor and Solar Siting Areas and, therefore, whether this species could potentially be impacted by the Project.

During field surveys in 2020 and 2021, Tetra Tech mapped eight habitat types within the Wind Energy Micrositing Corridor and Solar Siting Areas. Of these eight, five habitat types were removed from consideration as potential habitat for woven-spore lichen: agricultural land, developed/disturbed, non-native grassland, planted grassland, and rabbitbrush shrubland. Agricultural land, developed/disturbed, and non-native grassland habitat types were removed from consideration because these habitat types undergo continual disturbance and are dominated by non-native plant species. Although in some areas within the Wind Energy Micrositing Corridor and Solar Siting Areas, the planted grassland and rabbitbrush shrubland habitat types contained relatively high cover of native species, these two habitat types were excluded from the assessment because 1) they are not considered late-successional vegetation communities and 2) they have undergone repeated disturbance (e.g., agricultural production, planting of grasses and/or shrubs) in the past 20 years. Planted grasslands, and often rabbitbrush shrubland, within the Micrositing Corridor and Solar Siting Areas are generally located on former agricultural lands or other disturbed areas (e.g., areas disturbed by wildfire) that have been planted with non-native and/or native grasses. As discussed in Section 3.2.3.6 of this report, rabbitbrush shrubland was also mapped on hillslopes unlikely to have been previously cultivated for agriculture. These areas were also removed from consideration as these areas occur on slopes greater than 15 percent or contained high cover of non-native invasive grasses and forbs.

The remaining three habitat types—dwarf shrub-steppe, sagebrush shrub-steppe, and eastside (interior) grassland—were evaluated for their potential to provide suitable habitat for woven-spore lichen. To determine suitability, the following habitat factors, per McCune and Rosentreter (1992), Root and McCune (2012), Stone et al. (2018), and WNHP (2021c), were considered:

- Dominance of native species
- Presence of disturbance – i.e., past wildfires, heavy livestock grazing, presence of invasive species
- Percent slope – i.e., slopes greater than 15 percent were removed from analysis
- Proximity to a waterbody (e.g., river or drainage)

Table C-1 provides the habitat suitability criteria that was used to determine areas of dwarf shrub-steppe, sagebrush shrub-steppe, and eastside (interior) grassland mapped within the Wind Energy Micrositing Corridor and Solar Siting Areas that may provide suitable habitat for woven-spore lichen.

Table C-1. Habitat Suitability Criteria

Habitat Factor	Suitability Criteria
Dominance of native species	Area dominated by native species and with relatively low cover (less than approximately 50 percent cover) of non-native grasses and forbs
Presence of disturbance – livestock grazing	Areas where livestock grazing was not noted or where livestock grazing appeared to be light to moderate (some grazing and/or presence of cow sign noted)
Presence of disturbance – wildfire	No documented fires in area in the past 20 years (DNR 2021)
Percent slope	Slopes less than 15 percent
Proximity to a waterbody (e.g., river or drainage)	Drainages or other waterbodies are present within vicinity. ¹

¹ The literature does not define a distance to a waterbody to help determine habitat suitability for woven-spore lichen; therefore, this habitat suitability criterion was not used to eliminate any areas of potentially suitable habitat.

4 RESULTS

Based on the factors listed in Table C-1, approximately 18.9 acres of habitat was considered potentially suitable for woven-spore lichen (Figure C-1). This includes approximately 10.9 acres of dwarf shrub-steppe and 8.0 acres of sagebrush shrub-steppe habitat. All areas mapped as eastside (interior) grassland within the Micrositing Corridor and Solar Siting Areas were determined not to contain suitable habitat for woven-spore lichen based on at least one of the factors listed in Table C-1.

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FIGURE

Horse Heaven
Wind Project

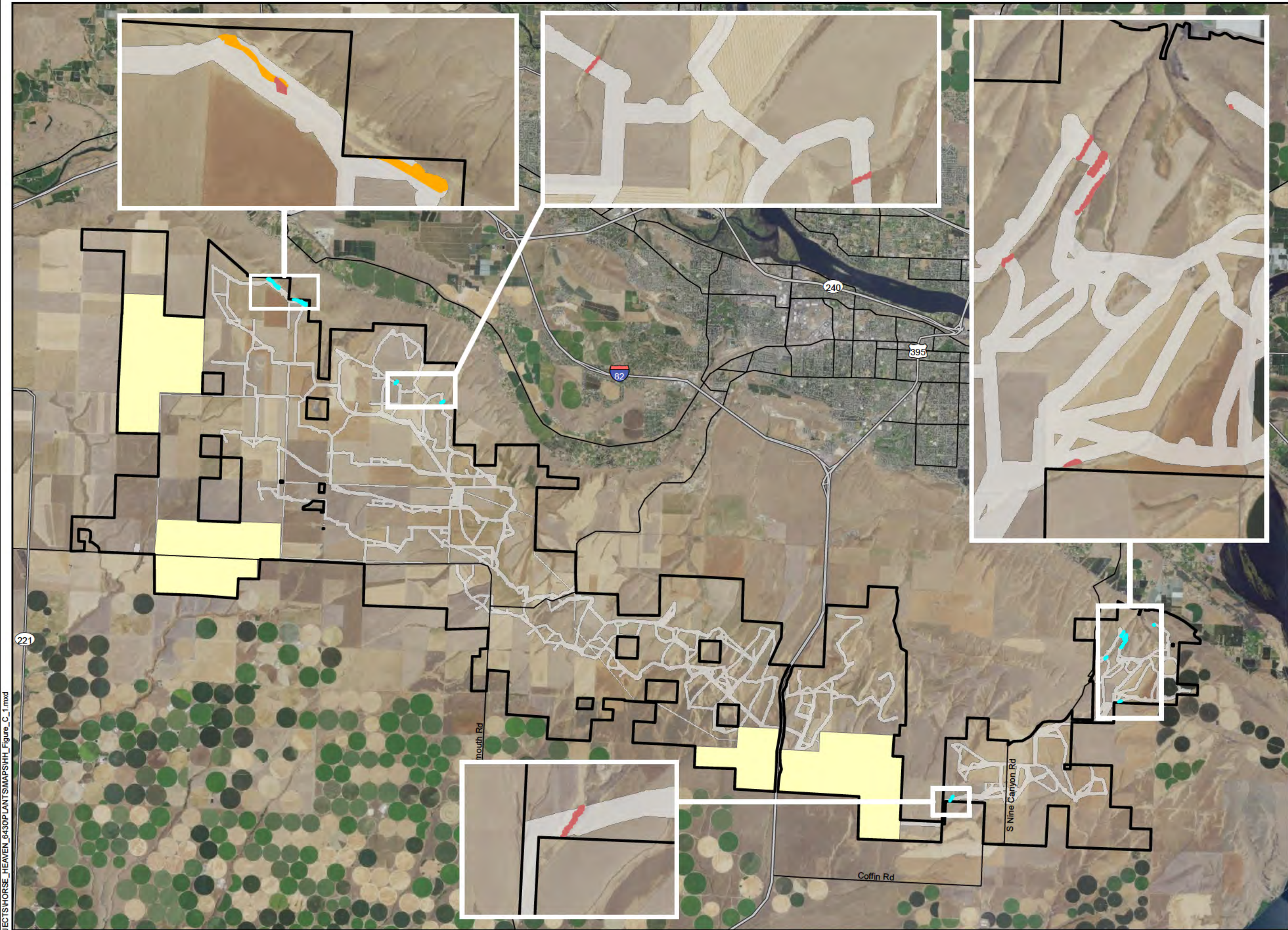


Figure C-1
Woven-spore Lichen
Habitat Suitability
BENTON COUNTY, WA

- Project Lease Boundary (12/01/20)
 - Wind Energy Micrositing Corridor (12/03/20)
 - Solar Siting Area
- Potential Suitable Habitat for Woven-spore Lichen
- Habitat Types
- Dwarf Shrub-steppe
 - Sagebrush Shrub-steppe



Reference Map



R:\PROJECTS\HORSE_HEAVEN_6430\PLANT\MAPS\HH_Figure_C_1.mxd



1:140,000 WGS 1984 UTM Zone 11N

0 1 2 4 Miles

NOT FOR CONSTRUCTION

ATTACHMENT D

REPRESENTATIVE HABITAT PHOTOGRAPHS



Photo 1. Active wheat field within northeastern portion of the 2021 Survey Area.



Photo 2. Fallow wheat field (foreground) adjacent to non-native grassland (left background) dominated by cereal rye (*Secale cereale*).



Photo 3. Fallow wheat field (left), active wheat field (background), and non-native grassland dominated by cereal rye (foreground) in central portion of 2021 Survey Area.



Photo 4. Developed/disturbed habitat: gravel pile for road repair and construction.



Photo 5. Eastside (interior) grassland dominated by needle-and-thread (*Hesperostipa comata*), cheatgrass (*Bromus tectorum*), and cereal rye in southeastern portion of 2021 Survey Area.



Photo 6. Eastside (interior) grassland dominated by Great Basin wildrye (*Leymus cinereus*). Non-native grassland dominated by cereal rye in background.



Photo 7. Eastside (interior) grassland habitat along Badger Canyon.



Photo 8. Non-native grassland dominated by cheatgrass (*Bromus tectorum*) and cereal rye. Active wheat field and remnant sagebrush shrub-steppe (located outside 2021 Survey Area) observable in background.



Photo 9. Non-native grassland dominated by cheatgrass, prickly lettuce (*Lactuca serriola*), and yellow salsify (*Tragopogon dubius*) in northeast portion of 2021 Survey Area.



Photo 10. Higher-quality planted grassland dominated by big bluegrass (*Poa secunda* ssp. *juncifolia*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) in northeast portion of 2021 Survey Area.



Photo 11. High cover of cheatgrass and yellow salsify in lower-quality planted grassland in southeast portion of 2021 Survey Area.



Photo 12. Dead grasses in planted grassland habitat in southwest portion of 2021 Survey Area.



Photo 13. Rabbitbrush shrubland in area burned during the Locust Grove Fire in 1990.



Photo 14. Rabbitbrush shrubland on hillslopes along I-82 in area burned during the Locust Grove Fire in 1990.

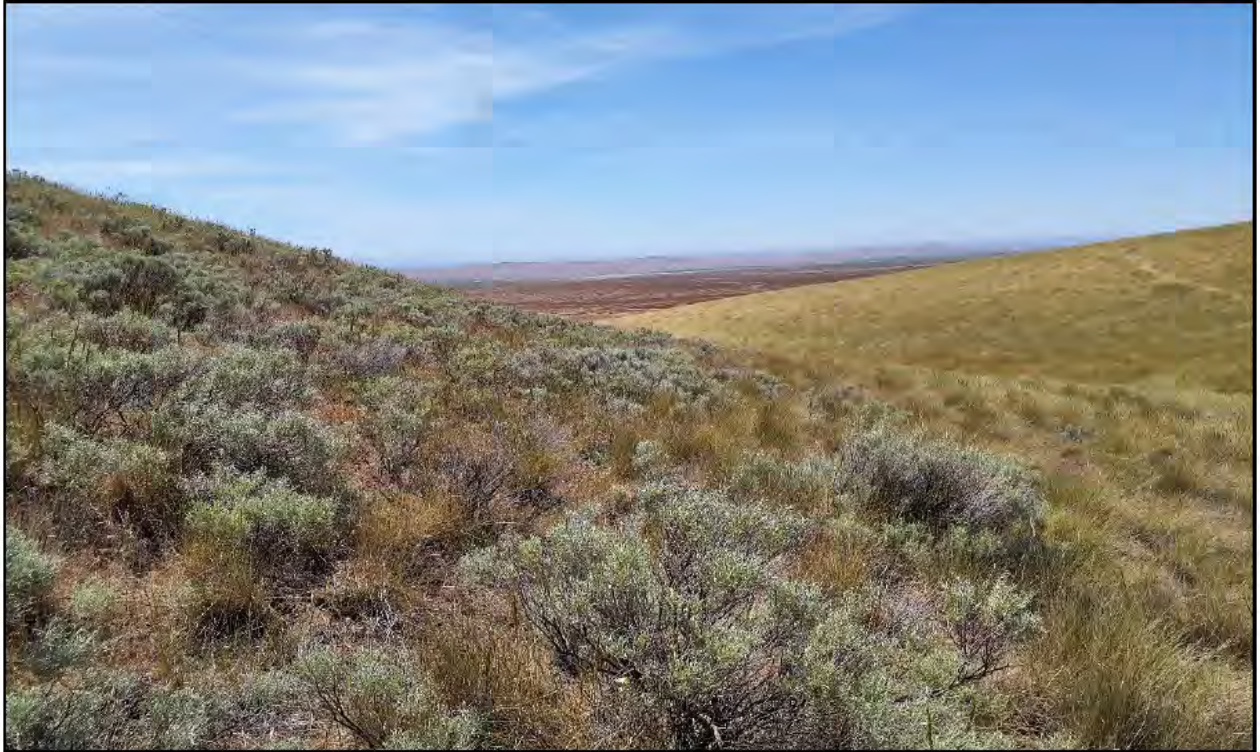


Photo 15. Rabbitbrush shrubland on hillslopes in central-eastern portion of 2021 Survey Area.



Photo 16. Patches of sagebrush shrub-steppe interspersed with non-native grassland on hillslopes and in drainage in southeastern portion of the 2021 Survey Area. Sagebrush shrub-steppe in background is located outside the 2021 Survey Area.



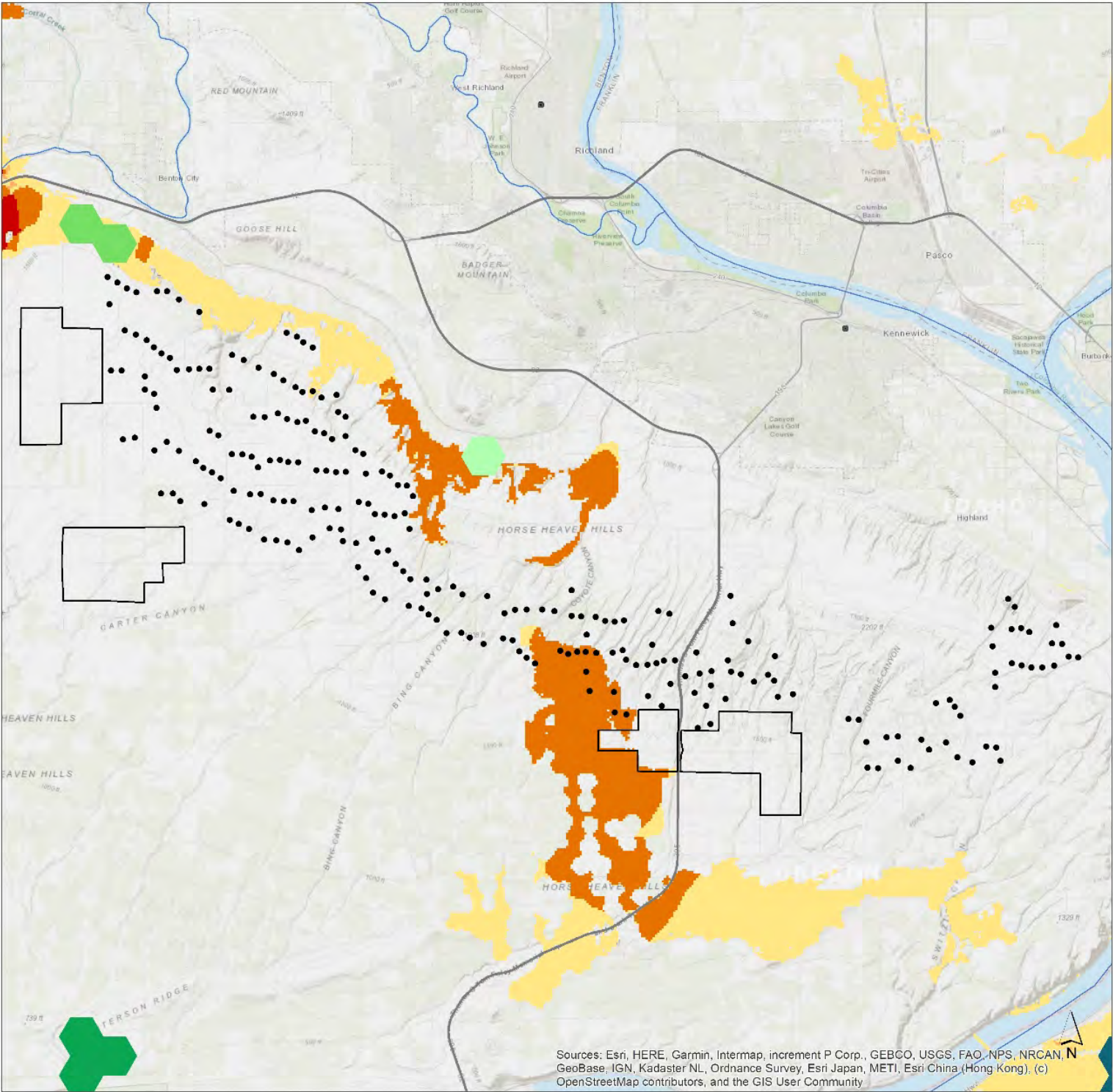
Photo 17. Sagebrush shrub-steppe habitat degraded by heavy grazing and high cover of cheatgrass.



Photo 18. Dead big sagebrush shrub (*Artemisia tridentata*) in area of sagebrush shrub-steppe habitat burned during the Dennis Road fire in 2020.

**Modeled Townsend's Ground Squirrel Habitat Concentration
Area Maps Prepared in Response to Data Request 2
submitted on August 6, 2021 (ALI 2021)**

Attachment Wildlife-20



ALI Priority Areas: ranked Marxan core areas and WHCWG high priority linkages

On 2/3/2014, the ALI Core Team agreed on the spatial priorities shown in this map. They include priority core areas (PCAs) from this analysis as well as high priority linkages identified by the WHCWG.

The Marxan PCAs (in blues and greens) are ranked by their contributions to under-represented targets. Under-represented targets are defined as those with less than their ALI percentage goal (at medium overall levels) currently falling within lands with GAP protected status 1 – 3. Contributions (percent of targets inside of PCA) were summed across targets for each PCA, and then normalized by PCA size to derive a ranking index.

The WHCWG linkages (in fire colors) were ranked in their 2013 analysis of linkage centrality. The “very high” and “high” centrality composite linkages were chosen as priority areas by the ALI. Areas where over four WHCWG focal species connectivity networks overlap are also ALI priorities

Priority Core Areas

Contribution of priority area to under-represented targets

- Low
- Medium-low
- Medium
- Medium-high
- High

Project Development

- Wind Turbine (244)
- Solar Area of Interest

WHCWG Linkages

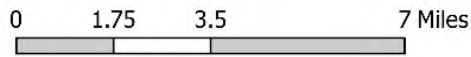
Linkage centrality cumulative rating

- Very high linkage centrality
- High linkage centrality

Number of overlapping WHCWG focal species networks

- 6 - 9 overlapping focal species networks
- 4 - 5 overlapping focal species networks

Data Sources: Arid Lands Initiative (ALI), WHCWG, Esri, USGS NHD, Natural Earth, Scout



Arid Lands Initiative

Figure 1. ALI Shared Priority Area Model Results and Horse Heaven Wind Farm Infrastructure

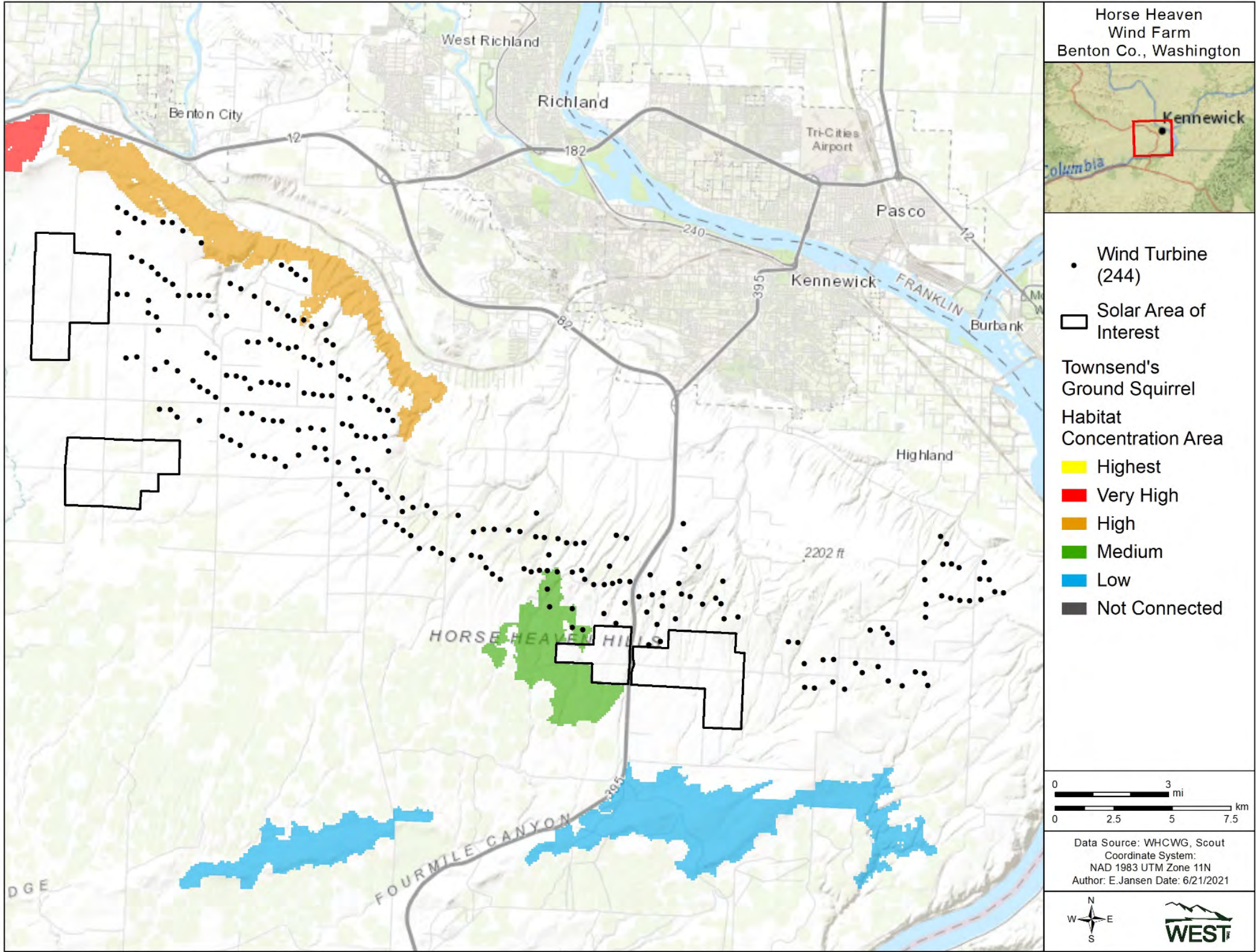


Figure 2. Townsend's Ground Squirrel Habitat Concentration Areas in the Horse Heaven Hills as Modeled by the WHCWG

**Ferruginous Hawk Supplemental Information Provided in
Response to Data Request 2 submitted on September 10,
2021 (WEST 2021)**

Attachment Wildlife-1

Additional Project-specific information is being provided in light of the recent up listing of the ferruginous hawk (*Buteo regalis*) by the Washington Fish and Wildlife Commission on August 27, 2021. This information supplements responses to Wildlife-1, Wildlife-2, Wildlife-4, Wildlife-5, and Wildlife-21.

Ferruginous hawk use and nesting at the Project was characterized as low during pre-construction surveys conducted 2017–2020. Four ferruginous hawk observations in four groups were recorded over 1,232 hours of avian use surveys conducted 2017–2020 at 94 point counts stations distributed throughout the Horse Heaven Hills. The average flight height when first observed was approximately 48 meters above ground level (range of 5–120 m agl). Of the four hawk observations, three were during spring, one during fall, and all were within the western Survey Area during 2018. Observations occurred at three point counts nearest to an active nest that was located approximately two miles away. Observations of ferruginous hawks exclusively at point counts nearest to an active nest suggests increased use was associated with an occupied nesting territory. Although the majority of historic ferruginous hawk nests in the Survey Area were located on [REDACTED] 13 [REDACTED]

[REDACTED] of the Project Area, all nests were available for breeding birds but inactive during the three years of aerial surveys conducted 2017–2019 within and two miles surrounding the Project. Accordingly, ferruginous hawk nesting was considered low during 2017 (1 inactive nest and 1 active nest out of 20 nests surveyed), 2018 (1 active nest out of 32 nests surveyed) and 2019 (1 active nest out of 44 nests surveyed). Low use and nesting activity during the course of the studies suggest that the likelihood for collisions with Turbines is comparatively low.

Ferruginous hawk are wide-ranging species that face a number of different threats to their survival. Individuals that over winter in California and nest in the Pacific Northwest can summer as far east as North Dakota, with many in southern Saskatchewan, Canada. Along the way, habitat loss from conversion to croplands and urbanization removes vital prey sources that are already prone to fluctuate annually (Hayes and Watson 2020). The use of pesticides and other chemicals to control prey populations throughout their range, particularly in the Central Valley of California, results in year-round pressure on migratory individuals. Other anthropogenic sources of mortality include wind energy, solar energy, oil and gas development, and power transmission which are all associated with infrastructure and human activity; however, the level of severity of these sources in context with the threats mentioned previously is poorly understood.

In the Pacific Region, five hawk fatalities have been attributed with Turbine collisions over a 10 year period (2003-2012; Hayes and Watson 2020) which is comparatively lower than other raptor species reported during post-construction monitoring (AWWI 2019, WEST 2019). To date, no ferruginous hawk fatalities have been reported at Nine Canyon Wind Project, located adjacent to the Horse Heaven Clean Energy Center (HHCEC) site, since the beginning of operations in 2003 (Energy Northwest 2020). Ng et al. (2020) report a similar low fatality estimate from studies conducted at the Altamont Pass Wind Resource Area in California and other studies the investigated mortality from transmission and distribution lines. The issue of climate change has been cited as an additional threat to ferruginous hawk survival (Hayes and Watson 2020, Ng 2020). While predicting how climate change will affect ferruginous hawk is uncertain, the reduction in fossil fuel use and purpose of the HHCEC is one measure that can be taken to assist in the effects of climate change.

Of the five ferruginous hawk fatalities recorded in the Pacific Region, four have been documented at three different wind facilities in Washington. Exposure to Turbine collision risk present primarily during the breeding season and migration, when the species occurs in the region. Use of the Project Area by ferruginous hawk will likely continue following construction. Exposure to Turbine collision risk likely increases at Turbines in proximity to occupied territories, particularly if the nest is active during the nesting period (Kolar 2013). Due to past nesting activity in the Horse Heaven Hills and the overall relatively low territory occupancy in the region, impacts to ferruginous hawk can result in abandonment of the nest territories located closer to Project facilities, particularly because of the tendency of the species to avoid human development and activity (Richardson 1996).

Project operations can further reduce territory occupancy and nest success of ferruginous hawk within the Horse Heaven Hills. To avoid and minimize potential impacts to ferruginous hawk, HHCEC will implement spatial and seasonal restrictions on ground disturbing activities, per WDFW recommendations. Compensatory habitat mitigation as directed by WDFW (2009) will be implemented to offset permanent and temporary impacts. Additional measures will be taken to minimize impacts to habitat and wildlife through Best Management Practices described in Appendix L to the Application for Site Certificate. These measures are the subject of ongoing discussions with WDFW and may be revised based on requests and input from this agency.

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To: Dave Kobus, Senior Project Manager, Scout Clean Energy

From: Matt Cambier, Wildlife Biologist, Tetra Tech and Erik Jansen, Wildlife Biologist, Western EcoSystems Technology, Inc.

Date: December 21, 2021

Subject: **WDFW Data Request Regarding Potential Impacts to Pronghorn from Wind and Solar Energy Development at the Horse Heaven Clean Energy Center, Benton County, Washington.**

INTRODUCTION

The purpose of this assessment was to evaluate the population status and distribution of pronghorn antelope (pronghorn; *Antilocapra americana*) in Washington, assess potential effects from the development of wind and solar energy development, and summarize measures the Horse Heaven Wind Farm (Project) has implemented to avoid and minimize potential impacts to pronghorn during construction and operation of the Project.

POPULATION STATUS AND DISTRIBUTION

Pronghorn were extirpated from Washington state by the start of the early twentieth century (Oyster et al. 2015). Currently, there is no open hunting season and the species is not listed as a Priority Species in the Washington Priority Habitat and Species program. After three failed reintroduction attempts between 1938–1968, the Confederated Tribes and Bands of the Yakama Nation (Yakama Tribe) successfully reintroduced 97 individuals in 2011 on the Yakama Reservation (Tsukamoto 2006; Oyster et al. 2015). In 2015, the Yakama Nation Wildlife Program (YNWP) and Washington Department of Fish and Wildlife (WDFW) began biennial aerial and ground surveys to obtain minimum population estimates (Oyster et al. 2015, 2017; Fidorra et al. 2019, Fidorra and Peterson 2021). Surveys were conducted in winter, and the survey area included portions of Klickitat, Yakima, and Benton Counties, Washington (Appendix A). The far eastern portion of the survey area included portions of the western portion of the Project. Each survey year, the survey area was generally replicated; however, it excluded irrigated agricultural fields in 2019 and 2021, which Yoakum (1980) and Tsukamoto (2006) classified as poor pronghorn habitat. This exclusion allowed survey crews to focus efforts in native land cover types (Fidorra et al. 2019).

Since 2011, minimum population estimates have increased from 97 to 250 individuals, (Figure 1; Fidorra and Peterson 2021). This includes supplemental reintroduction efforts in 2018–2019 that added 99 individuals to the population (Figure 1; Fidorra and Peterson 2021). Following the survey in 2019 a severe mortality event occurred resulting in the loss of approximately 40 of the recently introduced individuals. The fact that minimum population estimates remained relatively stable between 2019 and 2021, despite this severe mortality event, suggests that natural recruitment is likely playing a substantial role in sustaining the population. That recruitment is assumed to be the result of reproduction as the population is considered a closed population with no known movements across the Columbia River to the south where populations reside in Oregon, or east to populations re-introduced in north-central Washington by the Colville Tribe (Fidorra and Peterson 2021).

Geographic coordinates of observations during surveys are not available; however, descriptions from Oyster et al. (2015, 2017) and coarse location information from Fidorra et al. (2019) and Fidorra and Peterson (2021) suggest winter use of the eastern Horse Heaven Hills by pronghorn (Figure 2). Pronghorn were observed within the Project boundary in 2021 (Figure 2; Fidorra and Peterson 2021). Additional observations of pronghorn in the survey area were documented during avian use surveys conducted in the Project in May 2017 and September 2018 when a solitary pronghorn of unknown sex was observed, incidental to avian surveys, walking in a grassland west of Highway 395 (Jansen and Brown 2018).

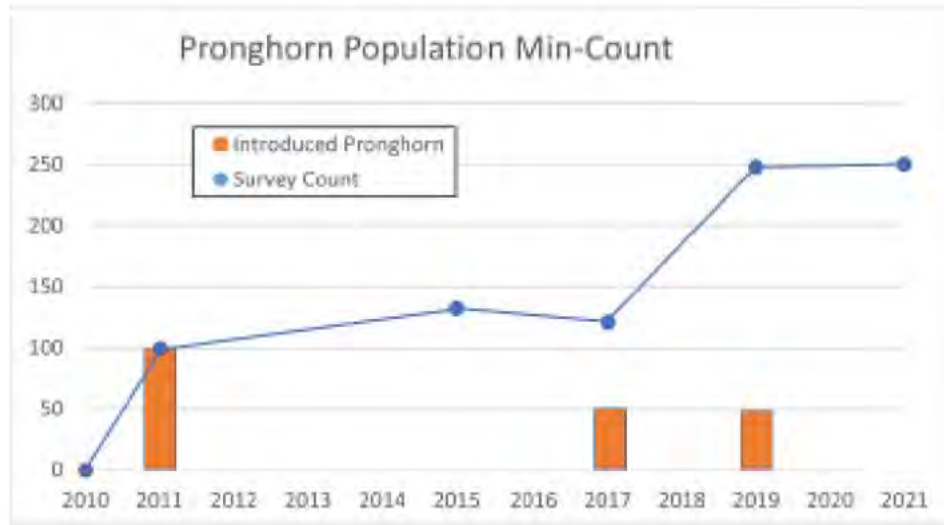


Figure 1. South-Central Washington Pronghorn Minimum Population Estimates Based on Counts from Survey Compared to the Total Number of Introduced Individuals (Fidorra and Peterson 2021)

Table 1. Summary Statistics of Minimum Pronghorn Population Counts during Surveys Conducted 2015-2021, Starting with Reintroduction in 2011

Year	Total Count	# Groups	Ave. Group Size ¹	Count On Reservation	Count Off Reservation	Comment
2011	97	1	97	97	0	Reintroduction starts
2015	132	15	8.8	49	57	One group of four individuals south of Kennewick, exact location unknown
2017	121	19	6.4	44	72	Off Reservation were located south and southeast of Reservation, west of the Project
2019	248	8	31.0	178	70	Off Reservation were located in Benton County, west of the Project

2021	250	34	7.4	124	126	Off Reservation were located in Yakima, Klickitat, and Benton County
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¹ Average group size = Total Count / # groups

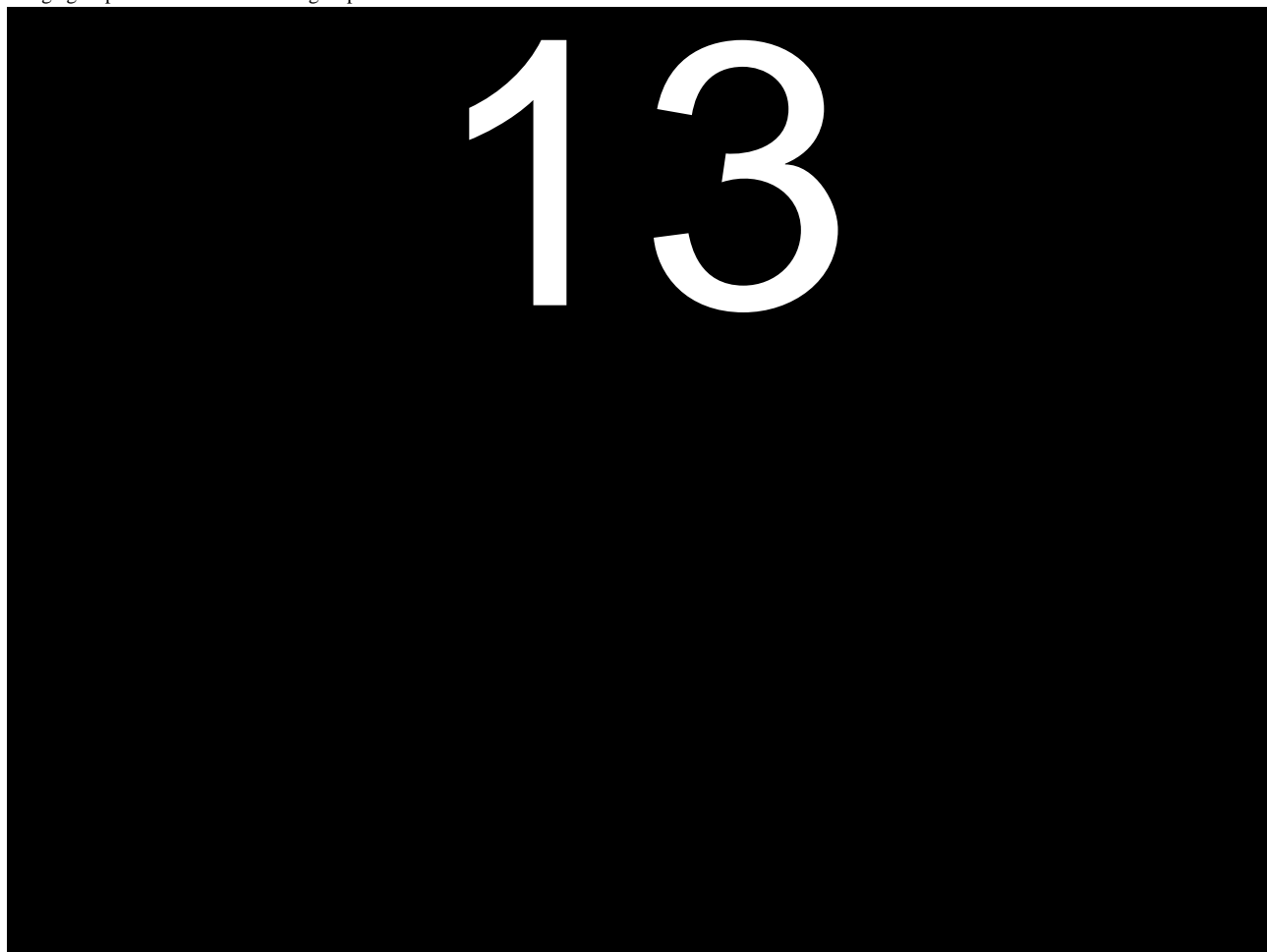


Figure 2. Pronghorn Group Locations Observed During 2021 Aerial Surveys (Fidorra and Peterson 2021) Relative to the Approximate Location of the Project. Location data from 2015 and 2017 surveys were unavailable.

HABITAT USE, SEASONAL MOVEMENT, AND THREATS TO SURVIVAL

Habitat Use

Traditionally considered a prairie obligate species that uses grassland, savanna, and shrub-steppe, pronghorn may use annual or perennial croplands, particularly in altered areas where native habitat have been lost (Torbit et al. 1993; Jones et al. 2015). Pronghorn have been documented to use dryland agricultural areas, like winter wheat fields, as sources of forage when nutrition of native forage is low during the winter (Torbit et al. 1993). Of the 34 total groups documented during 2015 and 2017 aerial surveys, most groups were observed in rangeland (25 groups, 74 percent), followed by cropland (8 groups, 24 percent), and land enrolled in the Conservation Reserve Program (1 group, 3 percent). Habitat use data from 2019 and 2021 surveys were unavailable. The majority of groups located outside of the

Reservation in 2015 and 2017 were described as south and southeast of the Reservation, which correspond to landscapes primarily composed of grasslands (herbaceous), shrub-steppe (shrub/scrub), and agriculture (cultivated crop; Figure 3; Oyster et al. 2015, 2017). In 2019 and 2021 surveys, more groups were located farther east of the Reservation in landscapes primarily composed of agriculture (Oyster et al. 2015, 2017; Fidorra et al. 2019; Fidorra and Peterson 2021; Figures 2 and 3).

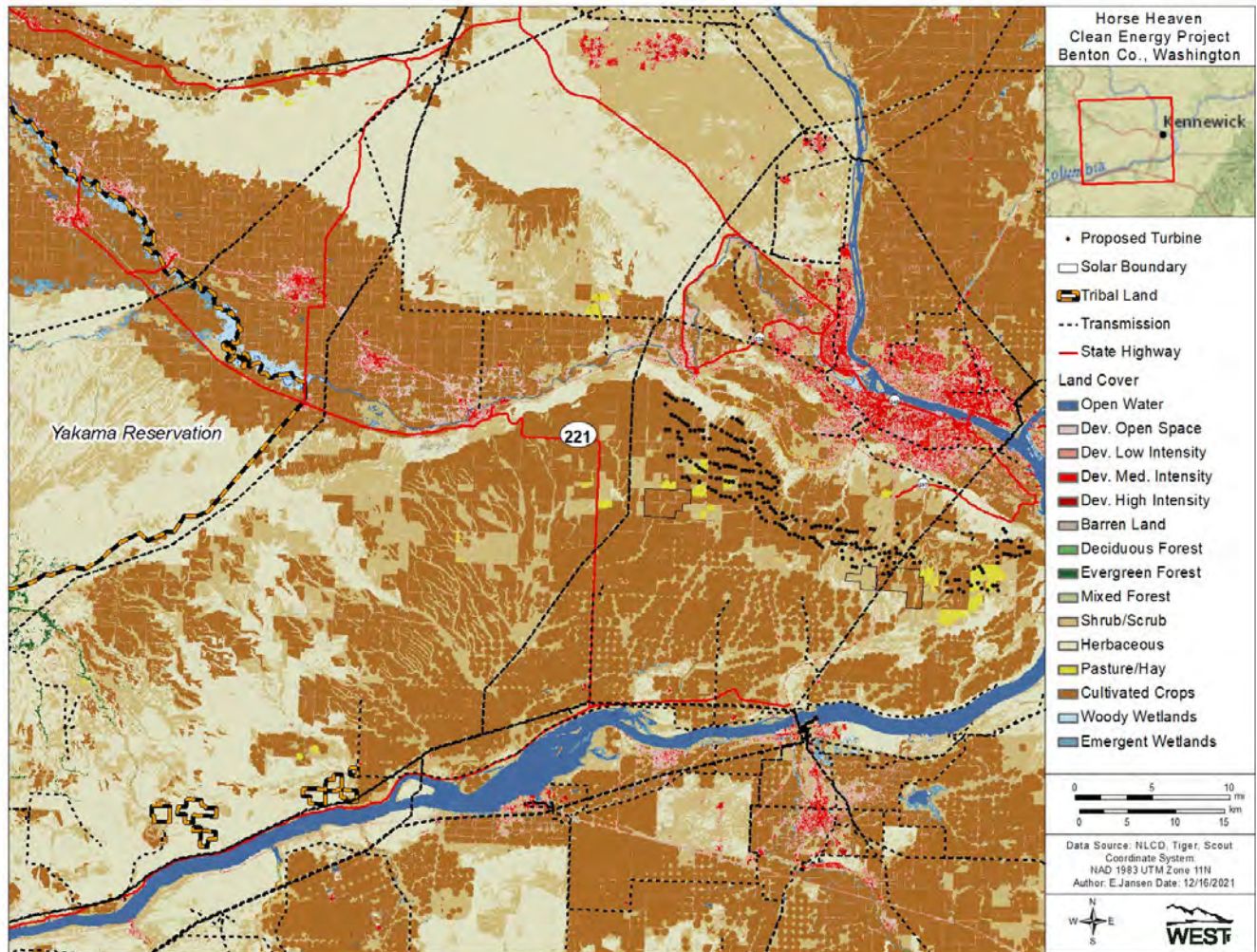


Figure 3. Land Cover Characteristics Between the Yakama Reservation and the Project

Seasonal Movement

Depending on winter severity, snow depth, and access to forage, pronghorn may exhibit distinct seasonal movements between their summer and winter ranges (Sawyer et al. 2002). Winter range provides the species with forage and thermal cover whereas summer range provides cooler temperatures, lush vegetation, and a place to have and raise their young. Winter range includes lower-elevation shrub-steppe habitat and agricultural fields (Sawyer et al. 2002). Migration is influenced by natural features and the juxtaposition of forage and cover resources on the landscape. Data from 2015-2021 YNWP/WDFW aerial surveys show approximately half the pronghorn established in the Yakama Reservation leave during the winter, with some migrating to surrounding lower-elevation rangelands and dryland agriculture areas of

Klickitat, Yakima, and Benton counties. Based on the location of individuals during winter, the Yakama pronghorn population can be considered partially migratory with a portion of the population remaining on the Reservation through the duration of winter, with others diffusing up to 30 miles outside of the Reservation into the surrounding counties. Based on the data available, there does not appear to be high directionality in seasonal movement, and no distinct migratory corridors have been identified. Data on summer use for this population are unavailable but it is suspected that the majority of the population may relocate onto Reservation lands where shrub cover, forage, and human disturbance are relatively less than the regions surrounding the Reservation and more conducive for rearing young (Christie et al. 2017).

Threats to Survival

A myriad of factors influence the survival of individuals and, more importantly, population viability, as is the situation of the small population of the reintroduced Yakama pronghorn population. Primary factors that influence survival of small populations include winter severity, habitat fragmentation, predation, and genetic isolation. An 8-year study of 175 collared females in the northern sagebrush-steppe ecosystem of southern Alberta and Saskatchewan, Canada, and northern Montana, USA, found winter severity as the primary factor that influenced survival of a partially migratory population (Jones et al. 2020). The relationship between survival and severe wind weather corresponds to survival patterns from other pronghorn studies in the northern portion of the species' range (O'Gara and Yoakum 2004; Reinking et al. 2018; Jakes et al. 2020).

Evolved as an open prairie obligate, pronghorn have mixed responses to habitat fragmentation that results from conversion to incompatible land cover types, fence construction for livestock management, transportation systems, and energy development (Gates et al. 2011; Hebblewhite 2011; Reinking et al. 2018). Direct impacts to survival include mortality resulting from vehicle collisions or entanglement with three-strand barbed wire fences. Indirect impacts to survival may result from conversion to incompatible land cover types or energy development (Sawyer et al. 2002; Xu et al. 2021; Zeller et al. 2021). Although wind and solar energy development does not pose a direct mortality risk, avoidance behavior that deters individuals from access to essential foraging or parturition habitat may lead to reduced fecundity, particularly when those habitat types are limiting on the landscape (Gates et al. 2012; Yoakum et al. 2014). WDFW has not established essential foraging, parturition, or any other seasonal habitat designations for pronghorn in Washington state.

Predation is another important factor affecting pronghorn populations. Coyotes (*Canis latrans*) account for upwards of 75 percent of predation-caused mortality on fawns (Berger and Conner 2008; Berger et al. 2008; White et al. 2009; Painting et al. 2021). Specific to the Yakama population, YNWP/WDFW identified coyote as a potential limiting factor in individual and population persistence (Oyster et al. 2015, 2017). Anecdotal observations from aerial surveys conducted in 2017 through 2019 in a 10-mile radius from the Project correspond with high numbers of coyote observed throughout the Horse Heaven Hills (E. Jansen, unpublished data).

Small population sizes, as observed in the Yakama population, result in reduced genetic variation that may lead to genetic bottlenecks where inbreeding depression can affect population viability (Stephen et al. 2005; Dunn and Beyers 2008). Supportive breeding, or additional reintroductions into the population assist in diversifying the genetic variability in small populations which are more resilient to stochastic environmental events such as severe weather (Dunn and Beyers 2008; Cancino et al. 2010). Supplemental

reintroduction of 98 individuals into the Yakama population in 2018 and 2019 helped diversify the genetic variability, increasing the resilience of the herd.

PRONGHORN RESPONSE TO RENEWABLE ENERGY DEVELOPMENT

All of the few publicly available studies on pronghorn response to wind or solar energy development have been conducted in Wyoming, where nearly half of the entire U.S. pronghorn population resides (Kobilinsky 2020; Smith et al. 2020; Sawyer et al. 2022). According to U.S. Geological Survey research assistant Meghan Milligan (Kobilinsky 2020), because research on the effects of energy development has mostly focused on oil and gas, it is unknown whether the negative effects on big game species from these studies can be inferred for wind or solar development. Extractive energy development creates different sources and intensity of disturbance on the landscape than renewable energy development. For instance, oil and gas development includes more human presence throughout construction and operation, while the increase in human activity during wind and solar development is more temporary and associated with construction (Kobilinsky 2020). High densities of oil and natural gas wells create a complex network of wells, roads, tank batteries, electrical systems, and other infrastructure that can effectively eliminate hundreds of areas of pronghorn habitat whereas wind is more dispersed over the landscape and solar is highly concentrated in a comparatively smaller area, resulting in high land-use efficiency (Hernandez et al. 2015). Wind energy development remains unfenced and permeable for pronghorn use whereas security fencing surrounding solar development excludes pronghorn and other large ungulates (Sawyer et al. 2013). For both wind and solar, once construction is complete, there is a lower level of human presence, including vehicle traffic, in and around the facilities during operations, reducing exposure to large mammals, when compared to oil and gas facilities (Sawyer et al. 2022).

Research in the Shirley Basin of south-central Wyoming during the winters of 2010 to 2012, and again from 2018 to 2020, focused on wind energy development and pronghorn behavior (Kobilinsky 2020). This area is designated crucial winter range for the Medicine Bow pronghorn herd (Kobilinsky 2020; USGS 2021). Findings of the study were inconsistent and variable. During the summer and winter months, the effects of wind energy on pronghorn were inconsistent; some years the pronghorn selected habitat closer to wind turbine generators (Turbines) and other years chose habitat farther away. Pronghorn selected habitat within proximity to Turbines because no other reasonable alternative was available considering the Turbines were placed in high-quality pronghorn habitat (Kobilinsky 2020). The study also found that pronghorn home range size was not influenced by Turbines. Finally, the study found that individual pronghorn in close range of the Turbines (30 to 40 miles) did not respond to them during the construction phase, but tended to avoid them during the post-construction phase.

At the Dunlap Ranch in south-central Wyoming, Smith et al. (2020) evaluated the potential impacts of wind energy infrastructure on pronghorn winter habitat selection. While the authors indicate that continued research is needed, they found that pronghorn avoided Turbines within their winter home ranges after development was complete. This general observation is consistent with findings from oil and gas developments that has found evidence that pronghorn response to energy development involves avoidance of infrastructure (Sawyer et al. 2019).

In another study at the Dunlap Ranch in Wyoming, the mortality risk for pronghorn on crucial winter range that included wind energy development was examined (Taylor et al. 2016). The study found that exposure to wind energy infrastructure was not an informative predictor of pronghorn mortality risk on winter

range, suggesting that adult pronghorn tolerate wind development. However, results also suggest that other factors such as environmental and non-wind anthropogenic effects (e.g., distance to major roads) may have influenced the vulnerability of pronghorn to wind energy infrastructure.

In the only study of pronghorn response to solar development, Sawyer et al. (2022) investigated the effects of a 568-acre, 80-megawatt project located in the middle of a high-use migratory corridor in southwest Wyoming. Although 30 radio-collared pronghorn continued to travel directly adjacent to the fence, use declined 40 percent within 1.2 miles from the project and 34 percent within 1.8 miles. Located adjacent to a state highway, barrier effects from the project inadvertently diverted animals onto a state highway, causing safety issues for animals and humans alike. Although the Wyoming herd comprises thousands of individuals that migrate 19 to 140 miles between summer and winter ranges, Sawyer et al. (2022), reiterated the importance of siting solar projects in previously disturbed areas or agricultural lands where environmental impacts are largely avoided (Cameron et al. 2012; Hernandez et al. 2015).

DISCUSSION

Based on four years of systematic aerial surveys by YNWP/WDFW, a portion of the pronghorn population have been observed using the agricultural areas of the Horse Heaven Hills during the winter. Pronghorn were observed further east in 2021 than in previous survey efforts, including some observations in the Project area. Areas south and southeast of the Reservation and west and outside of the Project, where the majority of groups were observed in 2015 and 2017, consist of more grasslands and shrub-steppe compared to the predominantly agricultural area of the eastern Horse Heaven Hills, which includes the Project. The Yakama Reservation is approximately 23 linear miles from the nearest proposed Turbine. Land ownership is primarily private with scattered parcels of trust lands managed by the Washington Department of Natural Resources. The south-facing, primarily flat grassland slopes south and east of the Reservation (outside of the Project area) offer suitable winter range for pronghorn; however, existing barriers throughout the landscape including countless three-stand barbed wire fences, roads, and highways pose a substantial impediment to pronghorn movement (Figure 3).

It is anticipated that pronghorn would avoid Project construction activities, with wintering individuals being the most likely to be exposed to these activities. Construction and operation of wind facilities would result in small areas of disturbance distributed over the larger Micrositing Corridor. While research on the effect of operational Turbines on pronghorn use of winter habitat varies, some studies indicate that animals avoid Turbines to varying degrees. Fenced solar arrays would permanently remove potential foraging habitat for pronghorn; however, removal of the primarily agricultural fields where solar development is proposed should not be limiting, considering the amount of similar habitat on the landscape (Figure 3). Survey data do not indicate the area of the proposed Project is along a primary migration corridor, as evidenced by the number of unaggregated winter observations; therefore, potential barriers to seasonal movement from solar development as observed by Sawyer et al. (2022) are not expected. To our knowledge, the Project would not be an impediment to pronghorn (or other big game) access to water features that are crucial for pronghorn during all seasons (Yoakum et al. 2014). Indirect impacts to pronghorn from avoidance of Project infrastructure is anticipated to some degree; however, because of the seasonal use of the Project area and availability of suitable winter habitat across the landscape, avoidance should not result in significantly adverse effect to individuals or the population.

PROJECT PRONGHORN AVOIDANCE AND MINIMIZATION MEASURES

The following avoidance and minimization measures were implemented in the Project design and planned for operations to reduce impacts to terrestrial wildlife, including pronghorn. As summarized in Section 1.10.1 of the Project's Application for Site Certification (ASC) as well as in related responses to data requests submitted to the Energy Facility Site Evaluation Council (EFSEC), these measures include the following:

Design Measures

- Project facilities were sited on previously disturbed (e.g., cultivated cropland) areas to the extent feasible to avoid impacts to native habitats and associated wildlife species.
- The Applicant will use industry standard BMPs to minimize impacts on vegetation, waters, and wildlife.
- Collection lines were co-located along existing roads and proposed access roads to reduce habitat disturbance.
- Sagebrush shrub-steppe habitat would be avoided to the extent possible. If avoidance is not possible, mitigation for impacts to sagebrush shrub-steppe habitat would be developed in consultation with the applicable agencies.
- The Applicant will limit construction disturbance by flagging any sensitive areas and will conduct ongoing environmental monitoring during construction to ensure flagged areas are avoided.

Operational Measures

- Following construction, temporarily disturbed areas will be revegetated with native or non-invasive, non-persistent non-native plant species as described in the Revegetation and Noxious Weed Management Plan (see Appendix N of the ASC).
- Traffic speeds on unpaved roads will be limited to 25 miles per hour to minimize vehicle collisions with wildlife.
- Construction of new 3-strand barbed wire fencing is not anticipated.
- Various measures will be implemented that reduce or eliminate the potential the risk of wildfire.
- The Applicant does not anticipate using pesticides during Project construction or operation; if unforeseen circumstances arise that require the use of pesticides, the Applicant would consult with WDFW and EFSEC.
- A Wildlife Handling and Incidental Reporting System (WHIRS) will be implemented at Project, which will facilitate a system where all wildlife fatalities and species of management interest will be reported through a mandatory reporting system. The WHIRS will be independent of the standardized 2-year post-construction fatality bird and bat monitoring program.

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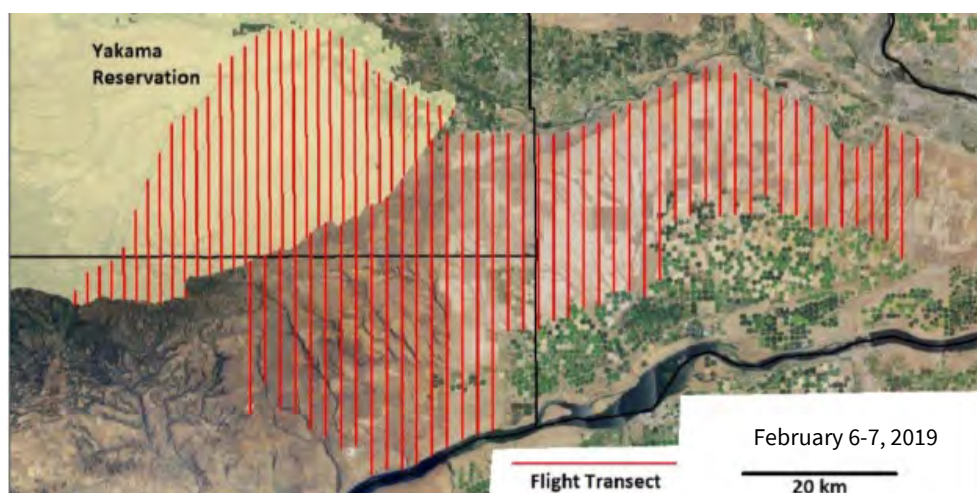
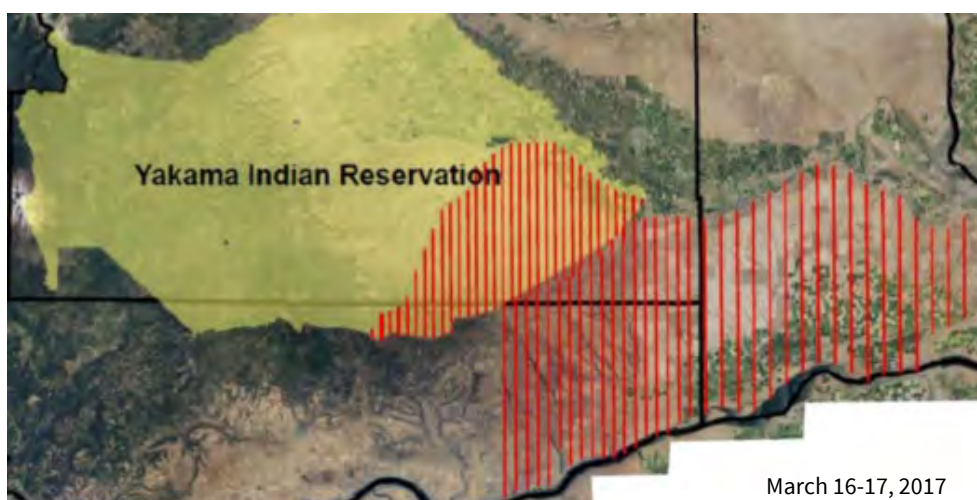
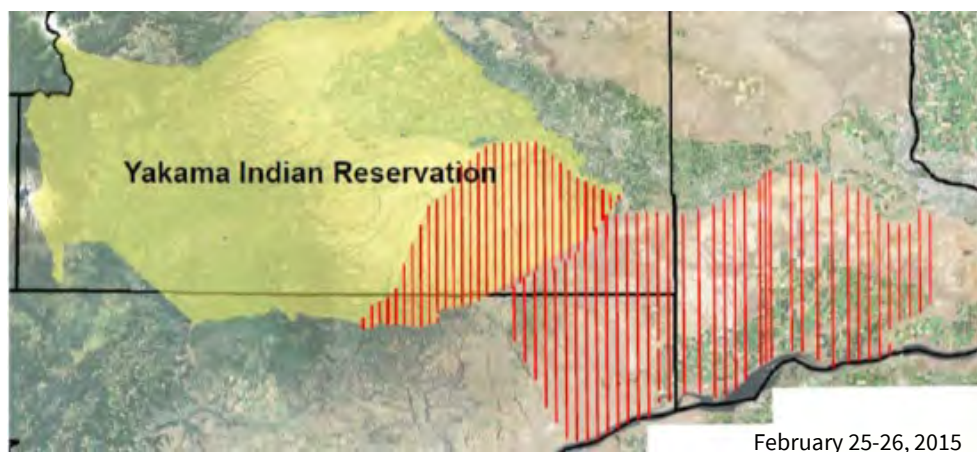
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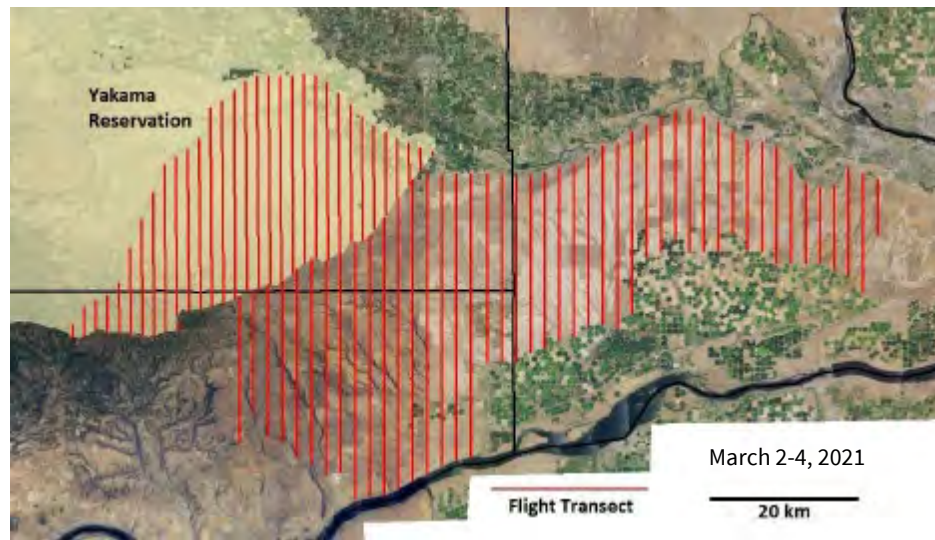
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Appendix A

Appendix A. Flight Transects within the Pronghorn Population Survey Area Conducted 2015–2019
(Oyster et al. 2015, 2017, Fidorra et al. 2019, Fidorra and Peterson 2021)





**Patterns of Ferruginous Hawk (*Buteo regalis*) Nesting in the
Horse Heaven Hills, Benton County, Washington, 2017–2019,
2022**

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Prepared for:

Horse Heaven Wind Farm, LLC
5775 Flatiron Parkway, Suite 120
Boulder, Colorado 80301

Prepared by:

Erik W. Jansen

Western EcoSystems Technology, Inc.
2725 NW Walnut Blvd.
Corvallis, Oregon 97330

June 5, 2022



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EXECUTIVE SUMMARY

Horse Heaven Wind Farm, LLC is proposing the development of the Horse Heaven Clean Energy Center (Horse Heaven and/or Project) in Benton County, Washington. As part of Project development, Western EcoSystems Technology, Inc. (WEST) was contracted to conduct raptor nest surveys throughout the Horse Heaven Hills during the 2017-2019 and 2022 nesting periods. Raptor nest surveys comply with guidelines described by the Washington Department of Fish and Wildlife (WDFW) and recommendations from the US Fish and Wildlife Service (USFWS).

Ferruginous hawk (*Buteo regalis*) was recently uplisted to endangered by the Washington Fish and Wildlife Commission in August 2021 (WDFW 2021). Based on the location of the Project relative to a core breeding area within the state and a desire to better understand ferruginous hawk nesting in the Horse Heaven Hills, the principal objectives of this study were to 1) survey and photo document all historic nests maintained in the WDFW Priority Habitat and Species (PHS) database within two miles (3.2 kilometers) of the proposed Project in 2022 to evaluate nest status and condition; 2) summarize nest status and condition for each survey year; and 3) contribute data to WDFW/PHS on ferruginous hawk nesting to facilitate understanding of nest occupancy and population trends within Washington. Primary conclusions from the assessment include:

- In 2022, over half of the 58 historic nests (30 nests, 52%) listed in the WDFW database were classified as Gone, 22 nests (38%) were classified as Inactive, and six nests (10%) were classified as Occupied by common raven (*Corvus corax*) or raptor species other than ferruginous hawk.
- During 2017-2019 and 2022, a total of four nesting attempts were made at two nests located in the Coyote Canyon and Badger Canyon territories. The Coyote Canyon territory was occupied and active for three consecutive years while the nesting attempt in Badger Canyon was abandoned or failed.
- During 2017–2019 and 2022, the number of occupied ferruginous hawk territories and nests declined even as the number of surveyed territories and nests increased each year.
- The overall four-year average of nest and territory occupancy was 6% and 7%, respectively. Historic nests were more likely to be occupied by other species. Nests not occupied by ferruginous hawk had an overall occupancy rate of 16%.
- Nest occupancy at Horse Heaven was lower than the average percent of occupied nests documented in Washington. Between 1978–2016, the estimated average state-wide occupancy rate was 41% (range 18–88%), with nest occupancy declining significantly in recent years (18% in 2016).
- Low nest occupancy at Horse Heaven during the survey period reflected a declining trend in occupancy state-wide. However, existing stressors on the landscape, including land conversion from expanding residential and intensive agricultural development, drought resulting in depressed prey populations, and predation, will likely continue to affect nest occupancy in the Horse Heaven Hills.

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Appendix A. Survey Areas for raptor nest surveys conducted 2017-2019, 2022 for the Horse Heaven Clean Energy Center, Benton County, Washington.

Appendix B. Photographic guide and description of ferruginous hawk nests and territories for the Horse Heaven Clean Energy Project, Benton County, Washington, 2017-2019, 2022.

Unit Conversions

Imperial	Metric
1 foot	0.3048 meter
3.28 feet	1 meter
1 mile	1.61 kilometer
0.621 mile	1 kilometer
1 acre	0.40 hectare
2.47 acre	1 hectare
Common Conversions	
Imperial	Metric
0.5 miles	800 meters
0.12 miles	200 meters
0.5 miles	0.8 kilometers
10 miles	16.1 kilometers

REPORT REFERENCE

Jansen, E. W. 2022. Patterns of Ferruginous Hawk nesting in the Horse Heaven Hills, Benton County, Washington 2017-2019, 2022. Prepared for Horse Heaven Wind Farm, LLC., Boulder Colorado. Prepared by Western EcoSystems Technology, Inc. (WEST), Corvallis, Oregon. June 5, 2022. 17 pages + appendices.

INTRODUCTION

Horse Heaven Wind Farm, LLC is proposing the development of the Horse Heaven Clean Energy Center (Horse Heaven and/or Project) in Benton County, Washington. As part of Project development, Western EcoSystems Technology, Inc. (WEST) was contracted to conduct raptor nest surveys throughout the Horse Heaven Hills during the 2017-2019 and 2022 nesting periods. Raptor nest surveys complied with recommendations described by the Washington Department of Fish and Wildlife (WDFW) *Wind Power Guidelines* (WPG; WDFW 2009), the US Fish and Wildlife Service's (USFWS) 2012 *Final Land-Based Wind Energy Guidelines* (WEG), Appendix C(1)(a) of the 2013 USFWS *Eagle Conservation Plan Guidelines* (ECPG), and the USFWS *Revisions to Regulations for Eagle Incidental Take and Take of Eagle Nests* (Final Eagle Rule; 81 FR 91494).

Ferruginous hawk (hawk, *Buteo regalis*) was removed from the list of threatened species and uplisted to endangered by the Washington Fish and Wildlife Commission in August 2021 (WDFW 2021). Primary reasons for uplisting included the continued conversion of native habitats to cropland, urbanization, and reductions in prey populations, which resulted in significant declines in nesting territory occupancy, nest success, and productivity between 1974–2016 (Hayes and Watson 2021). Habitat degradation, alteration, and depressed prey populations prevalent outside Washington contribute to stressors on the species during the fall migration and winter non-breeding period (WDFW 2021). Although not summarized as a primary threat in the listing decision, collisions with wind turbine generators (WTG) are an issue of conservation concern that may affect individual hawks as well as nest occupancy and productivity (Hayes and Watson 2021, Watson et al. 2021). To date, no hawk fatalities have been reported at the 63-WTG Nine Canyon Wind Project during standardized post-construction fatality monitoring and operational monitoring, 2003-2021 (Erickson et al. 2003, Energy Northwest). However, publically available data from 43 operating wind energy facilities within the Columbia Plateau Ecoregion reported eight hawk fatalities from collisions with wind turbines, 1999–2020 (WEST 2020).

Located in Benton County, the Project is considered part of the South Zone historical ferruginous hawk nesting territory as designated in the Recovery Plan (WDFW 1996). Based on historic nest location data, Benton and Franklin counties are considered the core ferruginous hawk breeding range within the state (WDFW 1996, Watson et al. 2018, Hayes and Watson 2021). State-wide nest surveys inform population status and trends and were last conducted by WDFW in 2016 when 56 of 66 historic nests in the Horse Heaven Hills were surveyed. This assessment provides a summary of the status and condition of ferruginous hawk nests from surveys conducted from 2017–2019 and 2022.

The principal objectives of this study were to 1) survey and photo document all historic ferruginous hawk nests maintained in the WDFW Priority Habitat and Species (PHS) database within two miles of the proposed Project in 2022 to evaluate the nest status and condition; 2) summarize ferruginous hawk nest status and condition within the area surveyed each survey year; and 3)

contribute data to WDFW/PHS on ferruginous hawk nesting to facilitate understanding of nest occupancy and population trends within Washington.

SURVEY AREA

Raptor nest surveys occurred within the eastern portion of the Horse Heaven Hills, located in southeastern Benton County, Washington. The size of the Survey Area varied annually and ranged between approximately 74–329 square miles (mi²), depending on the size of the Project Area under consideration (Appendix A). The Survey Areas were located adjacent to the Tri-cities urban areas of Kennewick, Richland, and Pasco, and included portions of exurban communities associated with Benton City and Highland.

A prominent topographic feature in the Survey Area was a broad, northeast-facing anticline ridge along the northern perimeter, consisting of numerous highly-eroded drainages and cliff-lined canyons (Badger Canyon, Coyote Canyon, Taylor Canyon, Webber Canyon; Figure 1). South of the ridge, toward the interior of the Survey Area, the landscape transitions to relatively rolling topography with shallow, meandering canyons that drain south into the Columbia River. Elevation within the Survey Area was lowest toward the Columbia River to the east (approximately 350 feet [ft]), rising to above 2,000 ft at prominent features including Jump Off Joe (2,200 ft), Johnson Butte (2,043 ft), and Chandler Butte (2,046 ft) which all have radio and telecommunication facilities installed (Figure 1).

Land cover within the Survey Area is a mosaic of dryland and irrigated cropland, shrub-steppe grasslands, and rural/urban development (Horse Heaven Wind Farm, LLC 2021). Cropland is the dominate land cover throughout the Project and surrounding area (>80%; see Horse Heaven Wind Farm, LLC. 2020). Shrub-steppe is found in topographically steep areas and drainage bottoms where conversion to cropland was not possible. Lands within the Project vicinity are also enrolled in the US Department of Agriculture's Conservation Reserve Program.

Land use in the Survey Area consists predominantly of actively-managed dryland winter wheat (*Triticum aestivum*) and the associated infrastructure including silos and warehouses. Abandoned and working farmsteads are scattered in low density throughout the landscape, reflecting historic land use of the area; while new residential development encroaches into the foothills and on top of the Horse Heaven Hills ridge, indicative of the growing Tri-cities area population. Several rock quarries are actively used for on-going road and other construction projects. Electrical systems include radio and telecommunication towers, several high-voltage (115-500 kV) Bonneville Power Administration transmission lines bisecting the Survey Area, and numerous low-voltage (34.5 kV) distribution lines servicing business and residential buildings. Portions of Nine Canyon Wind Project was located within or adjacent to the Survey Area, depending on the survey year (Figure 1). Nine Canyon Wind Project consists of 63 WTG that range between 61–80 meters (m) tall with 30–45 m radius rotor blades.

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METHODS

Raptor nest surveys were initiated February 22, 2017 and continued yearly to May 5, 2022 with interruptions in 2020 and 2021 due to health and safety restrictions related to the COVID-19 pandemic. The study design and survey methods incorporated guidance described in the WDFW *Wind Power Guidelines* (WDFW 2009), and the WEG (USFWS 2012), with specific measures adapted for bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) as described by the USFWS (Pagel et al. 2010, USFWS 2013, 81 FR 91494). Methods and results described here are specific to ferruginous hawk; for non-ferruginous hawk nest information, please see references listed in Table 1.

Survey Preparation and Consultation

Prior to aerial surveys in 2017, WEST conducted a literature search to identify nest locations in the area (WDFW 2016). Following the 2017 survey, results were presented to WDFW to review survey protocols and solicit feedback. Data from each survey was incorporated into subsequent survey efforts to develop a comprehensive database of nests in the in the area. In fall 2021, WEST obtained records of all historic ferruginous hawk nests from the WDFW PHS database. Depending on the survey year, the Project Area and/or proposed infrastructure was buffered by 2 miles in ArcMap (ESRI, Redlands, California) to create the Survey Area, and historical nests were imported into the respective Survey Area (Figure 2; Appendix A). In 2022, a group of historic hawk nests just outside the 2-mi buffer was included due to its proximity to the buffer and potential use by hawks as alternative nest locations. WEST developed a survey plan by plotting previously identified nests on maps and digital tablets (LG, Seoul, South Korea) with navigational software (Gaia GPS) that was used during aerial surveys.

Aerial Survey Methods

Each survey year, raptor nest surveys were conducted during two rounds of double-observer (i.e., a primary and secondary observer) aerial surveys. Each survey round was at least 30 days apart and preformed using a Robinson R-44 Raven II helicopter with bubble windows that provided excellent visibility (Photo 1; Pagel et al. 2010, USFWS 2013). Adult hawks begin to arrive in Washington mid-February and egg-laying may begin mid-March (WDFW 2016), thus the first survey was conducted to overlap the early nesting period of hawks in Washington when breeding pairs are exhibiting courtship, nest-building, and/or egg-laying and incubation behaviors (WDFW 2016). The second survey was conducted in May when, historically, more than 90% of 162 nests monitored by WDFW hatched by May 14, and hawks engaged in ongoing nesting activities would reliably be found on or around nests (WDFW 2016).

Using all WDFW historic ferruginous hawk nests in the region and three years of intensive WEST survey data, 2022 surveys focused on visiting each historic location twice (March and May) to check previously documented nests and searching for new nest locations. Emphasis was placed on locating and documenting the status of historic nests by repeating standard survey protocols used during previous survey years that entailed a cautious approach including circular or

stationary hover and multiple sweeps, if needed, until sufficient confidence was established regarding nest disposition.

During all survey years (2017–2019 and 2022), all stick nests that could be constructed by any raptor species or common ravens (*Corvus corax*) were documented within the Survey Area. Common raven nests were documented in addition to nests definitively constructed by raptors because of the potential for species to interchangeably use nest locations. Surveys utilized an intuitive controlled survey method that focused on areas with the highest potential to support raptor nests, including rock outcrops and cliffs, basalt talus and scree slopes along incised drainages and canyons, transmission towers, distribution poles, windmills, and trees. Nests located during the first survey round were revisited during the second survey to evaluate reproductive nesting status while also searching for new nests constructed by breeding pairs who may have arrived after the first survey round was completed.

During aerial surveys, the helicopter was positioned to allow thorough visual inspection of all appropriate habitat features. In general, the helicopter maintained a distance of no closer than 66 ft (20 m) from cliff faces and nests. When a nest was located, the helicopter reduced speed and adjusted the flight track to allow for a clear view of the nest for documentation and photographing. The amount of time spent circling/searching a particular area or the distance to which a nest was approached was adjusted when birds were present on or near the nest to minimize survey-related disturbance (e.g., flushing). In the event of eggs/nestlings, deference was provided and nests located directly adjacent to the eggs/nestlings (e.g., within 200 m) were not surveyed.

For each nest or group of nests (e.g., nest site), Global Positioning System (GPS) coordinates were recorded, photographs were taken from a distance using a Nikon digital single lens reflex camera with 55–200 mm telephoto lens to reduce nest disturbance, and nest attribute data were collected. A nest site was defined as two or more nests that occurred on the same shelf, cliff face, or tree within close proximity to one another (e.g., approximately 80 ft [25 m]). Data collected at each nest included the nesting species, status and physical attributes that included condition, substrate, size, and signs of recent nest tending that included fresh sticks, greenery, or whitewash. The following definitions were used to characterize nests:

Nest Status:

- Occupied Active (OA) = evidence of nest tending, with eggs/fragments, nestlings, and/or an adult in incubating/brooding position present at the time of the survey;
- Occupied Inactive (OI) = evidence of recent tending of the nest or presence of an adult, but no eggs, nestlings or an adult in incubating/brooding position observed;
- Inactive (I) = no evidence of nest tending and no eggs, nestlings or adults present;
- Unoccupied (U): nest was classified as inactive for at least two consecutive surveys;

- Gone (G) = nest determined to be completely missing or so degraded that only remnant material (scattered, loose sticks) were present that would need complete reconstruction in order to be used;
- Did Not Survey (DNS) = Nest was outside the survey area for that particular survey year.
- Did Not Locate (DNL) = Nest was not located during survey; typical of historic nests in Remnant condition;
- Unknown (UNK) = nest likely present, but status cannot be determined. Scenario typically arises when cryptic nests were obscured by tree leaves, survey was aborted due to young on a neighboring nest, or disturbance issues related to horses or other human factors limited survey effort.

Nest Condition:

Nest condition is a strong indicator of nest status; nests that are in better condition reflect the likelihood that the nest is currently in use or has been in use recently. However, longevity of the nest on the landscape is also affected by the stability of the nest construction, exposure of the nest to weather, wildfire, or human removal (WDFW 1996).

- Good = in excellent condition with very well-defined bowl, no sagging, may contain fresh material; possible to use immediately or currently in use;
- Fair = in generally Good condition with fairly well-defined bowl, minor sagging of material but lacks substantive damage; may require some repair or addition to use immediately;
- Poor = material sloughing or sagging that would require reconstruction of the nest bowl in order to be used; most likely not being used during the current nesting season and possibly multiple nesting seasons, depending on nest exposure and other factors;
- Remnant = only loose or scattered material remains at the nest site which would require complete reconstruction of the nest base, body, and bowl to be usable;
- Unknown = condition is unknown due to either nest status being Gone (G) or Unknown (UNK).

Nest Size:

Nest size may be correlated with nest status or nest condition, but can be another useful indicator of nesting activity if tracked over time. Ferruginous hawks typically construct stout nests that can measure equally tall as the nest is wide and persist on the landscape over long periods of time. Encompassing the range of nest sizes reported by WDFW (2016) and Hayes and Watson (2021), hawk nests can range between 24–51 inches diameter by 11–19 inches tall with exceptionally-sized nests measuring 74 inches diameter by 70 inches tall. We defined nest size as:

- Giant = greater than 36 inches in diameter; typically shaped as a stack, mound, platter or conical with noticeably more volume and substantial nesting material; can reflect periods of consistent annual use by *Buteo* or eagle species;

- Large = approximately 24–36 inches in diameter; typically shaped as a stack, mound, platter or conical; consistent with *Buteo* and eagle construction;
- Medium = approximately 12–24 inches in diameter; typically shaped as a bowl, platter or comparatively smaller mound; can reflect inactivity if originally constructed by ferruginous hawk;
- Small = Remnant to approximately 12 inches in diameter, typically shaped as a bowl or scattered material; can reflect prolonged periods of inactivity if originally constructed by ferruginous hawk.
- Unknown = size is unknown due to either nest status being Gone (G) or Unknown (UNK).

After each survey round, high-resolution aerial imagery, topographic maps, and flight tracks were used in ArcMap to georectify GPS coordinates recorded in the field to accurately correspond with the nest structure (tree, cliff face, rock outcrop, etc.) where the nest was observed. Nest photos were downloaded and labeled and a geodatabase was developed that tracked the status of each nest over the survey period. Annual and overall occupancy was calculated as the proportion of territories or nests that were occupied over the four-year survey period where the status could be conclusively determined (occupancy = total # years a nest was occupied / total # survey years a nest was observed). Conclusively determined was defined as historic territory or nest found during surveys and available for nesting with a nest condition of Remnant or better. Nests that were not located or not within the Survey Area were excluded from the calculation of nest occupancy.



Photo 1. Robinson R-44 Raven II helicopter used for ferruginous hawk nest surveys 2017-2019, 2022.

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RESULTS

The size of the Survey Area varied annually and ranged from 74–329 mi², depending on the size of the Project Area under consideration (Table 1; Appendix A). Survey coverage of suitable habitat within the Survey Area was typically accomplished within one day, with larger areas taking multiple days or longer flight times (8–9 hours per day).

Table 1. Aerial raptor nest survey dates and survey area for the Horse Heaven Clean Energy Project, Benton County, Washington, 2017-2019, 2022.

Year	Survey Date ¹		Survey Area (mi ²) ²	Reference
	Round 1	Round 2		
2017	March 31	May 10	74.7	Jansen 2017
2018	March 05	May 10	152.6	Jansen and Brown 2018
2019	March 05, 07	May 16	328.8	Chatfield et al. 2019a,b; Jansen et al. 2019
2022	March 23	May 05	245.5	Jansen 2022

¹ During 2017–2019, in addition to aerial surveys, ground-based surveys to document new nests and follow-up surveys were conducted for certain nests during year-round avian point count surveys.

² Survey Area 2017 = Generalized, conceptual area + 2-mi buffer

Survey Area 2018–2019 = Leased lands + 2-mi buffer

Survey Area 2022 = Proposed turbines and solar areas + 2-mi buffer

During 2022, WEST biologists surveyed 56 historic ferruginous hawk nests comprised of 18 territories within and directly adjacent to the 2-mi Survey Area (Figure 2). One previously documented nest unassociated with a historic WDFW nest and one additional new nest found during the 2022 effort were surveyed for a total of 58 nests (Table 2). Of the 58 nests, 28 nest sites were documented in 16 territories (Appendix B). Two historic territories (Nine Canyon and Badger Canyon) contained no nests. Of the 58 nests, 30 nests (52%) were classified as Gone, 22 nests (38%) were classified as Inactive, and six nests (10%) were occupied by a raptor species or common raven. Occupied nests consisted of three common raven nests, two Swainson's hawk (*Buteo swainsoni*) nests, and one great horned owl (*Bubo virginianus*) nest (Figures 3–6). No historic nests were occupied by ferruginous hawk during 2022 surveys.

The majority of 2022 nests were in Remnant to Poor condition (15 nests; 54%), followed by Fair condition (6 nests; 21%), and 7 nests (25%) were in Good condition. Nests in good condition were either being used by a common raven or other raptor or likely had recent nesting activity, as was the case for Nest 12 (PHS 56177). Of the 13 historic nests included in the 2022 Survey Area that were not surveyed or located during previous survey years, 7 nests (54%) were in Remnant to Poor condition, three nests (23%) were in Fair condition, and three nests were in Good condition and occupied by common raven (Nest 101, PHS 56441), great horned owl (Nest 87, PHS 56682), and a Swainson's hawk in the 13 Territory (Nest 111, PHS 56201) that built a new nest in an isolated tree surrounded by cropland (Appendix B).

Ferruginous hawk nesting was infrequently observed during the eight survey rounds conducted over four survey years. Over four survey years, four nesting attempts were made at two nests located in the Coyote Canyon and Badger Canyon territories. Of 12 historic ferruginous hawk

nests surveyed three or more years, Nest 03 (PHS 157192) in Coyote Canyon was Occupied Active (OA) during three consecutive survey years (2017–2019); however, a pair of Swainson’s hawk were observed perched on the nest tree in 2022 during the second survey round. Although a third follow-up visit to the nest was not conducted to determine nesting status, it is assumed Swainson’s hawk attempted nesting at Nest 03 in 2022. In 2017, Nest 08 (PHS 56311) in Badger Canyon was classified as Occupied Inactive (OI) with a single adult ferruginous hawk observed perched above the nest during the first survey round and no sign of nesting was observed during the second survey round. The absence of sign (e.g., egg shells or young in the nest) suggests the nesting attempt was abandoned or failed. Nest 08 remained in Good condition during the 2018–2019 surveys but the nest was Gone during 2022 surveys with sticks scattered throughout the area of the canyon where the nest was once located.

During 2017–2019 and 2022, the number of occupied ferruginous hawk territories and nests declined even as the number of surveyed territories and nests increased each year (Table 2). Annual territory and nest occupancy was highest in 2017 at approximately 20% and declined to no nesting activity observed in 2022. The overall four-year average of nest and territory occupancy was 6% and 7%, respectively. Historic nests were occupied by other raptor species and common raven more frequency than ferruginous hawk. Over four survey years, nine historic nests were occupied 10 times by species other than ferruginous hawk; the majority by common raven (five occurrences), Swainson’s hawk (three occurrences), great horned owl (one occurrence), or red-tailed hawk (*Buteo jamaicensis*, one occurrence). Historic nests not occupied by ferruginous hawk had an overall occupancy rate of 16%.

Table 2. Annual and overall ferruginous hawk territory and nest occupancy rates.

Survey Year	Territories			Nests		Comment ²
	# Occupied	# Surveyed	% Occ. ¹	# Available	% Occ. ¹	
2017	2	9	22%	10	20%	Nest 08 = OI, Nest 03 = OA 13 not surveyed
2018	1	10	10%	12	8%	Nest 03 = OA 13 not surveyed
2019	1	17	6%	16	6%	Nest 03 = OA 13 not surveyed
2022	0	18	0%	28	0%	Nest 03 = SWHA
Overall	4	54	7%	66	6%	

¹ % occupied = # occupied divided by the # territories surveyed or the number of nests recorded in a survey year

² OA = Occupied Active, OI = Occupied Inactive, SWHA = Swainson’s hawk

DISCUSSION

Ferruginous hawk nest occupancy in the Horse Heaven Hills was low based on four years of aerial raptor nest surveys. Four nesting attempts in two territories were documented during 66 nest years (6% nest occupancy) was lower than the average percent occupied nests previously documented across the species’ range in Washington. Between 1978–2016, Watson et al. (2021) estimated an average of 41% occupancy rate (range 18–88%) during years when more than 70% of known nesting territories were surveyed (average = 54 territories, range 30–78); however,

occupancy rates significantly declined range-wide in recent years. Despite the comparatively smaller sample size reported here than used in range-wide assessments of territory occupancy, occupancy at Horse Heaven appears on the low end of the range compared to other areas in Washington that may have more favorable conditions (larger areas of native habitat and prey populations and less human disturbance). The dilapidated condition of a majority of nests at Horse Heaven further indicated consistent low nest occupancy as tended nests can typically be used with limited maintenance. Over time, Inactive nests slowly deteriorate due to exposure to the elements, which appears to be case of the 2017 Occupied nest in [REDACTED] 13 (Nest 08) that slowly deteriorated in subsequent years. All historic nests classified in 2022 as Fair or Good condition were either previously or currently occupied by another bird species. Inactive nests in Fair condition, as are found in [REDACTED] 13 (Nest 73), and the Good condition nest at [REDACTED] 13 (Nest 92U) may be a function of a microclimate protected from the elements or nest occupancy in the intervening years when surveys did not occur (2020–2021).

Low nest occupancy during 2017-2019 was reflected in the low use of ferruginous hawk documented during 1,232 hours of point count surveys conducted year-round throughout the Horse Heaven Hills from August 2017-September 2020 (Horse Heaven Wind Farm, LLC. 2020). During this time, four total observations at three point counts located nearest to Nest 03 were documented in March (two observations), April (one observation), and October (one observation). Low avian use indicates the species had low abundance and was not widely distributed when point count surveys occurred.

Surveys were scheduled to consider broader survey objectives, including surveying species other than ferruginous hawk (eagles, other hawks, falcons, and owls), prior to tree leaf out to increase nest detection, and to account for asynchronous nesting chronology of various raptor species (e.g., early owls and later *Buteos*). Surveys conducted in March and May were prior to the time when ferruginous hawk nest success can be typically be determined as young generally fledge from the nest in June and July. However, the primary survey objective was to determine nest status (nest occupancy) and not nest success (# young successfully fledged). Nevertheless, there was high confidence each survey year that nest surveys coincided with the return of ferruginous hawks from wintering grounds in California due to observations reported from ground-based avian point count and other raptor nest surveys that were conducted throughout eastern Washington and Oregon during 2017-2019 and 2022.

Primary threats to nesting in the Horse Heaven Hills currently include agricultural activities which may affect availability of native habitat that support small mammal prey populations; similarly, encroachment of residential and exurban development into the foothills (e.g., Clodfelter and Clodfelter West) and along the escarpment reduces the suitability of nesting and foraging shrub-steppe habitat. Predation at ground nests may also be a factor influencing nest occupancy and success. Although anecdotal, each aerial survey noted coyotes (*Canis latrans*) throughout the Survey Area and concentrated along [REDACTED] 13 of the escarpment where historic ferruginous hawk nests were located (Photo 2). Interestingly, the most consistent nesting attempts by ferruginous hawks were in a [REDACTED] 13 where

adults were observed incubating 2017-2019. The use of trees for nesting may represent a shift away from ground nests where predators have easier access to young (Ng et al. 2020).



Photo 2. Numerous coyotes were observed along the escarpment and interior agricultural fields of the Horse Heaven Hills during each survey round. Ground predators reduce the suitability of ground nests.

Historic nest data from the WDFW PHS database did not note nest occupancy in 2016 at nests in the Horse Heaven Hills when the last comprehensive range-wide survey effort was made. Based on historic data from WDFW and contemporary survey results, many ferruginous hawk nests have disappeared from the landscape or have been unoccupied for ≥ 5 years. The highly modified and changing landscape continues to present challenges to ferruginous hawk nest occupancy and nesting success in the Horse Heaven Hills. Existing stressors on the landscape, including land conversion from expanding residential and agricultural development, depressed prey populations, and predation are primary factors that affect hawks (WDFW 1996, Hayes and Watson 2021), and will likely continue to affect nest occupancy in the Horse Heaven Hills. Comparatively low nest occupancy relative to state-wide averages suggest populations in the Horse Heaven Hills have sustained low occupancy rates for nearly half a decade, although ferruginous hawk have exhibited a declining population trend in Washington since state-wide counts began in the late 1970's (Hayes and Watson 2021).

Table 3. Historic ferruginous hawk nest status and condition during surveys conducted 2017-2019, 2022 in the Horse Heaven Hills, Benton County, Washington. Territories listed in alphabetical order.

WEST Alias	WEST ID (2022)	PHS ID (OccurPoint)	Nest Substrate	Nest Condition (2022)	Nest Size (2022)	Nest Status				Photo?	Updated GPS?	Comments
						2017	2018	2019	2022			
13 Road												
46	98	56497	Tree	Good	Large	DNS	DNS	CORA	CORA	X	X	2001 = area surrounding trees plowed under; 2007 = trees burned; 2016 = nest gone, 2019 and 2022 = common raven. WDFW coordinates 100 m off
Badger Canyon												
	89	56314	Ground	Unknown	Unknown	DNL	DNL	DNL	G	--	--	No 13 at WDFW coordinates; 13
8	95	56311	Rock outcrop	Unknown	Unknown	FEHA	I	I	G	X	X	Nest in a 13 along Badger Canyon. Adult observed standing above nest in 2017 during first survey round; inactive 2018-2019 and Gone in 2022. Once a large nest, now sticks can be seen scattered throughout canyon
	96	56312	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	--	--	Extensive search in area could not relocate historic nest; Canyon extensively search over survey years; scattered sticks observed along Canyon walls
	97	56313	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	--	--	Extensive search in area could not relocate historic nest; Canyon extensively search over survey years
Badger Canyon 13												
	61	56601	Ground	Poor	Large	DNL	DNL	DNL	I	X	--	Large nest with material scattered everywhere; substrate changed to ground. Nest trending to Poor condition.
85U	85	56600	Ground	Poor	Large	DNL	DNL	DNL	I	X	X	Large nest with material scattered everywhere; substrate changed to ground. Nest trending to Poor condition.
13 Road												
	64	56310	Tree	Unknown	Unknown	DNS	DNS	DNL	G	X	--	Nest lost to residential development around 2008. Updated coordinates in 2010. No sign of nesting during recent surveys
43	90	56309	Tree	Fair	Large	DNS	DNS	SWHA	I	X	--	13. 2019 = SWHA and CORA
Chandler Butte												
34	91	56214	Rock outcrop	Poor	Large	DNS	DNS	I	I	X	--	13. Substantial material sloughing off. Good condition in 2019
92U	92	56215	Rock outcrop	Fair	Medium	DNS	DNS	DNL	I	X	X	Two nests located 13 One nest in Poor condition with substantial nest material on ground below nest; another nest in Good condition – site averaged to Fair condition
13												
111U	111	56201	Tree	Good	Medium	DNS	DNS	G	SWHA	X	X	Swainson's hawk nesting 13 of WDFW territory coordinates; no nest in 2019, SWHA established in 2022
13												
22	22	NEW	Rock outcrop	Remnant	Small	DNL	I	I	I	X	--	Possible duplicate with Nest 113 which is located 13

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WEST Alias	WEST ID (2022)	PHS ID (OccurPoint)	Nest Substrate	Nest Condition (2022)	Nest Size (2022)	Nest Status				Photo?	Updated GPS?	Comments
						2017	2018	2019	2022			
	60	56315	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	--	--	1985: territory active; 2010: no nests in canyon
	65	56317	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	--	--	
	66	56318	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	--	--	
	81	56320	Rock outcrop	Unknown	Unknown	DNS	DNS	DNL	G	--	--	13
	113	56321	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	--	--	Possible duplicate with Nest 22 which is located 13
	114	56316	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	X	--	13
							13					
67U	67	56319	Rock outcrop	Remnant	Small	DNL	DNL	DNL	I	X	X	Updated GPS coordinates in 2022 to opposite side of drainage
	86	56596	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	--	--	Nest active in the late 1980's and early 1990's
04	103	56597	Rock outcrop	Poor	Medium	I	I	I	I	X	X	Updated GPS coordinates in 2022 to reflect accurate location; rocks in nest bowl
Coyote Canyon												
03	107	157192	Tree	Good	Large	FEHA	FEHA	FEHA	SWHA	X		Discovered by WEST 2017 = 1 adult incubating; 2018 = adult incubating w eggs; 2019 = 1 adult incubating; 2022 = 2 SWHA perched on tree
							13	Road				
	74	56173	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	--	--	No evidence of previous nesting
	75	56175	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	--	--	Very Poor nest substrate/structure at coordinates. Searched extensively
	77	56174	Rock outcrop	Poor	Small	DNL	DNL	DNL	I	X	--	13
	78	56176	Rock outcrop	Remnant	Small	DNL	DNL	DNL	I	--	--	Reduced to nest fragments and scattered sticks on the ground
12	82	56177	Cliff	Good	Large	RTHA	I	I	I	X	X	2019 condition was Poor with sticks at base of cliff; 2022 condition was Good suggesting nesting in intervening years.
13	83	56178	Ground	Remnant	Small	I	I	I	I	X	X	13
	84	56179	Rock outcrop	Remnant	Small	DNL	DNL	DNL	I	X	--	Reduced to nest fragments and scattered small-diameter sticks on the ground
							13					
33	88	56322	Rock outcrop	Good	Large	DNS	DNL	CORA	CORA	X	X	2019 = 4 young, approximately 1-2 weeks old at second survey
Nine Canyon												
	112	56308	Rock outcrop	Unknown	Unknown	DNS	DNS	DNL	G	X	--	By 1993, nest degenerated & 13; 2010: no sign of nest
Sheep Canyon												
	99	56241	Unknown	Unknown	Unknown	DNL	DNL	DNL	G	--	--	13
	100	56242	Rock outcrop	Unknown	Unknown	G	G	G	G	--	--	WDFW notes indicate nest gone but remnants remain; was not able to verify in 2022

Table 3. Historic ferruginous hawk nest status and condition during surveys conducted 2017-2019, 2022 in the Horse Heaven Hills, Benton County, Washington. Territories listed in alphabetical order.

WEST Alias	WEST ID (2022)	PHS ID (OccurPoint)	Nest Substrate	Nest Condition (2022)	Nest Size (2022)	Nest Status				Photo?	Updated GPS?	Comments
						2017	2018	2019	2022			
	104	56243	Unknown	Unknown	Unknown	DNL	DNL	DNL	G	--	--	Duplicate nest location with PHS 56244 & 56241
	105	56244	Unknown	Unknown	Unknown	DNL	DNL	DNL	G	--	--	Duplicate nest location with PHS 56243 & 56241
11	108	56246	Ground	Remnant	Large	I	I	I	I	X	X	13
	116	NEW	Ground	Fair	Large	DNL	DNL	DNL	I	X	X	New nest discovered in 2022, apparently unassociated with WDFW nest, no recent nest activity noticeable
	109	56245	Tree	Unknown	Unknown	G	G	G	G	--	--	WDFW = tree removed in 2010. No current activity observed
10	110	56247	Ground	Remnant	Small	I	I	I	I	X	--	Changed from rock outcrop to ground. Nest trending to gone. Functionally unusable
						13						
	87	56682	Tree	Good	Medium	DNS	DNS	DNS	GHOW	--	--	13
Webber Canyon												
	59	56130	Unknown	Unknown	Unknown	DNL	DNL	DNL	G	--	--	No Nest or stick material present
	69	56134	Ground	Unknown	Unknown	DNL	DNL	DNL	G	--	--	
	70	56135	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	--	--	See Nest 30; Updated coordinates
	71	56137	Unknown	Unknown	Unknown	DNL	DNL	DNL	G	--	--	
72U	72	56139	Ground	Remnant	Small	DNL	DNL	DNL	I	--	--	
30	73	56136	Ground	Fair	Large	DNL	I	I	I	X	X	13; condition, substrate changed from unknown to ground
	76	56138	Rock outcrop	Unknown	Unknown	DNL	DNL	DNL	G	--	--	
15	79	56132	Rock outcrop	Poor	Large	I	I	I	I	X	X	
	80	56133	Unknown	Unknown	Unknown	DNL	DNL	DNL	G	--	--	
17	93	56129	Ground	Remnant	Small	I	I	I	I	X	X	
	94	56131	Unknown	Unknown	Unknown	DNL	DNL	DNL	G	--	--	
						Webber Canyon 13						
16	62	56595	Ground	Fair	Large	I	I	I	I	X	X	Nest substrate changed from rock outcrop to ground
						13 Fourmile Canyon						
	63	56511	Tree	Unknown	Unknown	DNS	DNS	DNL	G	X	--	WDFW 2016: only 1 tree/nest remains at site. 2022 = both nests gone
	68	56510	Tree	Fair	Large	DNS	DNS	DNL	I	X	--	WDFW 2016: CORA nesting since 2010. 2022: nest completely collapsed on the other, very low in tree
						13						

Table 3. Historic ferruginous hawk nest status and condition during surveys conducted 2017-2019, 2022 in the Horse Heaven Hills, Benton County, Washington. Territories listed in alphabetical order.

WEST Alias	WEST ID (2022)	PHS ID (OccurPoint)	Nest Substrate	Nest Condition (2022)	Nest Size (2022)	Nest Status				Photo?	Updated GPS?	Comments
						2017	2018	2019	2022			
	101	56441	Cliff	Good	Small	DNS	DNS	DNL	CORA	X	--	13
	102	56443	Rock outcrop	Unknown	Unknown	DNS	DNS	DNL	G	X	--	13
	106	56442	Rock outcrop	Unknown	Unknown	DNS	DNS	DNL	G	X	--	13

¹ WEST Alias = Nest ID used in previous survey years and used in technical reports; WEST ID (2022) = Unique nest ID used in 2022
² Nest Status = DNS: Did Not Survey, DNL: Did Not Locate, G: Gone, I: Inactive, CORA: common raven, FEHA: ferruginous hawk, GHOW: great horned owl, RTHA: red-tailed hawk, SWHA: Swainson's hawk

13

13

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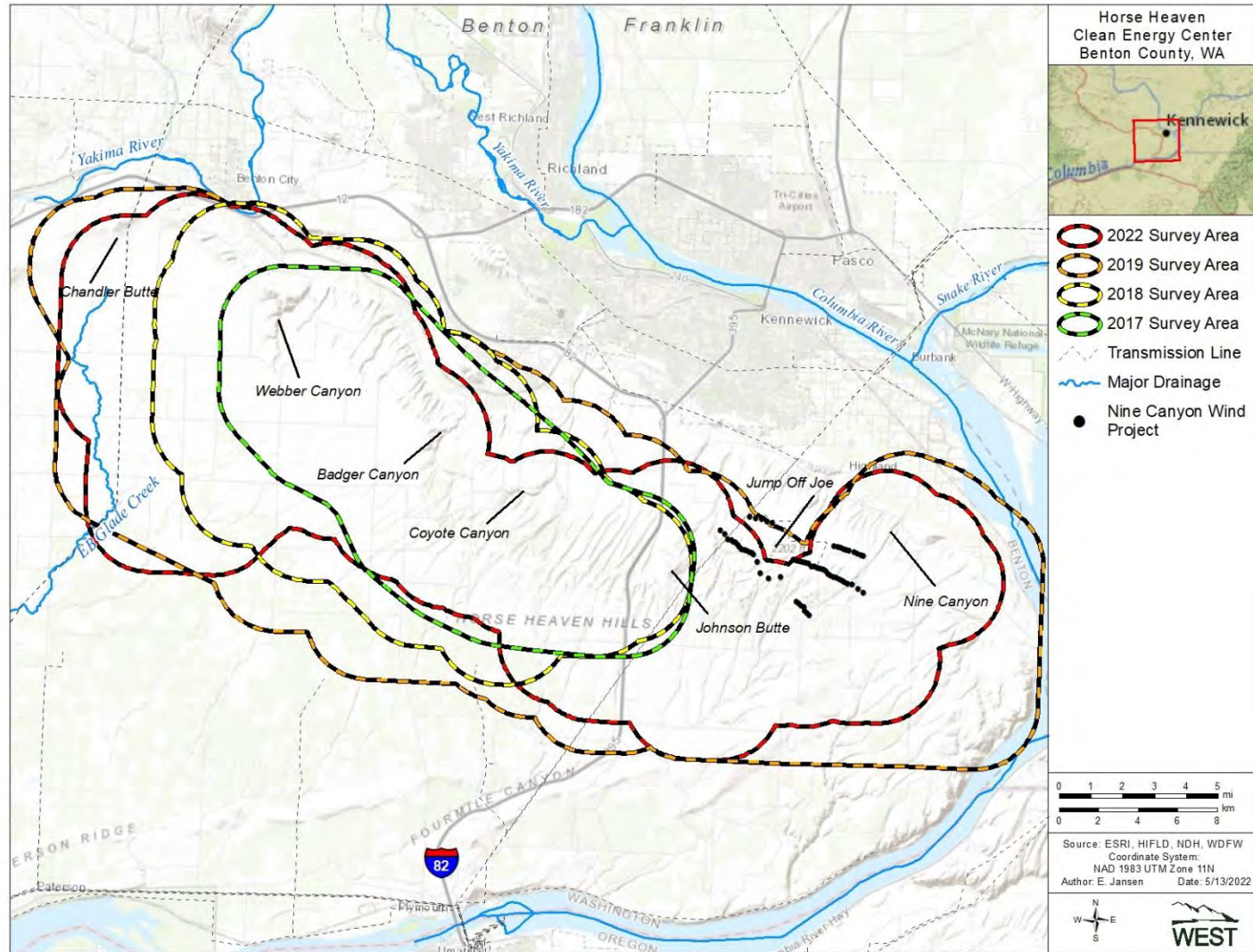
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Appendix A. Survey Areas for raptor nest surveys conducted 2017-2019 and 2022 for the Horse Heaven Clean Energy Center, Benton County, Washington.



Appendix A. Survey Areas for raptor nest surveys conducted 2017-2019 and 2022 for the Horse Heaven Clean Energy Center, Benton County, Washington.

Appendix B. Photographic guide and description of ferruginous hawk nests and territories for the Horse Heaven Clean Energy Project, Benton County, Washington, 2017–2019, 2022.

Note: Territories are names assigned by WDFW and summarized here as they occur on the landscape, from west to east as shown in Figure 2. Nest ID numbers are unique to WEST survey efforts, PHS ID numbers (PHS #####) are unique to the WDFW PHS Program, represent the OccurPoint field in the database, and provided here for reference. The nests surveyed in a particular year reflect the geometry of the 2-mile Survey Area. The most comprehensive survey effort was 2022, when the location of historic hawk nests were obtained from the PHS Program. Current threats to a territory are noted as they were perceived in the field and do not include an exhaustive list common to all territories and associated nests (e.g., climate change, wildfire, loss of native habitat, reduction in prey populations and the synergistic affects between them).

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