Appendix A

Eagle Conservation Plan

Biglow Canyon Wind Project

Eagle Conservation Plan for the Biglow Canyon Wind Farm

Prepared for

Portland General Electric

Prepared by

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Portland, OR 97201

July 2019

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1.0 INTRODUCTION AND PURPOSE

Portland General Electric Company (PGE) constructed, owns, and operates the Biglow Canyon Wind Farm (Project) in Sherman County, Oregon (Figure 1). The Project is located within the breeding range of the bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) and has the potential for take of these species during normal operations. PGE contracted Tetra Tech, Inc. (Tetra Tech) to create this Eagle Conservation Plan (ECP) to support an application for an incidental eagle take permit. The intention of this ECP is to secure take authorization for the Project, with take to be managed collectively across all three phases of the Project. An additional objective of this ECP is to document PGE's commitments with respect to minimizing impacts to eagles for the life of the Project.

Bald and golden eagles are protected under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA; see Section 3.0). Permits for the incidental take of eagles were not available during the development of the Project; however, permits for up to 30 years for incidental eagle take are currently available with the submission of a permit application and an ECP to the U.S. Fish and Wildlife Service (USFWS; USFWS 2016a). This document follows the Eagle Conservation Plan Guidance (ECPG) released by the USFWS in April 2013 (USFWS 2013a) and, for consistency with recommendations in the ECPG, documents the following Project stages:

- Stage 1 – Site Assessment
- Stage 2 – Site-specific Surveys and Assessment
- Stage 3 – Predicting Eagle Fatalities
- Stage 4 – Avoidance and Minimization of Risk and Compensatory Mitigation
- Stage 5 – Calibrating and Updating of the Fatality Prediction and Continued Risk-assessment

This ECP has been developed in consultation with USFWS (Table 1).

Table 1. Record of Consultation with USFWS

Date	Purpose	Attendees
March 5, 2014	Project and team introduction and discussion of ECP content	Kristi Boken, Greg Concannon, Sean Humphreys – PGE Jerry Cordova, Matt Stuber – USFWS Eric Lubell, Laura Nagy – Tetra Tech
June 10, 2014	Site visit	Kristi Boken, Greg Concannon, Sean Humphreys, Robert Marheine – PGE Jerry Cordova – USFWS Julia Garvin, Laura Nagy, Jenny Taylor – Tetra Tech
June 24, 2014	In-person meeting with USFWS to discuss components of ECP	Kristi Boken, Greg Concannon – PGE Jerry Cordova, Matt Stuber – USFWS Julia Garvin, Laura Nagy, Jenny Taylor – Tetra Tech
October 14, 2014	In-person meeting with USFWS to discuss NEPA process for eagle take permit	Kristi Boken, Greg Concannon – PGE Matt Stuber – USFWS Julia Garvin – Tetra Tech Barbara Craig, Sarah Curtiss – Stoel Rives, for PGE

Date	Purpose	Attendees
October 17, 2014	In-person meeting with USFWS to discuss eagle take modelling for ECP	Kristi Boken, Greg Concannon – PGE Matt Stuber – USFWS Chris Farmer, Julia Garvin – Tetra Tech
December 3, 2014	In-person meeting with USFWS to discuss eagle take modelling and FCMR	Kristi Boken, Greg Concannon – PGE Matt Stuber – USFWS Chris Farmer, Julia Garvin – Tetra Tech
December 8, 2014	Phone call and webinar with USFWS to discuss FCMR and Bayesian model	Kristi Boken, Greg Concannon – PGE Matt Stuber – USFWS Chris Farmer, Julia Garvin, Jenny Taylor – Tetra Tech
February 26, 2015	Phone call with USFWS to discuss FCMR approach, analysis, and results	Kristi Boken – PGE Matt Stuber – USFWS Chris Farmer, Julia Garvin, Tom Snetsinger, Jenny Taylor – Tetra Tech
March 9, 2015	Phone call with USFWS to discuss FCMR approach and take values for ECP and ITP	Kristi Boken, Greg Concannon – PGE Matt Stuber – USFWS Chris Farmer, Julia Garvin, Tom Snetsinger – Tetra Tech
March 31, 2015	Draft ECP submitted to USFWS for review	Not applicable
June 26, 2015	Phone call with USFWS to discuss the status of USFWS review of the ECP and scope of analysis for EA	Kristi Boken, Rich George – PGE Jerry Cordova, Matt Stuber– USFWS Julia Garvin, Susan Hurley, Tom Snetsinger – Tetra Tech Barbara Craig, Sarah Curtiss – Stoel Rives, for PGE
July 9, 2015	EA outline submitted to USFWS for review	Not applicable
August 12, 2015	Phone call with USFWS to discuss USFWS comments on the ECP and EA outline	Kristi Boken, Rich George – PGE Jerry Cordova, Matt Stuber – USFWS Julia Garvin, Tom Snetsinger – Tetra Tech Sarah Curtiss – Stoel Rives, for PGE
August 20, 2015	Phone call with USFWS to discuss FCMR data input and Bayesian model conjugate update, iterative approach	Matt Stuber– USFWS Julia Garvin, Tom Snetsinger – Tetra Tech
September 14, 2015	Phone call with USFWS to discuss FCMR data inputs and analysis approach	Kristi Boken – PGE Jerry Cordova, Matt Stuber – USFWS Chris Farmer, Julia Garvin, Tom Snetsinger – Tetra Tech
October 8, 2015	Phone call with USFWS to discuss take values and schedule for USFWS take modelling	Kristi Boken – PGE Matt Stuber – USFWS Chris Farmer, Julia Garvin, Tom Snetsinger – Tetra Tech
November 19, 2015	Phone call with USFWS to discuss FCMR analysis and EA alternatives for analysis	Kristi Boken – PGE Matt Stuber – USFWS Susan Hurley, Julia Garvin, Tom Snetsinger – Tetra Tech Barbara Craig – Stoel Rives, for PGE
February 8, 2016	Phone call with USFWS to discuss corrections to FCMR program and results of take modelling	Kristi Boken – PGE Matt Stuber – USFWS Julia Garvin, Tom Snetsinger – Tetra Tech

Date	Purpose	Attendees
March 18, 2016	Mitigation plan outline submitted to USFWS for review	Not applicable
March 22, 2016	Phone call with USFWS to discuss status and schedule of ECP and mitigation plan	Kristi Boken – PGE Matt Stuber – USFWS Susan Hurley, Julia Garvin, Tom Snetsinger – Tetra Tech
April 19, 2016	Phone call with USFWS to discuss components of the mitigation plan and status of the ECP and EA	Kristi Boken – PGE Matt Stuber – USFWS Susan Hurley, Julia Garvin, Tom Snetsinger – Tetra Tech
May 27, 2016	Draft mitigation plan submitted to USFWS for review	Not applicable
May 31, 2016	Phone call with USFWS to discuss progress updates on ECP and EA	Kristi Boken – PGE Matt Stuber – USFWS Susan Hurley, Julia Garvin – Tetra Tech
June 14, 2016	Phone call with USFWS to discuss progress updates on ECP and EA	Kristi Boken – PGE Matt Stuber – USFWS Susan Hurley, Julia Garvin, Tom Snetsinger – Tetra Tech
July 19, 2016	In-person meeting to discuss adaptive management strategy and mitigation plan	Kristi Boken, Rich George – PGE Matt Stuber, Phillip Kline – USFWS Susan Hurley, Julia Garvin, Tom Snetsinger – Tetra Tech Barbara Craig – Stoel Rives, for PGE
September 6, 2016	Phone call with USFWS to discuss adaptive management strategy and fatality monitoring	Kristi Boken – PGE Matt Stuber – USFWS Susan Hurley, Julia Garvin, Tom Snetsinger – Tetra Tech
October 4, 2016	In-person meeting to discuss conservation commitments with respect to the EA alternatives.	Kristi Boken, Rich George – PGE Matt Stuber, Phillip Kline – USFWS Susan Hurley, Julia Garvin – Tetra Tech Barbara Craig – Stoel Rives, for PGE
May 10, 2017	Phone call with USFWS to discuss revisions needed as a result of revised permit regulations	Kristi Boken, Rich George – PGE Matt Stuber, Katie Powell – USFWS Susan Hurley, Julia Garvin – Tetra Tech Barbara Craig – Stoel Rives, for PGE
August 28, 2018	Phone call to discuss the EA and compliance monitoring	Kristi Boken, Rich George – PGE Matt Stuber, Katie Powell – USFWS Susan Hurley, Julia Garvin – Tetra Tech Barbara Craig – Stoel Rives, for PGE
February 26, 2019	In-person meeting to discuss the EA, compliance monitoring, and 5-year administrative evaluation process	Kristi Boken, Rich George – PGE Matt Stuber– USFWS Susan Hurley, Julia Garvin – Tetra Tech Barbara Craig – Stoel Rives, for PGE

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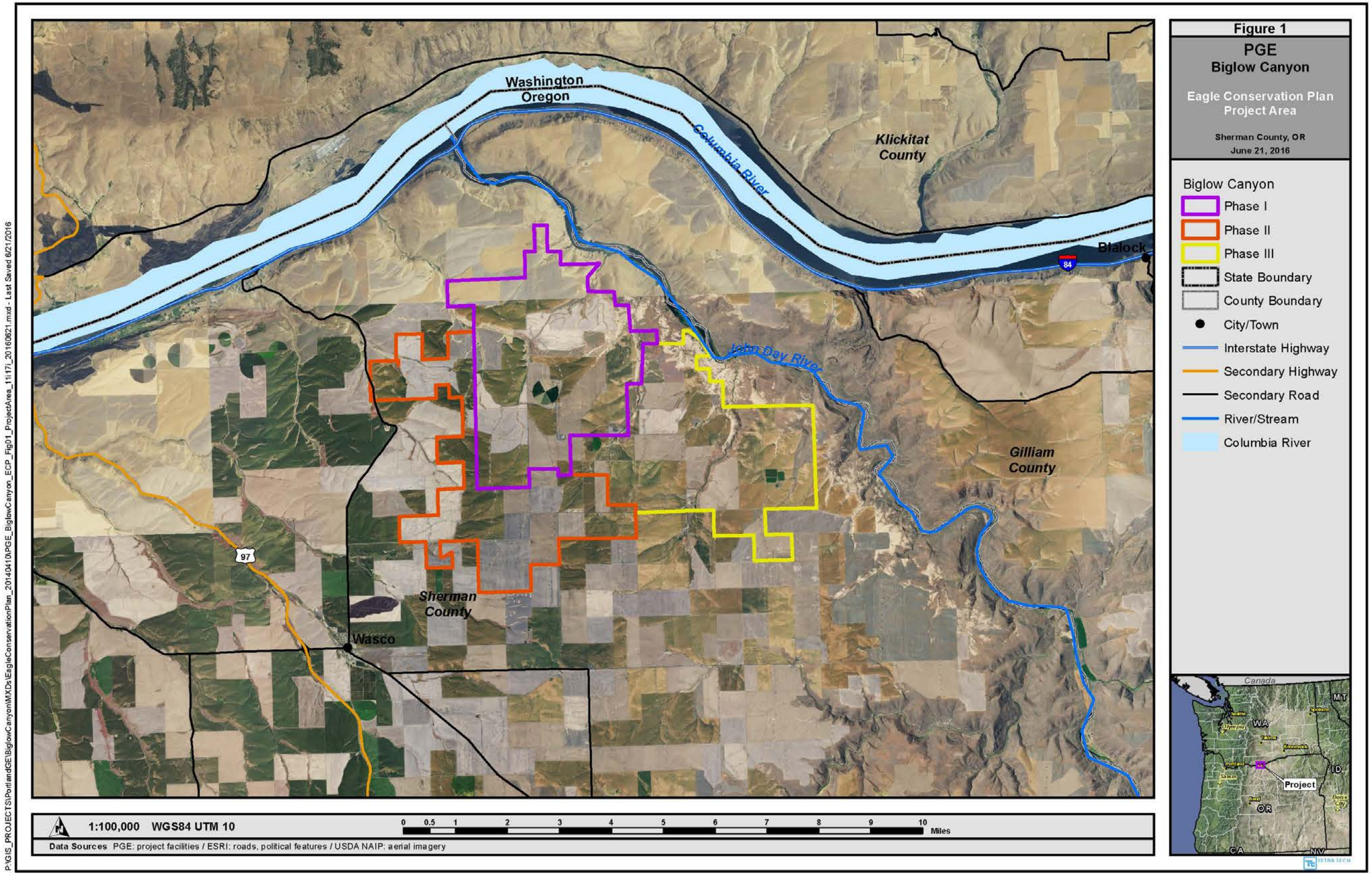
Figure 1
PGE
Biglow Canyon
Eagle Conservation Plan
Project Area
Sherman County, OR
June 21, 2016
Biglow Canyon
Phase I
Phase II
Phase III
State Boundary
County Boundary
City/Town
Interstate Highway
Secondary Highway
Secondary Road
River/Stream
Columbia River
Washington
Oregon
Columbia River
Klickitat County
Blalock
84
John Day River
Gilliam County
Sherman County
Wasco
97
Canada
MT
WA
ID
OR
Project
CA
NV
1:100,000 WGS84 UTM 10
0 0.5 1 2 3 4 5 6 7 8 9 10 Miles
Data Sources PGE: project facilities / ESRI: roads, political features / USDA NAIP: aerial imagery
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2.0 PROJECT DESCRIPTION

The Project, constructed in three phases (Table 2), was permitted through the Oregon Energy Facility Siting Council (EFSC) and treated as a single project. EFSC granted a Site Certificate to the previous owner, Orion Sherman County Wind Farm, LLC (Orion), a wholly owned subsidiary of Orion Energy LLC, in June 2006 for the construction of the Project. PGE acquired the permitted Project in November of 2006 following an amendment to the Site Certificate that named PGE as the certificate holder in place of Orion. PGE began construction of Phase I of the Project in April 2007 with operations commencing December 21, 2007 (Table 2). The Project's Site Certificate was amended again in 2007 and 2008 to allow for the construction of Phases II and III, respectively (ODOE 2008; Table 2).

The Project is located on the Columbia Plateau, approximately 5 miles (8.0 kilometers) northeast of the city of Wasco, Oregon. The Project is located west of the John Day River and south of the Columbia River with several small canyons to the south and east of the Project. Agricultural lands, predominantly dryland wheat, are the dominant land use throughout the Project area and vicinity where not precluded by steep slopes (Figure 2). The Project consists of 217 wind turbines across all three phases (Phases I, II, and III; Figure 2) with a total installed generating capacity of 450 megawatts (MW). The Project encompasses 19,844 acres (8,030 hectares) of privately-owned land. Project facilities are located on less than 1 percent (185 acres [74.0 hectares]) of this area and include turbine pads, above-ground collection lines including conductors and poles, an operations and maintenance building, 4 permanent un-guyed met towers, and access roads. The Project uses two wind turbine models that have similar hub heights, but different specifications for the diameter of the rotor blades (Table 2).

Table 2. Wind Turbine Specifications

Project Phase	Month and Year Construction Initiated	Date Operational	No. of Turbines	Turbine Model (MW)	Hub Height in Feet (meters)	Blade Length in Feet (meters)	Maximum Blade Tip Height[1] in Feet (meters)
Phase I	April 2007	December 21, 2007	76	Vestas V82 (1.65)	262.5 (80.0)	134.5 (41.0)	364.2 (111.0)
Phase II	August 2008	August 17, 2009	65	Siemens (2.30)	262.5 (80.0)	152.6 (46.5)	415.0 (126.5)
Phase III	August 2009	August 20, 2010	76	Siemens (2.30)	262.5 (80.0)	152.6 (46.5)	415.0 (126.5)

1. Height from base of tower to tip of fully extended blade.

Elevations at the Project range from 250 feet (76 meters) above sea level near the mouth of the John Day River to 1,600 feet (487 meters) on the higher ridges. Precipitation throughout the region ranges from 6.0–12.0 inches (15–30 centimeters) per year (Thorson et al. 2003). Land cover within the Project is predominantly dry-land wheat agriculture with isolated parcels of land enrolled in the Conservation Reserve Program (CRP) (i.e., Grassland/Herbaceous; Table 3, Figure 2). Additional grassland habitats as well as shrub/scrub are located in areas that are too steep or otherwise unsuitable for agriculture. The remaining land covers make up less than 3 percent of the Project combined.

Table 3. Project Land Cover Composition by Phase

Land Cover[1]	Phase I acres (hectares)	Phase II acres (hectares)	Phase III acres (hectares)	Total acres (hectares)	Percent Composition
Cultivated Crops	5,464 (2,211)	4,328 (1,752)	4,532 (1,834)	14,325 (5,797)	72.2
Developed, Medium Intensity	2 (1)	-	-	2.2 (1)	0.0
Developed, Open Space	151 (61)	154 (62)	159 (65)	464 (188)	2.3
Emergent Herbaceous Wetlands	0.8 (0.3)	-	-	0.8 (0.3)	0.0
Grassland/Herbaceous	397 (161)	97 (39)	339 (137)	833 (337)	4.2
Mixed Forest	3 (1)	-	-	3 (1)	0.0
Shrub/Scrub	1,349 (546)	894 (362)	1,970 (798)	4,213 (1,705)	21.2
Woody Wetlands	-	-	2.2 (0.9)	2.2 (0.9)	0.0
Total	**7,367 (2,981.3)**	**5,473 (2,251)**	**7,002 (2,834.9)**	**19,843 (8,030.2)**	**-**

1. Source: National Land Cover Database 2011 (Jin et al. 2013).

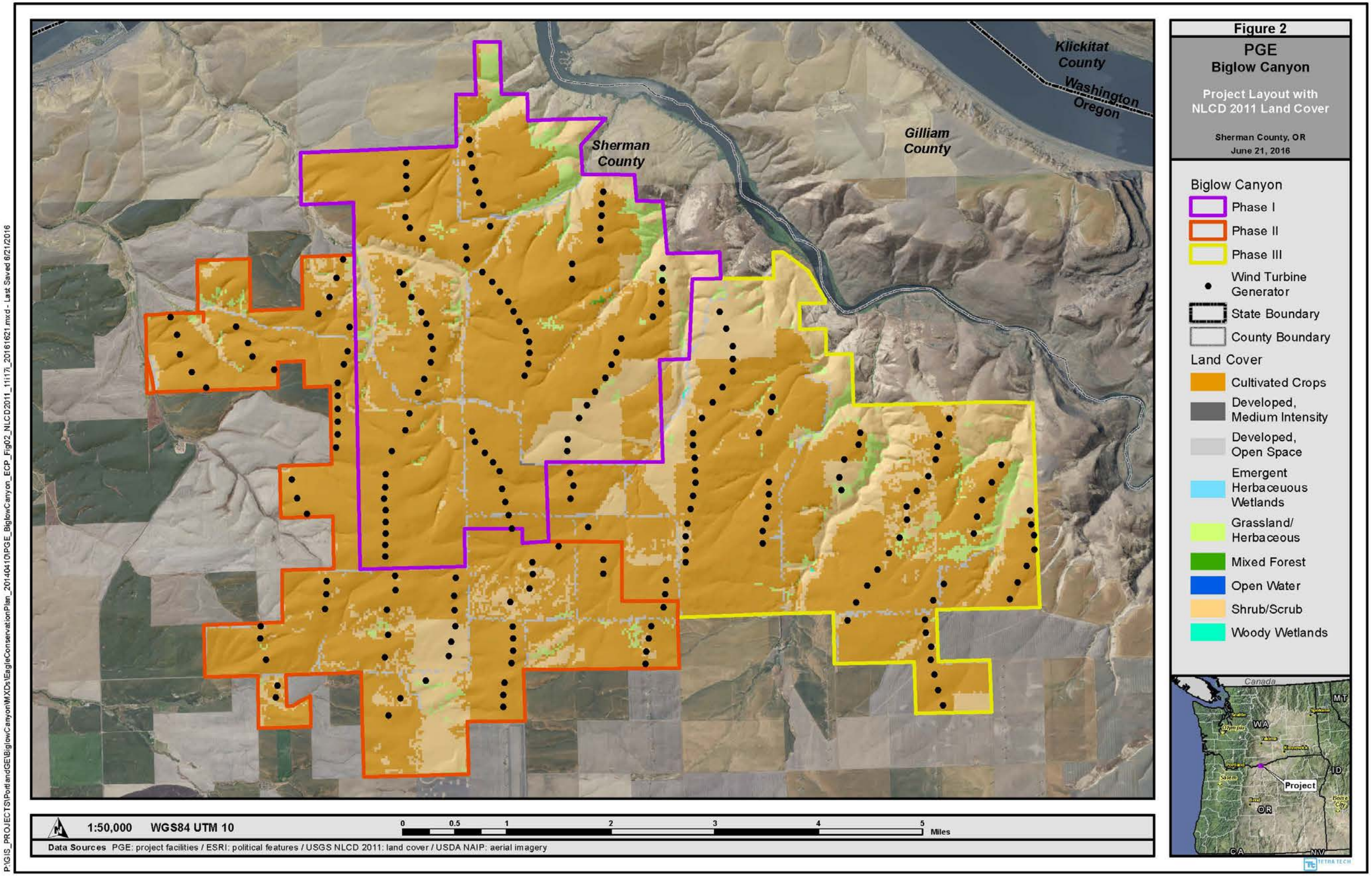
Figure 2
PGE
Biglow Canyon
Project Layout with
NLCD 2011 Land Cover
Sherman County, OR
June 21, 2016
Klickitat County
Washington
Oregon
Sherman County
Gilliam County
Biglow Canyon
Phase I
Phase II
Phase III
Wind Turbine Generator
State Boundary
County Boundary
Land Cover
Cultivated Crops
Developed, Medium Intensity
Developed, Open Space
Emergent Herbaceuous Wetlands
Grassland/ Herbaceous
Mixed Forest
Open Water
Shrub/Scrub
Woody Wetlands
Canada
WA
OR
ID
MT
CA
NV
Project
1:50,000 WGS84 UTM 10
0 0.5 1 2 3 4 5 Miles
Data Sources PGE: project facilities / ESRI: political features / USGS NLCD 2011: land cover / USDA NAIP: aerial imagery
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3.0 REGULATORY FRAMEWORK

Federal and state regulations that are relevant to eagles and the Project are described in the following subsections.

3.1 Bald and Golden Eagle Protection Act

The BGEPA prohibits the take of any bald or golden eagle, alive or dead, including any part, nest, or egg. “Take” is defined as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb” a bald or golden eagle. “Disturb” means to agitate or bother an eagle to a degree that causes, or is likely to cause, (1) injury to an eagle; (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior. Under 50 CFR §22.26 eagle incidental take permits are available for take associated with otherwise lawful activities (USFWS 2009a, USFWS 2016a). The USFWS typically requires an ECP be prepared in support of the incidental take permit issuance. The Eagle Conservation Plan Guidance (USFWS 2013a), which outlines the recommended steps for take permit applications, was used in the development of this ECP. Additionally, survey and information requirements stipulated in the December 2016 revision to 50 CFR §22.26 (Eagle Rule Revision) were also incorporated into the development of this document (USFWS 2016a).

3.2 Migratory Bird Treaty Act

The MBTA protects migratory birds and prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when authorized by the USFWS under a permit (16 U.S.C. §703; 50 CFR §21; 50 CFR §10).Under the MBTA, “take” is defined as “to pursue, hunt, shoot, wound, kill, trap, capture, or collect” or to attempt any of these acts (50 C.F.R. § 10.12). USFWS has identified that the BGEPA take authorization for eagles serves as authorization under MBTA per 50 C.F.R. § 22.11(b) (USFWS 2013b).

A December 22, 2017 memorandum from the U.S. Department of the Interior’s (USDOI’s) Office of the Solicitor found that the prohibitions of take under the MBTA apply only to “affirmative actions that have as their purpose the taking or killing of migratory birds, their nests, or their eggs” (USDOI 2017). An April 11, 2018 memorandum from the USFWS provides clarifying guidance that the USDOI no longer considers incidental take a violation of the MBTA if the purpose of the activity is not to take birds. As a result, the MBTA is currently limited to actions with the purpose of killing migratory birds, their nests, or their eggs, such as hunting or poaching.

3.3 Oregon Regulations

The Oregon EFSC must approve a Site Certificate prior to the construction of electric energy projects that exceed 105 MW, and projects must meet EFSC standards applicable to fish and wildlife habitat and threatened and endangered species, as well as follow the conditions of the Site Certificate which ensure compliance with those standards. The golden eagle is considered a species of special interest to the public, and at the time of the Site Certificate application for the Project, the bald eagle was state-listed as threatened. In 2012, the Oregon Fish and Wildlife Commission approved the removal of the bald eagle from the Oregon Endangered Species List. Although the state-listed threatened status of the bald eagle influenced the development of the Project as reflected in the Site Certificate and Final Order on the Application for Site Certificate, this ECP has been developed based upon the current state status for both eagle species as species of interest to the public.

Regarding wildlife habitat, EFSC standards require "that the design, construction, and operation of a proposed facility (including mitigation) be consistent with the habitat mitigation goals and standards in OAR chapter 635, division 415" (OAR 345-022-0060 – Fish and Wildlife Habitat). Additionally, to issue a Site Certificate, the "EFSC must consult with ODFW and decide whether the design, construction and operation of the proposed facility, taking into account mitigation, is not likely to cause a significant reduction in the likelihood of survival or recovery of a species listed under the Oregon Endangered Species Act" (OAR 345-022-0070 – Threatened and Endangered Species).

4.0 SITE ASSESSMENT AND SURVEYS TO DATE (ECPG STAGES 1, 2, 5)

The following sections summarize the available data on bald and golden eagles at the Project according to the stages outlined in the ECPG (USFWS 2013a). Studies relating to eagle use included a desktop evaluation and preliminary site assessment (Stage 1), pre- and post-construction avian use and raptor nest surveys (Stage 2), and fatality monitoring (Stage 5; Table 4). Because the Project was developed, constructed, and became operational before issuance of the ECPG and the current eagle permit regulations, not all surveys followed currently recommended methodologies.

4.1 Site Assessment (ECPG Stage 1)

A variety of data requests and site surveys were conducted as part of the site-screening and EFSC permitting processes for the Project. In 2005, information on threatened, endangered and sensitive species within and surrounding the Project area was received from the Oregon Natural Heritage Information Center (ORNHIC) in response to a data request by PGE. Similarly, a list of federally-listed species that may occur in Sherman County was received from the USFWS in 2005 in response to a data request by PGE. Supplementing the information provided by ORNHIC and USFWS, a number of other sources were consulted for information on special status and sensitive species. Frank Isaacs of the Oregon Cooperative Fish and Wildlife Research Unit (F. Isaacs, pers. comm., January 2002, updated July 2005) was contacted for data on the mid-winter bald eagle surveys conducted along the Columbia River and documentation of any bald eagle nests within 5.0 miles (8.0 kilometers) of the Project area. This information, along with baseline and monitoring data from other wind facilities in the region and elsewhere, and site characteristics such as habitat and topography, were used to develop a landscape scale assessment of risk (Orion 2005).

4.2 Pre- and Post-construction Surveys (ECPG Stage 2)

Information gathered during pre- and post-construction avian studies pertinent to bald and golden eagles at the Project is summarized in this section. For the purposes of this document, "pre-construction" is used to refer to surveys performed prior to construction of the phase of interest.

Table 4. Chronological List of Avian Studies Conducted at the Project

Type of Study	Related Project Phase	Study Timing	Year Conducted	Reference
Pre-construction				
Raptor nest survey	All Phases	Pre-construction	2001	WEST 2005a
Raptor nest survey	All Phases	Pre-construction	2004	WEST 2005a
Avian use study	All Phases	Pre-construction	2004 –2005	WEST 2005a
Avian use study	All Phases	Pre-construction	2005 –2006	WEST 2007
Raptor nest survey	All Phases	Pre-construction	2006	PGE 2012
Raptor nest survey	Phase I	Pre-construction	2007	WEST 2007
Raptor nest survey	Phase II	Pre-construction	2008	PGE 2008
Raptor nest survey	Phases II and III	Pre-construction	2009	PGE 2009
Raptor nest survey	Phase III	Pre-construction	2010	PGE 2010
Post-construction				
Raptor nest survey	Phase I	Post-construction	2008	PGE 2008
Avian use study and fatality monitoring	Phase I	Post-construction	2008	Jeffrey et al. 2009
Avian use study and fatality monitoring	Phase I	Post-construction	2009	Enk et al. 2010
Avian use study and fatality monitoring	Phase II	Post-construction	2009 –2010	Enk et al. 2012a
Raptor nest survey	Phase II	Post-construction	2010	PGE 2010
Avian use study and fatality monitoring	Phase II	Post-construction	2010 –2011	Enk et al. 2012b
Avian use study and fatality monitoring	Phase III	Post-construction	2010 –2011	Enk et al. 2012c
Raptor nest survey	Phase III	Post-construction	2011	PGE 2011
Avian use study and fatality monitoring	Phase III	Post-construction	2011 –2012	Enz et al. 2013a
Raptor nest survey	All Phases	Post-construction	2012	PGE 2012
Raptor nest survey	All Phases	Post-construction	2017	PGE 2017

4.2.1 Pre-construction Avian Point-Count Surveys

Baseline avian use surveys for all phases combined were initially conducted from March 26, 2004, through March 23, 2005 (Table 5). These surveys used a fixed-point avian count study protocol and were designed to evaluate the spatial and temporal patterns of avian use and estimate potential impacts prior to development. Surveys were conducted at 22 point-count locations, each with a radius of 0.5-miles (800-meters). Nine of these point-count locations were located throughout the three phases of the Project (points A – I; Figure 3), and 13 were reference points located approximately 5 miles (8.0 kilometers) south of the Project where no development was expected (WEST 2005a; not shown in Figure 3). Surveys were conducted twice per month with approximately five surveys at each point per season; seasons were defined as spring (March 15 to May 31), summer (June 1 to August 14), fall (August 15 to October 31) and winter (November 1 to March 14). Observers recorded the number, distance, and height of each bird species seen or heard within the 0.5-mile (800 meters) survey plot during the 30-minute point-count. No bald or golden eagles were observed during these surveys.

Table 5. Pre-Construction Avian Point-Count Studies Conducted 2004-2006

Month and Year Conducted	No. of Survey Points	Count Duration (min)	Survey Frequency	Total No. of Surveys[1]	Reference
March 2004 – March 2005	22 (9 at Project, 13 Reference)	30	Twice monthly	404 (163 at Project, 241 Reference)	WEST 2005a
September – October 2005	15	20	Twice weekly	225	Orion 2005
November 2005 – August 2006	4	30	Weekly	220	WEST 2007

1. To the extent practicable, each station was surveyed about the same number of times each season; however, the schedule varied in response to adverse weather conditions (e.g., fog), which caused delays and missed surveys.

To respond to concerns raised by ODFW, additional pre-construction surveys were performed starting in September 2005 at the original nine locations within the Project as well as at six new point-count locations. The six new points (points A1 – A6) were located throughout the three phases of the Project area, with two points per phase (Figure 3). Surveys were conducted approximately twice per week at each of the 15 points from September 15 to October 20, 2005 (Table 5). The data collection protocol was similar to the protocol used previously; however, the individual count duration was 20 minutes (Exhibit P in Orion 2005).

Point-count surveys were then continued weekly from November 17, 2005 to August 8, 2006 at the four points along the John Day River (points H, I, A5, A6 [John Day Canyon Points]; Figure 3) to aid in estimating indirect avian impacts of Phase I and guide potential mitigation (WEST 2007). These surveys were focused on raptors and other large birds. The data collection protocol followed that used during the March 2004 study outlined above. Individual survey durations were 30 minutes.

The methods for these pre-construction eagle use surveys were consistent with many of the currently recommended standards (e.g., 2 years of monitoring, representative coverage of habitats and topography within the Project footprint, surveys distributed among daylight hours). However, the methods deviated from the ECPG and Eagle Rule Revision in some respects such as minutes of eagle flight not being explicitly recorded, survey durations were less than 60 minutes, spatial coverage of the turbines and a 1-km buffer was less than 30 percent, and sampling was less than 12 hours per plot in 2004-2005.

Eleven golden eagles were observed between September 2005 and March 2006. Golden eagle observations primarily occurred at point-count locations in proximity to the John Day River (points H, I, A5, A6 Figure 4) during this timeframe. Ten golden eagles were observed passing within the survey plots and one golden eagle was observed outside of the survey plot (pers. comm. Kimberly Bay, WEST, November 1, 2013). The ten golden eagles observed within the survey plots consisted of two perched individuals and eight individuals in flight, all with flight heights of 656 feet (200 meters) or below (Figure 4). The golden eagle observed outside of the survey plots was flying at heights above 984 feet (300 meters; pers. comm. Kimberly Bay, WEST, November 1, 2013).

Two bald eagles were observed between September 2005 and March 2006 at point-count locations in proximity to the John Day River (points I and A6; Figure 3). Both individuals were observed flying within the survey plots at heights of 656 feet (200 meters) or below (flight paths not shown in Figure 4 for simplicity).

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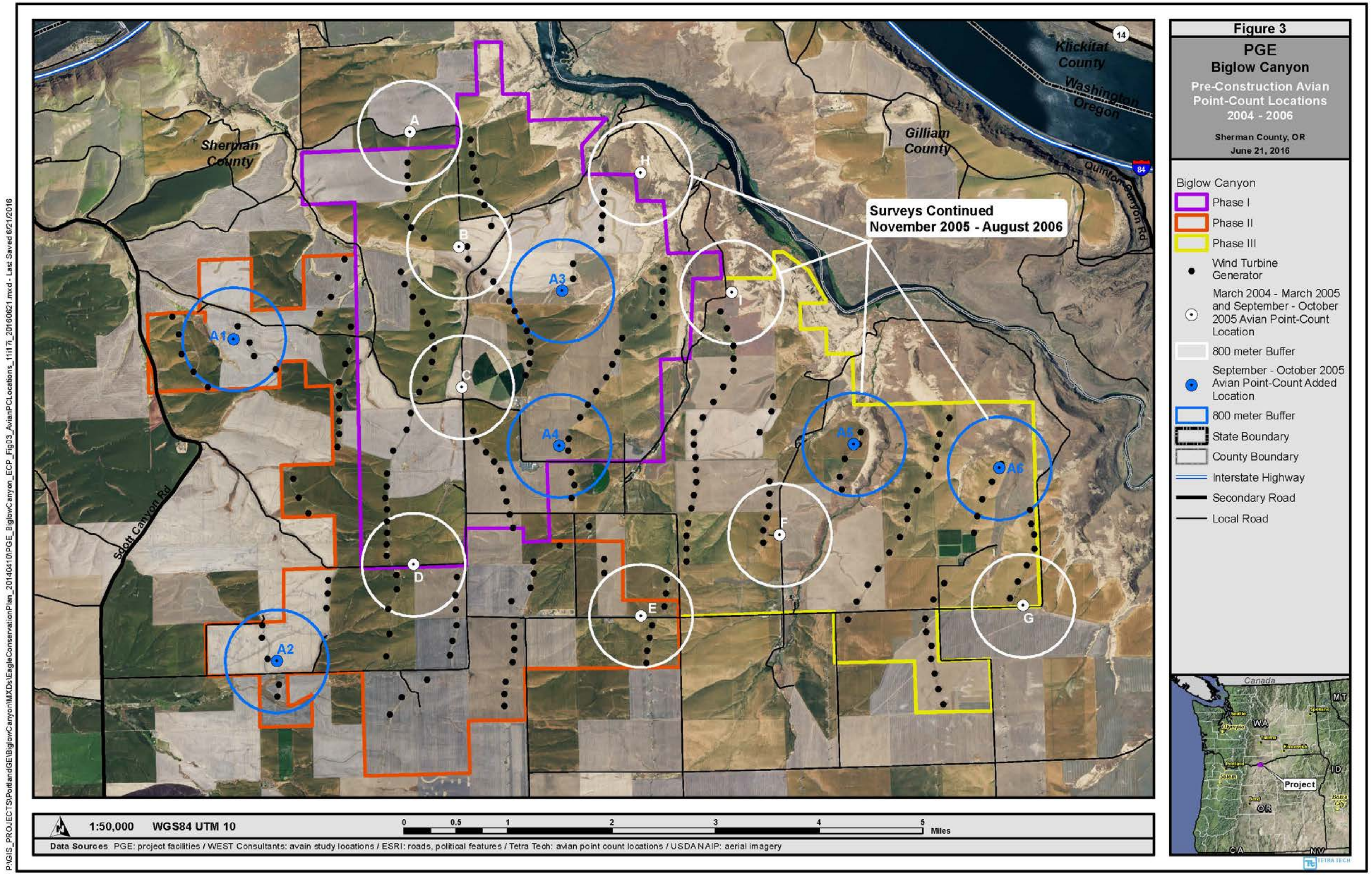
Figure 3
PGE
Biglow Canyon
Pre-Construction Avian Point-Count Locations 2004 - 2006
Sherman County, OR
June 21, 2016
Biglow Canyon
Phase I
Phase II
Phase III
Wind Turbine Generator
March 2004 - March 2005 and September - October 2005 Avian Point-Count Location
800 meter Buffer
September - October 2005 Avian Point-Count Added Location
800 meter Buffer
State Boundary
County Boundary
Interstate Highway
Secondary Road
Local Road
Surveys Continued November 2005 - August 2006
Klickitat County
Washington
Oregon
Gilliam County
Sherman County
Quinton Canyon Rd
Scott Canyon Rd
1:50,000 WGS84 UTM 10
0 0.5 1 2 3 4 5 Miles
Data Sources PGE: project facilities / WEST Consultants: avain study locations / ESRI: roads, political features / Tetra Tech: avian point count locations / USDA NAIP: aerial imagery
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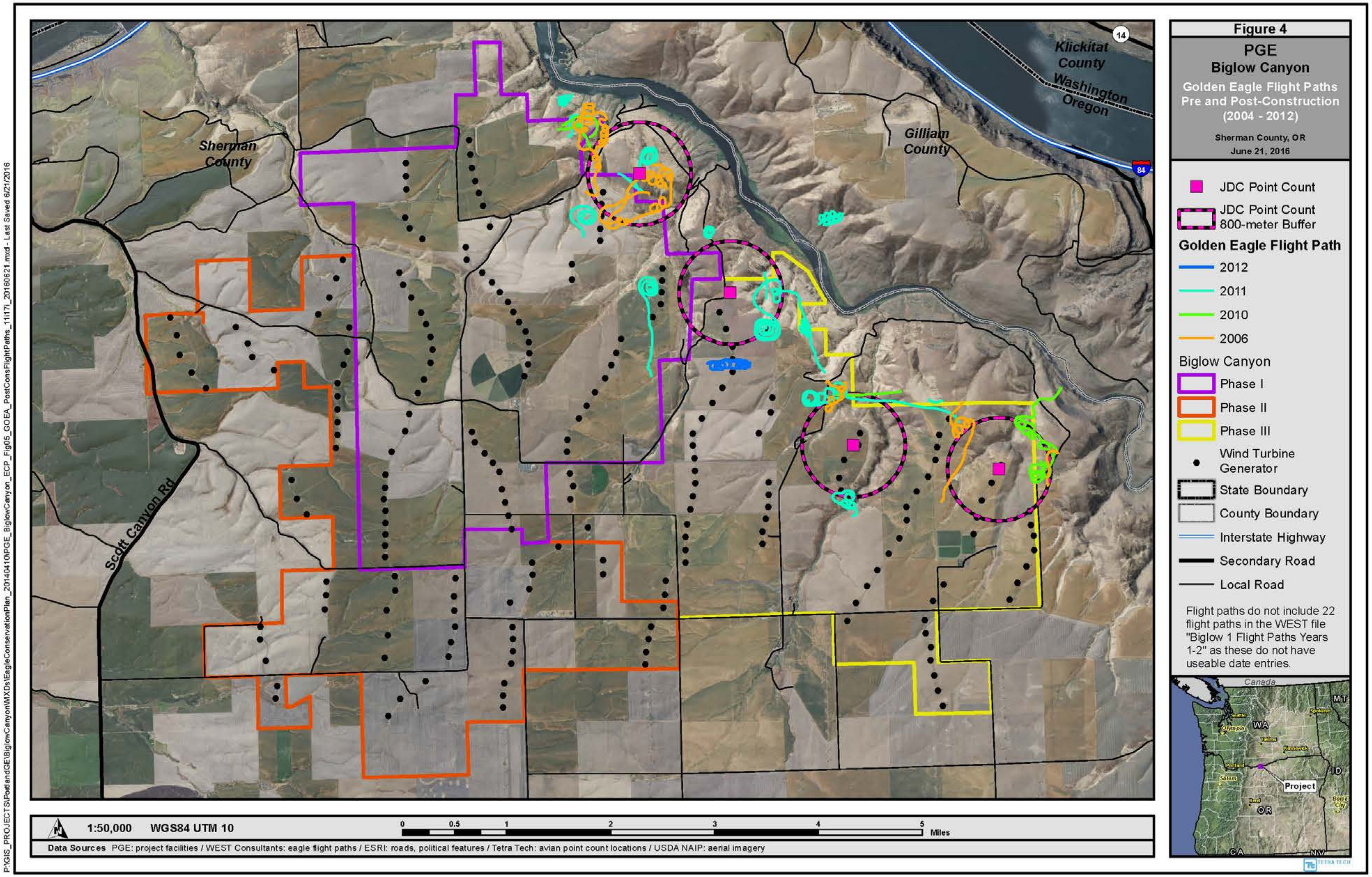
Figure 4
PGE
Biglow Canyon
Golden Eagle Flight Paths
Pre and Post-Construction
(2004 - 2012)
Sherman County, OR
June 21, 2016
JDC Point Count
JDC Point Count 800-meter Buffer
Golden Eagle Flight Path
2012
2011
2010
2006
Biglow Canyon
Phase I
Phase II
Phase III
Wind Turbine Generator
State Boundary
County Boundary
Interstate Highway
Secondary Road
Local Road
Flight paths do not include 22 flight paths in the WEST file "Biglow 1 Flight Paths Years 1-2" as these do not have useable date entries.
Klickitat County
Washington
Oregon
Gilliam County
Sherman County
Scott Canyon Rd
14
84
Canada
WA
OR
ID
MT
Project
1:50,000
WGS84 UTM 10
0 0.5 1 2 3 4 5 Miles
Data Sources PGE: project facilities / WEST Consultants: eagle flight paths / ESRI: roads, political features / Tetra Tech: avian point count locations / USDA NAIP: aerial imagery

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4.2.2 Post-construction Avian Use and Behavior Surveys

PGE conducted avian use and behavior surveys for 2 years following the construction of each phase of the Project (2008-2012; Figure 5). The principal objectives of these studies were to (1) document bird use and abundance near the John Day Canyon rim relative to the wind project, and (2) document bird use and abundance near the Project turbines. Methods for the John Day Canyon post-construction surveys were the same as pre-construction surveys in order to allow for before/after comparisons (Section 4.2.1).

Methods for post-construction surveys at points immediately adjacent to the Project wind turbines (PWT) were designed to establish general post-construction bird use and behavior at the wind energy facility. The PWT points were located at the 50 turbines that were searched for fatalities (Section 4.3.1; Figure 5). Surveys at PWT points were conducted once monthly in winter and summer, twice monthly in spring and fall, and immediately prior to conducting searches for fatalities (2008-2012; Table 6). Use surveys consisted of 5-minute counts and all birds within 0.25 miles (400 meters) of the surveyor were counted. Data recorded included species, number of individuals, and height above ground.

Thirty bald eagle observations and 54 golden eagle observations (excluding incidental observations) were recorded during the 5,952 post-construction surveys conducted at the three phases of the Project between 2008 and 2012 (Table 6; Figure 4).

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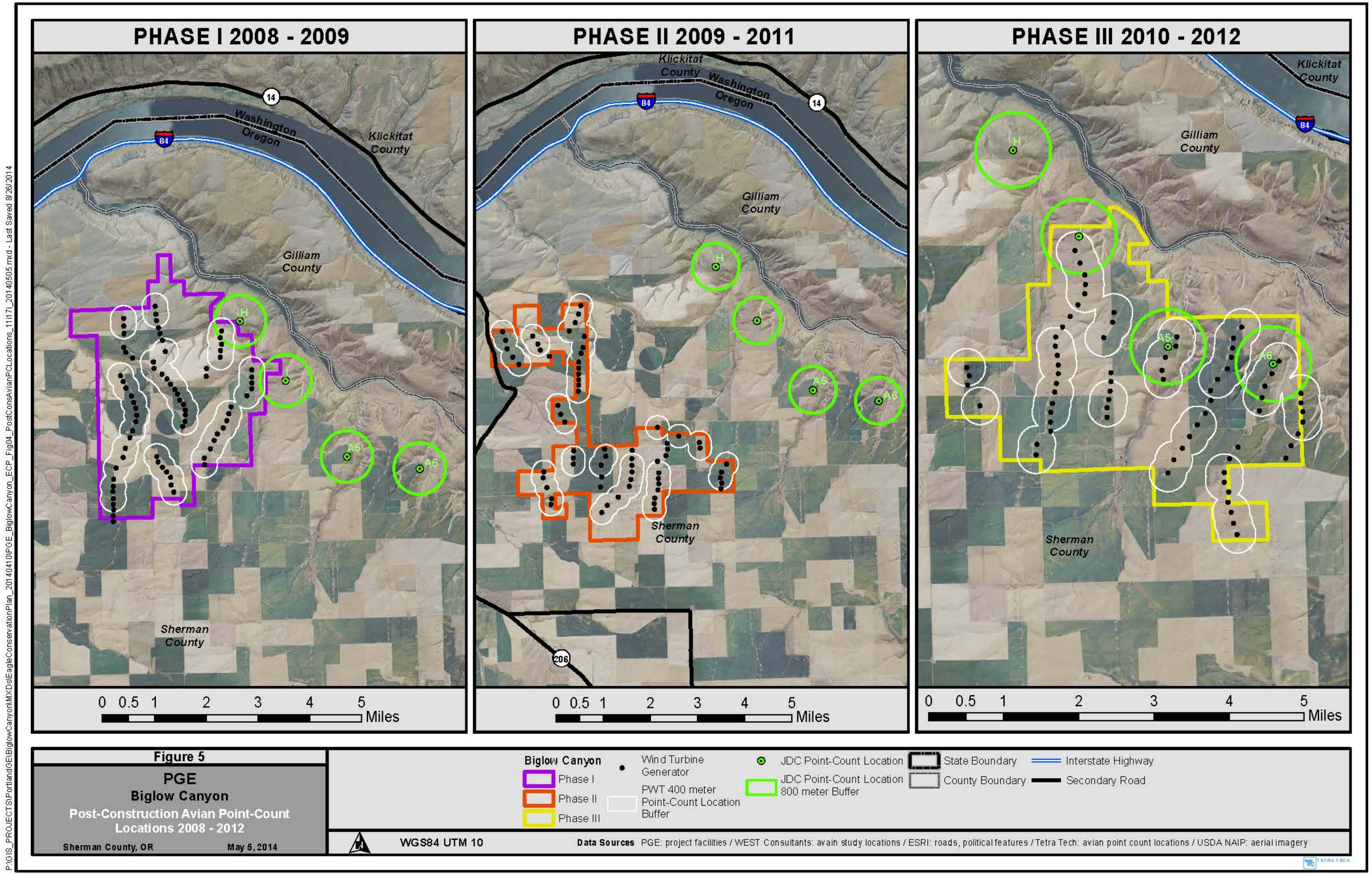
PHASE I 2008 - 2009
PHASE II 2009 - 2011
PHASE III 2010 - 2012
Washington
Oregon
Klickitat County
Gilliam County
Sherman County
Miles
Figure 5
PGE
Biglow Canyon
Post-Construction Avian Point-Count Locations 2008 - 2012
Sherman County, OR
May 5, 2014
Biglow Canyon
Phase I
Phase II
Phase III
Wind Turbine Generator
PWT 400 meter Point-Count Location Buffer
JDC Point-Count Location
JDC Point-Count Location 800 meter Buffer
State Boundary
County Boundary
Interstate Highway
Secondary Road
WGS84 UTM 10
Data Sources PGE: project facilities / WEST Consultants: avain study locations / ESRI: roads, political features / Tetra Tech: avian point count locations / USDA NAIP: aerial imagery

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Table 6. Bald and Golden Eagle Observations during Post-Construction Avian Use Surveys by Phase

Project Phase	Study Year	Survey Location[1]	Months Conducted	No. Survey Points	Point Radius	Survey Length (min)	No. Survey Periods	Total Surveys[2]	No. Bald Eagle Observations	No. Golden Eagle Observations	No. Incidental Bald Eagle (Golden Eagle)[3]	Source
Phase I	2008	JDC	January –December	4	800	30	68	271	8	16	0 (2)	Jeffrey et al. 2009, Enk et al. 2010
		PWT	January –December	50	400	5	21	850	2	1		
	2009	JDC	January –August	4	800	30	42	168	0	5	1 (6)	
		PWT	January –December	50	400	5	22	849	4	3		
Phase II	2009 – 2010	PWT	September –September	50	400	5	19	842	0	1	0 (0)	Enk et al. 2012a
	2010 – 2011	PWT	September –September	50	400	5	16	800	0	0	0 (0)	Enk et al. 2012b
Phase III	2010 – 2011	JDC	September –September	4	800	30	71	284	3	10	0 (0)	Enk et al. 2012c, Enz et al. 2013a, Enz et al. 2013b
		PWT	September –September	50	400	5	16	800	0	2		
	2011 – 2012	JDC	September –August	4	800	30	73	288	12	15	1 (2)	
		PWT	September –August	50	400	5	16	800	1	1		
All Phases	**2008 – 2012**	**All Locations**	**N/A[4]**	**N/A**	**N/A**	**N/A**	**364**	**5,952**	**30**	**54**	**2 (10)**	**N/A**

1. JDC = John Day Canyon; PWT = Project Wind Turbines
2. Not all survey points were able to be surveyed during each survey period.
3. Incidentals are defined as observations that occurred outside of the point-count period
4. N/A = Not applicable because values do not sum

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4.2.3 Pre-construction Raptor Nest Surveys

Pre-construction raptor nest surveys were conducted between 2001 and 2010 (i.e., prior to the release of the ECPG) to evaluate the species occupancy and distribution of nesting raptors within the vicinity of the Project (Table 7). As part of the EFSC permitting process, each phase was surveyed for raptor nests during a minimum of two nesting periods (i.e., between March and June) prior to construction. Surveys were conducted from a helicopter or from the ground if weather precluded aerial surveys. A minimum of one aerial survey was performed per nesting period. Baseline surveys were conducted out to 2 miles (3.2 kilometers) from the Project boundary, with subsequent surveys focused on areas within 0.5 miles (0.8 kilometers) of proposed construction corridors, per EFSC requirements. Surveys focused on areas with potential nesting habitat, such as cliffs, trees, and human structures (e.g., power poles). In addition to searching for new nests, all previously known nest sites were checked for signs of use during the surveys.

Table 7. Pre-Construction Raptor Nest Surveys Conducted at Project 2001-2010

Project Phase	Survey Method	Survey Dates	Results	Reference
Phases I, II, III[1]	Aerial survey within 2 miles (3.2 kilometers) of Project boundary	May and June 2001[2]	No eagle nests observed within 2 miles (3.2 kilometers) of Project boundary[3]	WEST 2005a
Phases I, II, III	Two aerial surveys within 2 miles (3.2 kilometers) of Project boundary.	April 20 and 21, 2004	No eagle nests observed	WEST 2005a
Phases I, II, III	Aerial survey within 2 miles (3.2 kilometers) of Project boundary.	Spring 2006[2]	No eagle nests observed	PGE 2012
Phase I	Three aerial surveys within 0.5 miles (0.8 kilometers) of construction sites.	March 6, March 29, and May 1, 2007	No eagle nests observed	WEST 2007
Phase II	Three aerial surveys within 0.5 miles (0.8 kilometers) of construction sites.	March 4, March 25, and April 30, 2008	No eagle nests observed	PGE 2008
Phases II and III	Two ground and one aerial survey within 0.5 miles (0.8 kilometers) of construction sites.	March 9, March 31, April 3, and April 21, 2009	No eagle nests observed, one observation of a golden eagle	PGE 2009
Phase III	Three aerial surveys within 0.5 miles (0.8 kilometers) of construction sites.	March 4, March 25, and April 23, 2010	No eagle nests observed	PGE 2010

1. Surveyed as part of the Klondike I Wind facility, located directly south of Project.
2. Exact survey dates not specified.
3. One golden eagle nest was detected approximately 4 miles (6.4 kilometers) from the closest Project turbine, and an individual golden eagle was observed within 2 miles (3.2 kilometers) of the Klondike I Wind facility (ABR, Inc. 2005).

No bald or golden eagle nests were observed within 2.0 miles (3.2 kilometers) of the Project during pre-construction surveys conducted between 2001 and 2010. Raptor nest survey data from the Klondike I Wind Facility 2001 aerial nest survey indicated that one golden eagle nest was located 4.5 miles (7.2 kilometers) southeast of the Biglow Canyon Project (ABR, Inc. 2005). Additionally, two golden eagles were observed incidental to raptor nest surveys conducted in 2004. No location or flight height information was recorded for these two incidental observations.

4.2.4 Post-construction Raptor Nest Surveys

Raptor nest surveys were conducted between 2008 and 2012 within 2.0 miles (3.2 kilometers) of turbine corridors for 2 years post-construction of each individual phase. One year of post-construction nest surveys was conducted during the first nesting season after construction of a given phase was completed (2008-2011; Table 8). The second year of post-construction nest surveys at each phase was conducted during the 2012 nesting season to synchronize the surveys for long-term nest surveys (see below). No bald or golden eagle nests were observed within 2.0 miles (3.2 kilometers) of the Project during 4 years of post-construction aerial raptor nest surveys (Table 8). One observation of an individual golden eagle was made during a ground-based nest survey conducted in early April 2009 (PGE 2009).

As a condition of the Site Certificate, long-term nest surveys are scheduled every 5 years following completion of the last post-construction raptor nest survey. These surveys employ the same protocols as previous raptor nest surveys with the exception that surveys are limited to known nest locations from past surveys and are not inventories of the entire survey area. Project-specific surveys are not performed in Washington, but information on breeding area and nest status is available from statewide surveys (see below). The first long-term raptor nest survey was conducted by PGE in 2017. The results of this survey are summarized below and supplemented with information available from statewide eagle nest surveys in Oregon and Washington.

The raptor nest survey performed by PGE in 2017 included four golden eagle breeding areas known from Oregon statewide surveys in 2012 (Isaacs 2013; Table 9, Figure 6) within a 10-mile (16.1-kilometer) buffer of the Project. One of the breeding areas was occupied (OR_GE_0063), and the remaining three golden eagle breeding areas surveyed by PGE in 2017 were confirmed to be unoccupied (Table 9). Golden eagle breeding areas OR_GE_1130 and OR_GE_1080 were unknown prior to 2011 (Isaacs 2013). Occupancy and productivity data for these breeding areas are generally limited, with four or fewer years of data collected between 2011 and 2018 (Isaacs 2019), but available information is summarized in Table 9.

One bald eagle breeding area (OR_BE_01) is known to occur within a 10-mile (16.1 kilometer) buffer based on Oregon statewide surveys in 2010 (Isaacs 2013). This nest was located approximately 4 miles (5.8 kilometers) from the Project boundary (Figure 6), but it was on a nest platform that is no longer present as of the 2017 surveys (PGE 2017).

Table 8. Project-specific Post-Construction Raptor Nest Surveys Conducted 2008-2017

Project Phase	Survey Method	Survey Timing	Survey Results	Source
Phase I	Two aerial surveys within 2.0 miles (3.2 kilometers) of turbine corridor.	April and June 2008	No eagle nests observed	PGE 2008
Phase II	Two aerial surveys within 2.0 miles (3.2 kilometers) of turbine corridor.	April and June 2010	No eagle nests observed	PGE 2010
Phase III	Two aerial surveys within 2.0 miles (3.2 kilometers) of turbine corridor.	April and June 2011	No eagle nests observed	PGE 2011
Phases I, II, III	Three aerial surveys within 2.0 miles (3.2 kilometers) of turbine corridor.	April, May, June 2012	No eagle nests observed	PGE 2012
Phases I, II, III	Four aerial surveys of known eagle nests within 10.0 miles (16.1 kilometers) of turbine corridor; excludes Washington.	March, April, May and June 2017	One occupied and three unoccupied golden eagle breeding areas Historic bald eagle nest gone	PGE 2017

Information on eagle nests in the state of Washington is available from the Washington Department of Fish and Wildlife (WDFW) who has performed eagle nest surveys between 1990 and 2014. These surveys have detected six golden eagle breeding areas and no bald eagle breeding areas within a 10-mile radius of the Project (WDFW unpublished data; Table 9, Figure 6). The two nearest golden eagle breeding areas are located approximately 4 miles (6.4 kilometers) northwest of the Project (Figure 6). Available information on occupancy of these breeding areas and associated nest status since 2010 is presented in Table 9.

In total, the centroids of 11 known golden eagle breeding areas lay within 10 miles (16.1 kilometers) of the Project boundary (Figure 6). There is one known bald eagle breeding area within 10 miles (16.1 kilometers) of the Project boundary.

Table 9. Post-Construction Data on Eagle Breeding Area Occupancy and Productivity from 2010-2014 and 2017

Breeding Area Name	Eagle Species	Available Nest Survey Data			
		2010-2014 [1]		2017 [2]	
		Territory Status	Productivity	Territory Status	Productivity
OR_BE_01	Bald eagle	Detected in 2010 but occupancy not reported	Unknown	Nest no longer present	Not applicable
OR_GE_0063	Golden eagle	Occupied at least once between 2011-2012	Unknown	Occupied	Successful, 1 fledgling
OR_GE_1080	Golden eagle	Occupied at least once between 2011-2012	Unknown	Unoccupied	Not applicable
OR_GE_1083	Golden eagle	Unoccupied in 2011 and 2012	Not applicable	Unoccupied	Not applicable
OR_GE_1130	Golden eagle	Occupied at least once between 2011-2012, occupied in 2014	Successful in 2014	Unoccupied	Not applicable
WA_GE_JOHN DAY DAM WEST	Golden eagle	Detected in 2011 but occupancy not reported, occupied in 2014	Unknown	Not surveyed	Unknown
WA_GE_JOHN DAY DAM EAST	Golden eagle	Detected in 2014 but occupancy not reported	Unknown	Not surveyed	Unknown
WA_GE_GOODENOE HILLS	Golden eagle	Detected in 2013 but occupancy not reported	Unknown	Not surveyed	Unknown
WA_GE_HARRISON RIDGE	Golden eagle	Occupied in 2014 but nest found on ground in September	Unknown	Not surveyed	Unknown
WA_GE_ROCK GREEK	Golden eagle	Detected in 2011 but occupancy not reported, occupied in 2014	Unknown	Not surveyed	Unknown
WA_GE_MILLER ISLAND	Golden eagle	Occupied in 2013	Unknown	Not surveyed	Unknown

1. Source data: Oregon - Isaacs 2013, Isaacs 2015; Washington – WDFW, unpublished data.
2. Source data: PGE 2017

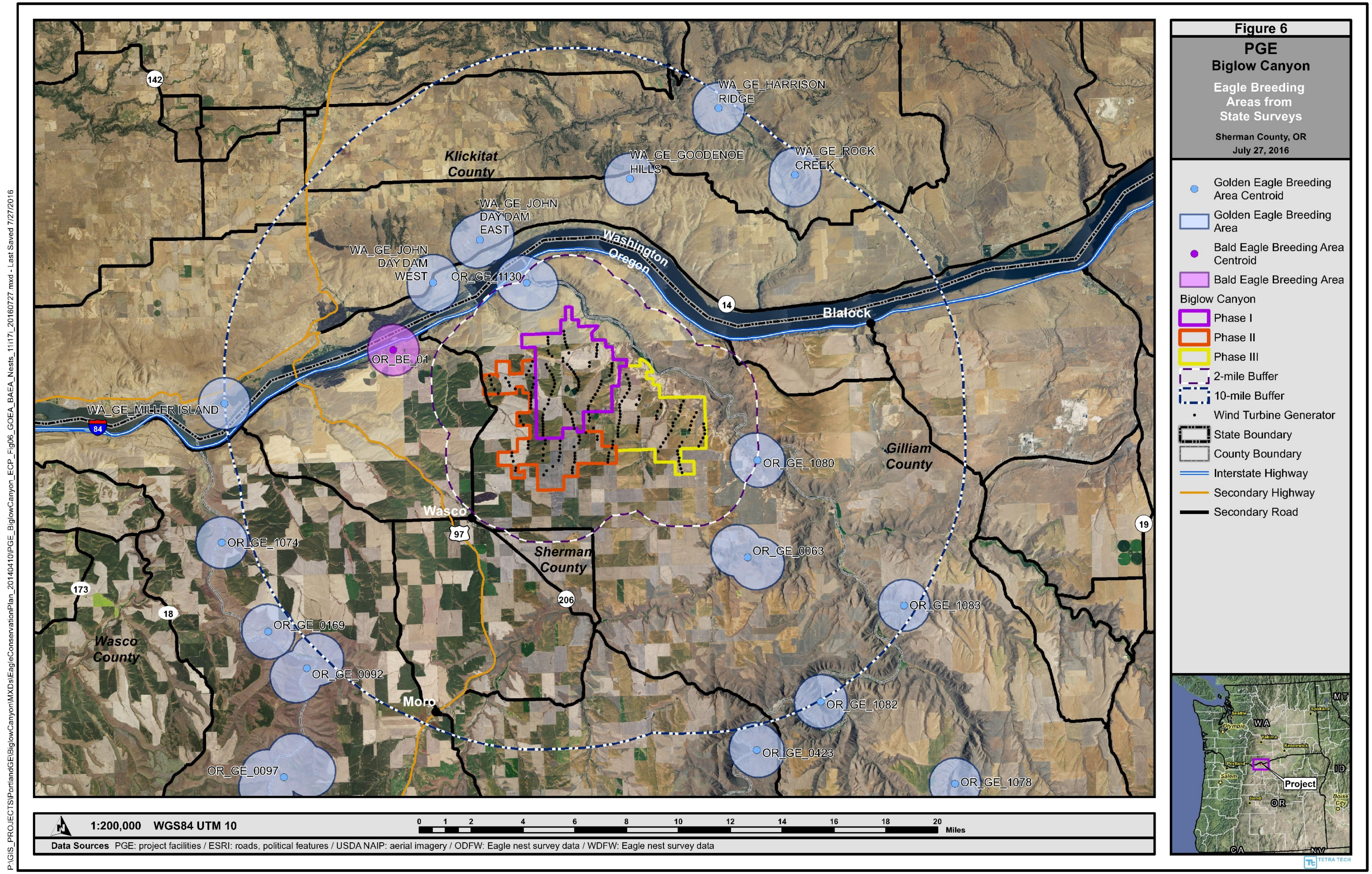
Figure 6
PGE
Biglow Canyon
Eagle Breeding Areas from State Surveys
Sherman County, OR
July 27, 2016
Golden Eagle Breeding Area Centroid
Golden Eagle Breeding Area
Bald Eagle Breeding Area Centroid
Bald Eagle Breeding Area
Biglow Canyon
Phase I
Phase II
Phase III
2-mile Buffer
10-mile Buffer
Wind Turbine Generator
State Boundary
County Boundary
Interstate Highway
Secondary Highway
Secondary Road
WA_GE_HARRISON RIDGE
WA_GE_GOODENOE HILLS
WA_GE_ROCK CREEK
WA_GE_JOHN DAY DAM EAST
WA_GE_JOHN DAY DAM WEST
OR_GE_1130
OR_BE_01
WA_GE_MILLER ISLAND
OR_GE_1080
OR_GE_1074
OR_GE_0063
OR_GE_1083
OR_GE_0169
OR_GE_0092
OR_GE_1082
OR_GE_0423
OR_GE_0097
OR_GE_1078
Klickitat County
Washington
Oregon
Blalock
Gilliam County
Sherman County
Wasco County
Wasco
Moro
142
14
84
97
19
173
18
206
WA
MT
ID
OR
CA
NV
Project
1:200,000 WGS84 UTM 10
0 1 2 4 6 8 10 12 14 16 18 20 Miles
Data Sources PGE: project facilities / ESRI: roads, political features / USDA NAIP: aerial imagery / ODFW: Eagle nest survey data / WDFW: Eagle nest survey data
P:\GIS_PROJECTS\PortlandGE\BiglowCanyon\MXDs\EagleConservationPlan_20140410\PGE_BiglowCanyon_ECP_Fig06_GOEA_BAEA_Nests_11i17_20160727.mxd - Last Saved 7/27/2016

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4.3 Fatality Monitoring and Incidental Monitoring (ECPG Stage 5)

As required by EFSC in the Project Site Certificate, PGE completed 2 years of post-construction fatality monitoring (PCFM) at each phase in addition to avian use and raptor nest monitoring (see section 4.2 for avian use and nest monitoring). PCFM included searches for fatalities as well as carcass persistence and searcher efficiency trials to correct for sources of bias (ODOE 2007). Prior to field surveys, the ODOE and ODFW reviewed and approved the study design and protocol as part of the Project's Wildlife Monitoring and Mitigation Plan (ODOE 2007). Survey protocols were standardized among years for all phases.

4.3.1 Fatality Monitoring Surveys

PGE conducted year-round fatality surveys for 2 years following the construction of each phase (2008-2012; Table 10). Search plots in Phase I were rectangular with sides 361 feet (110 meters) long centered on a turbine (Jeffrey et al. 2009, Enk et al. 2010), and search plots in Phases II and III had sides 413 feet long (125 meters) centered on a turbine (Enk et al. 2012a, Enk et al. 2012b, Enk et al. 2012c, Enz et al. 2013a). Turbines were searched once every 14 days during spring and fall and once every 28 days during summer and winter. A total of 50 turbines were sampled in each phase using criteria established in the Project's Wildlife Monitoring and Mitigation Plan (ODOE 2007). Transects were spaced at 16- to 20-foot (4- to 6-meter) intervals across each search plot, and a surveyor walked transects at a speed of approximately 151 to 197 feet (46 to 60 meters) per minute.

PGE also conducted searcher efficiency and carcass removal trials in conjunction with fatality surveys in each phase of the Project to derive fatality estimates from survey results adjusted for potential biases. Searcher efficiency trials were conducted simultaneously with fatality surveys during each season surveyed. For each trial, bird carcasses in two size classes (small and large) were marked and distributed randomly within search plots by field supervisors immediately prior to surveys by searchers unaware of the trial. Small birds were represented by house sparrow (*Passer domesticus*) and common quail (*Coturnix coturnix*). Large birds were represented by mallard (*Anas platyrhynchos*), ring-necked pheasant (*Phasianus colchicus*), and rock pigeon (*Columba livia*). Searcher efficiency for each trial was determined by the number of marked carcasses found by searchers. Annual mean searcher efficiencies for large birds (representing eagles) are provided in Table 10.

Carcass removal trials were conducted seasonally to assess scavenging rates at turbines within each phase that were not in the fatality survey sample. Small and large bird carcasses (generally the same species used in searcher efficiency trials) were marked and distributed randomly within plots around each turbine that were of similar size to survey plots. Field staff monitored carcasses at 10 pre-determined days over a 40-day period, recording dates when carcasses disappeared. Mean carcass persistence (removal time) was calculated for each season and size class. Annual mean removal time for large birds (representing eagles) are provided in Table 10.

No bald or golden eagle fatalities were recorded during the 4,949 fatality surveys conducted between 2008 and 2012 (Table 10).

Table 10. Summary of Post-Construction Fatality Monitoring Conducted 2008 –2012

Project Phase	Year	Date Range (mm/dd)	No. Fatality Surveys	% Turbines Surveyed	No. Eagle Fatalities	Searcher Efficiency Large Bird	Mean Carcass Removal Time Large Bird (days)	Source
Phase I	2008	01/10 –12/10	850	66	0	0.90	17.8	Jeffrey et al. 2009
	2009	01/26 –12/11	850	66	0	0.94	24.7	Enk et al. 2010
Phase II	2009 –2010	09/10 –09/12	850	77	0	0.78	9.7	Enk et al. 2012a
	2010 –2011	09/13 –09/15	799	77	0	0.81	27.7	Enk et al. 2012b
Phase III	2010 –2011	09/13 –09/09	800	66	0	0.76	35.8	Enk et al. 2012c
	2011 –2012	09/19 –09/18	800	66	0	0.80	25.8	Enz et al. 2013a

4.3.2 Incidental Fatality Monitoring

In order to document fatalities that are not detected during PCFM surveys, PGE established a protocol termed the Wildlife Incident Response and Handling System (WIRHS; see Section 9.2) for reporting incidental avian and bat finds during regular operations and maintenance. The system instructs operations personnel how to report bird and bat fatalities found throughout the Project area. The WIRHS protocol describes how personnel should respond, what types of data to record, and how carcasses should be handled, including special considerations and coordination with ODFW and USFWS for state- and federally-listed species. The WIRHS program was initiated once each phase became operational and is ongoing.

4.3.3 Eagle Fatalities to Date

On September 14, 2012, one juvenile golden eagle fatality was discovered by Project maintenance personnel. The eagle was located between turbines 339 and 340, approximately 150 feet (46 meters; Figure 7) from the nearest turbine. The carcass was estimated to be up to 7 days old based on carcass condition at the time of discovery. PGE followed the Project's WIRHS and contacted USFWS to report the incident. At the direction of USFWS, the eagle was moved to a freezer for storage. The carcass was transported to Portland, Oregon one month later and transferred to USFWS custody.

On February 3, 2015, one adult golden eagle fatality was discovered by Project maintenance personnel approximately 64 feet (20 meters) from turbine 434 (Figure 7). This carcass was estimated to be between 2 and 14 days old based on carcass condition at the time of discovery. PGE followed the Project's WIRHS and contacted the USFWS to report the incident. At the direction of USFWS, the eagle was moved to an onsite freezer for storage. The carcass was picked up in Hood River by USFWS on February 26, 2015.

On December 15, 2017 one subadult golden eagle fatality was discovered by Project maintenance personnel. The eagle was located near an access road with remains located up to 243 feet (74 meters) from the nearest turbine (turbine 357; Figure 7). The carcass was estimated to be between 7 and 20 days old based on carcass condition at the time of discovery. PGE followed the Project's WIRHS and contacted USFWS to report the incident. At the direction of USFWS, the eagle was moved to a freezer for storage. The eagle was shipped directly to the Eagle Repository in Colorado per USFWS direction on January 30, 2018.

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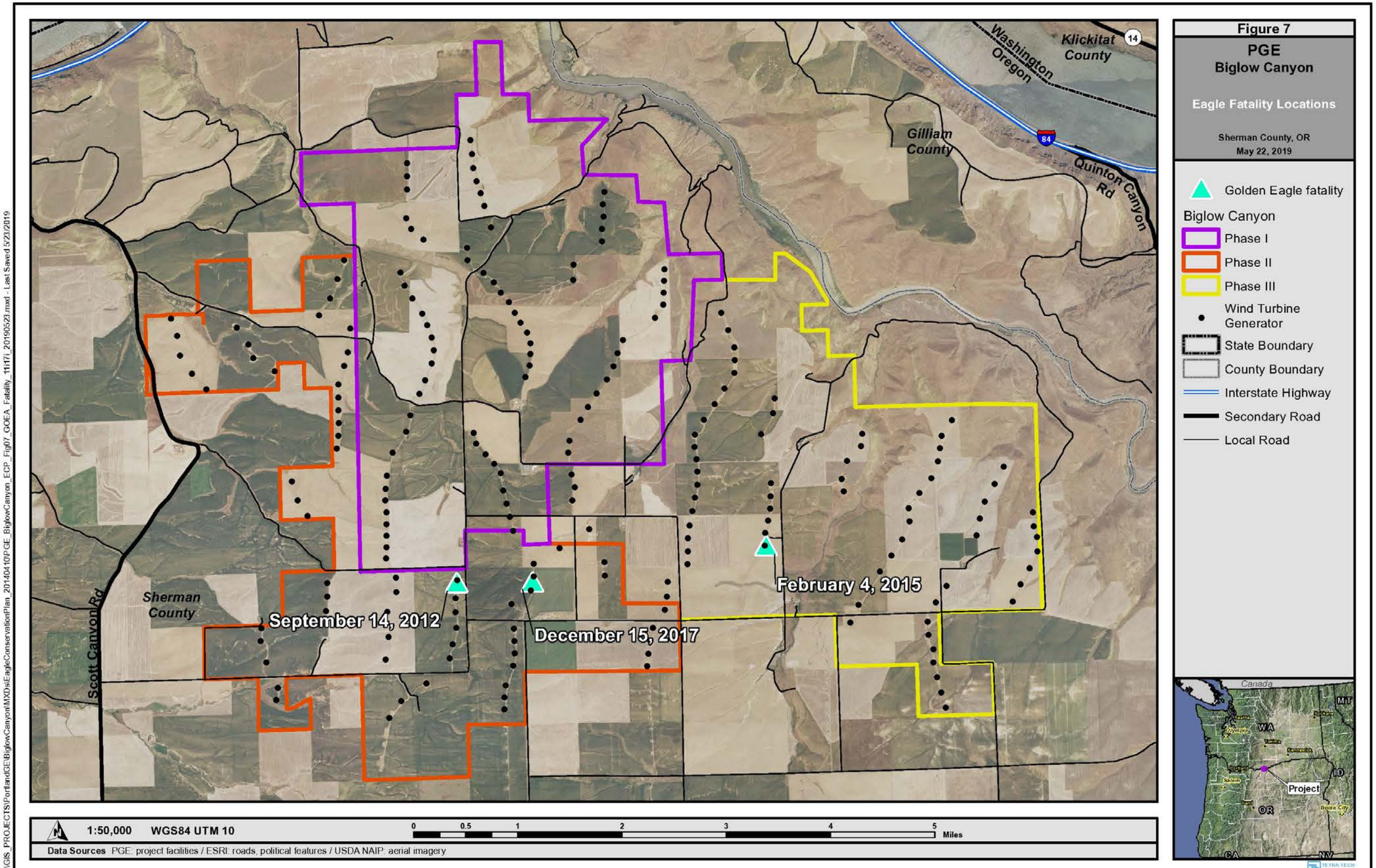
Figure 7
PGE
Biglow Canyon
Eagle Fatality Locations
Sherman County, OR
May 22, 2019
Golden Eagle fatality
Biglow Canyon
Phase I
Phase II
Phase III
Wind Turbine Generator
State Boundary
County Boundary
Interstate Highway
Secondary Road
Local Road
September 14, 2012
December 15, 2017
February 4, 2015
Sherman County
Gilliam County
Klickitat County
Washington
Oregon
Quinton Canyon Rd
Scott Canyon Rd
14
84
1:50,000 WGS84 UTM 10
0 0.5 1 2 3 4 5 Miles
Data Sources PGE: project facilities / ESRI: roads, political features / USDA NAIP: aerial imagery
Canada
WA
OR
ID
MT
CA
NV
Project

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5.0 RISK ASSESSMENT (ECPG STAGE 3)

This section focuses on the existing and future risk to bald and golden eagles of collision, electrocution, and disturbance posed by the operation of the Project. As this document was developed after construction was completed, impacts from the construction of the Project are not analyzed.

5.1 Collision

The Project is operational; therefore, data are available on the numbers of eagle fatalities caused by collision with Project facilities. As such, risk of bald and golden eagle collision with Project turbines is quantified in two ways: first by using the USFWS Bayesian collision risk model (Section 5.1.1), and second by using the observed (unadjusted) annual rate of fatalities (Section 5.1.2). The observed rate of fatalities represents the minimum number of fatalities rather than a statistically robust fatality estimate that accounts for imperfect detection rates; nevertheless, it provides context for the predicted rate of fatalities at the Project (Section 5.1.3). Both of these methods of risk assessment are based on simplifying assumptions, including that collision risk is uniform throughout the Project area and that all turbines present the same level of risk to eagles.

PGE implemented recommendations by the Avian Power Line Interaction Committee (APLIC) such as minimum conductor spacing and anti-perch guards to reduce the risk of raptor collision with Project power lines (APLIC 2012); therefore, risk of collision with Project collector and transmission lines is expected to be low.

5.1.1 USFWS Bayesian Collision Risk Model

The USFWS-recommended Bayesian collision risk model is used to estimate the risk of eagle fatalities at a given wind facility (USFWS 2013a). The risk of collision is modeled as the mean number of fatalities per year resulting from a Bayesian analysis using minutes of eagle observations during pre-construction avian point-count surveys as the input data. This analysis assumes that collision risk is proportional to use of the Project by eagles (USFWS 2013a). Bayesian models use existing information to estimate the statistical distribution (called prior distribution in Bayesian analysis) of variables of interest, and then use new data to update the distribution (referred to as a posterior distribution). Variables incorporated into the USFWS Bayesian collision risk model (version CollisionModelv4) are summarized in Table 11.

Table 11. Variables Used in the USFWS Bayesian Collision Risk Model

Symbol	Name	Description (Units)
t	Eagle minutes	Minutes of eagle flight detected at < 656 feet (< 200 meters) above ground level within point-count plots (units = minutes).
N	Number of point-counts	The number of point-count periods surveyed.

Symbol	Name	Description (Units)
λ	Exposure rate	The number of exposure minutes per hour per km^2 in the sampled area (units = eagle minutes/hours/km^2).
δ	Hazardous area	Total area within one rotor radius of a turbine (km^2).
T	Total daylight hours	Total hours of daylight per year estimated using USFWS R code “DayLen” and latitude of 45.644148, longitude of -102.623715.
ε	Expansion factor	Scaling factor that scales mean exposure minutes to the hazardous area (δ) and total daylight hours (τ).
C	Collision probability	The probability, given one minute of flight below 656 feet (200 meters), of a collision with a turbine.
F	Eagle fatalities	Estimated eagle fatalities per year.

In the USFWS Bayesian collision risk model, the total annual eagle fatalities (F) as the result of collisions with wind turbines are predicted as the product of the rate of eagle exposure (λ) to turbine hazards, the probability that eagle exposure will result in a collision with a turbine (C), and an expansion factor (ε) that scales the resulting fatality rate to all daylight hours over the entire project (Equation 1).

$$F = \varepsilon \lambda C \qquad \text{Equation 1}$$

Within the Bayesian estimation framework, prior distributions for exposure rate (λ) and collision probability (C) are derived by USFWS from previous studies (see below). The expansion factor (ε) is a constant based on the proportion of daylight hours and hazardous area around turbines that is sampled by the point-counts. The expanded product (to the total hazardous area around turbines and total daylight hours) of the posterior distributions of exposure rate and collision probability yields the predicted mean number of annual fatalities.

Exposure Rate

The exposure rate λ is the expected number of exposure events (eagle-minutes) per daylight hour per square kilometer. In the ECPG (USFWS 2013a), the USFWS defined the prior distribution for exposure rate for golden eagles (also used for bald eagles because a bald-eagle specific prior is not yet available) based on information from a range of projects under USFWS review and others described with sufficient detail in Whitfield (2009). When modeled in three dimensions (i.e., volumetric), the prior distribution for exposure rate was Gamma ($\alpha = 0.97$, $\beta = 0.55$; M. Stuber, USFWS, pers. comm. September 2015). The posterior distribution for exposure rate is produced using the prior distribution and the minutes of eagle exposure measured during point-counts (t). The new posterior λ parameter is the sum of the mean of the prior distribution and the eagle minutes observed (t), with the standard deviation of the posterior distribution determined by the number of point-counts performed (N).

Data inputs for the calculation of exposure rate consisted of minutes of eagle exposure over the Project area. Pre-construction point-count surveys at the Project were conducted in three ways: (1)

30-minute point-counts at nine vantage points throughout the three phases (white points in Figure 3), (2) 20-minute point-counts at 15 points throughout the three phases (white and blue points in Figure 3), and (3) 30-minute point-counts at four vantage points that overlooked the John Day River (called-out points in Figure 3; referred to as "John Day Canyon" points in Section 4.2). To facilitate analysis, the 20-minute point-counts were converted to the equivalent number of 30-minute counts prior to entry into the model. The point-count surveys did not record eagle minutes; the number of eagle sightings for these surveys was therefore converted to estimated eagle minutes of exposure by assuming that each sighting equaled one minute of exposure. This follows the recommendations in the ECPG for analyses of point-count data lacking eagle exposure minutes (USFWS 2013a), but this assumption may either over or underestimate actual exposure minutes.

PGE combined the pre-construction eagle exposure data for all three Project phases in order to estimate eagle fatalities for the entire Project. A set of criteria for data inclusion were developed based on the ECPG to best represent eagle use of the Project area and meet the assumptions of the USFWS Bayesian collision risk model. The eagle observation data had to meet the following criteria in order to be incorporated into the model:

1. Eagle observations occurred during the count duration (i.e., not an incidental observation);
2. Eagle observations occurred within the 2,625-foot (800-meter) survey plot during the count duration;
3. Eagle observations were of individuals in flight below 656 feet (200 meters) in altitude above ground;
4. Data were collected prior to construction of the given phase.

Collision Probability

Collision probability (C) is the probability of an eagle colliding with a turbine given an eagle's exposure to turbine collisions (one minute of flight in the hazardous area). For the purposes of the model, all collisions are assumed fatal, and all flight paths are assumed to be independent. For operational projects, the USFWS recommends using PCFM data to update the prior distribution for collision probability (i.e., collision prior) with site-specific information on collision risk. Based on USFWS recommendations, PGE used the Fatality CMR (FCMR) program developed by U.S. Geological Survey (USGS) for this purpose. The FCMR program estimates rates of wildlife fatalities based on the results of PCFM surveys and accounts for carcass persistence time and searcher efficiency (Péron and Hines 2014). A summary of the FCMR analysis for the Project is provided below.

FCMR Program Analysis

The FCMR program requires information be entered on the specific data collection procedures used during fatality monitoring (e.g., the timing of the survey period, the implementation of carcass persistence checks). The PCFM protocols for the Project (Section 4.3) were developed and implemented prior to the development of this program, and therefore do not match some of the

FCMR program assumptions. Specifically, the FCMR program assumes that the search interval is the same for all turbines being searched. This assumption was not met in the following two ways: (1) the time between searches at individual turbines during a given survey period varied; and (2) scheduled searches at individual turbines were occasionally missed (e.g., weather conditions, turbine maintenance) resulting in longer survey periods at individual turbines. As a result of these limitations, the average time between individual turbine searches for a given survey was used in the input data files developed for the FCMR program. Because the turbines selected for standardized searching varied between the two years of PCFM surveys at each phase, separate data input files were created for each year of monitoring at each phase of the Project (i.e., analysis periods). The relevant information specific to each analysis period are provided in Table 12.

The proportion of the carcass distribution that was searched at the Project was based on the Hull and Muir (2010) ballistics paper, which USFWS recommended for calculating the theoretical proportion of the carcass distribution sampled (M. Stuber, USFWS, pers. comm. February 2015). Hull and Muir estimated carcass distributions for three turbine sizes:

1. Small—Hub height =65 meter and rotor swept diameter = 66 meters;
2. Medium—Hub height = 80 meters and rotor swept diameter = 90 meters; and
3. Large—Hub height = 94 meters and rotor swept diameter = 112 meters.

The 80 meter hub height and 62 – 93 meter rotor swept diameter of the Project turbines corresponds most closely with Hull and Muir's medium turbines. Therefore, PGE used the medium turbine data and large bird data (representing eagles) from Table 5 in Hull and Muir (2010) to estimate the carcass distribution searched at the Project. Search plot sizes varied with the phases and associated Project turbine sizes. Where search plot sizes fell in between dimensions identified in Table 5 from Hull and Muir (2010) or phases with different search plot sizes were analyzed as a group, the value for the proportion of the carcass distribution searched was linearly interpolated. Using this approach the estimate of the proportion of the carcass distribution searched for Phase I was 0.5 and for Phases II and III was 0.57, and the estimated proportions of the carcass distribution searched for the various analysis periods ranged from 0.50 to 0.57 (Table 12).

The FCMR program output summarizes carcass persistence and searcher efficiency results and provides an "ad hoc" estimate of the eagle fatalities at the Project for the monitoring period and their respective standard errors (SE). The ad hoc estimate represents the expected number of fatalities at a given facility (Jim Hines, USGS, pers. comm. August 8, 2016). The ad hoc estimates were scaled up from proportion of the year that was monitored to annual rates, and resulting values ranged from 0.285 to 1.706 eagles per year (Table 12). These values were used to update the collision prior (see below). The same FCMR values were used to update the collision priors of both eagle species because carcasses of neither species were detected during the PCFM analysis periods.

Table 12. Input and Output Values from FCMR Analysis of Post-construction Monitoring Results per Project Analysis Period

Phases and Monitoring Years Grouped for Analysis [1]		Input Values						Output Values				
		Fatality Monitoring Period			Proportion of Carcass Distribution Searched (Hull and Muir 2010)	Number of Operational Turbines Used in Analysis	Number of Turbines Searched Used in Analysis	Ad Hoc in Eagles/Analysis Period		Adjusted Annual Ad Hoc Estimate Eagles/ Year	Bias Correction Trials Summary Results	
Phase(s) Operational	Phase(s) Monitored (Duration)	Start (First Search)	End (Last Search)	Number of Effective Days[2]				Estimate	SE		Mean Persistence (days)	Percent of Carcasses Found
Analysis Period 1 (1 year of operations at Phase I January 2008 –December 2008)												
I	I (1 year)	01/10/08	12/12/08	306	0.50[3]	76	50	0.239	0.065	0.285	13.8	88.9%
Analysis Period 2 (partial year of operations at Phase I January 2009 –September 2009)												
I	I (238 days)	01/26/09	09/05/09	210	0.50[3]	76	50	0.175	0.058	0.304	17.8	90.3%
Analysis Period 3 (1 year of operations at Phases I and II September 2009 – September 2010)												
I, II	I,II (0.25 years)	09/05/09	12/11/09	77	0.54[4]	141	100	0.271	0.096	1.706	7.7	89.1%
I, II	II (0.75 years)	12/11/09	09/12/10	276	0.54[4]	141	50	1.379	0.241		5.9	75.9%
Analysis Period 4 (1 year of operations at Phases I – III September 2010 – September 2011)												
I, II, III	II, III (1 year)	09/13/10	09/15/11	349	0.57[5]	217	100	0.663	0.090	0.693	15.7	78.2%
Analysis Period 5 (1 year of operations at Phases I – III September 2011 – September 2012)												
I, II, III	III (1 year)	09/19/11	09/18/12	352	0.57[5]	217	50	1.336	0.271	1.385	13.5	79.6%

1. Values represent each phase and its respective duration of operations used in the data grouped for analysis.
2. Effective days are the average number of days between the first search and last search at all search turbines during an analysis period.
3. Value based on data from Table 5 in Hull and Muir (2010) for medium turbines and large birds with search plots for Phase I that extend at least 55 meters from the base of the turbine in each direction. Phase I search plots were 110 x 110 meters square.
4. Value represents a linear interpolation of the proportion of the carcass distributions searched for Phase I turbines (0.50) and Phase II turbines (0.57) resulting from searches at both Phase I and II turbines for Analysis Period 3.
5. Value represents a linear interpolation of data from Table 5 in Hull and Muir (2010) for medium turbines and large birds with search plots for Phases II and III that extend at least 62.5 meters from the base of the turbine in each direction. Phase II and III search plots were 125 x 125 meters square.

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Updating the Collision Prior

The ad hoc fatality estimates derived from the FCMR program were used to update the collision prior of the Bayesian collision risk model so that it was informative (i.e., conditioned by information specific to the Project). Updating of the collision prior in the Bayesian collision risk model was accomplished by substituting the ad hoc fatality estimate (i.e., collision rate) for the default median collision rate used by USFWS to calculate the baseline collision prior. On the recommendation of USFWS, the variance of the collision rate derived from the FCMR analysis was not used to update the collision prior; therefore, the updated collision prior had the same variance as the default used in baseline modeling.

Upon recommendation by USFWS, the collision prior update occurred for both bald and golden eagles in an iterative manner to reflect the variable collision probability at the Project over time, given the phased construction of the Project. As such, the Bayesian collision risk model was run using just those turbines that were first operational at the Project and incorporating the FCMR value calculated from the PCFM performed at that phase over the same period of time (i.e., Analysis Period 1). The posterior distribution for collision probability generated by this initial model run was then used as the collision prior for the model run for the subsequent year of operation (Analysis Period 2), and so on. After sequentially updating the collision prior with each of five analysis periods, the updated collision prior for the Project was estimated as Beta (α = 5.25, β = 462.34) for bald eagles and Beta (α = 5.34, β = 622.79) for golden eagles.

Expansion Factor

The expansion factor (ε) scales the per-unit fatality rate (λC, fatalities per hour per km^2) to the total daylight hours, τ, in 1 year (or other time period if calculating and combining fatalities for seasons or stratified areas) and total hazardous area (km^3) within the project footprint (Equation 2):

$$\varepsilon = \tau \sum_{i=1}^{n_t} \delta_i \qquad \text{Equation 2}$$

where n_t is the number of turbines, and δ is the hazardous area surrounding a turbine. For the volumetric model used here, δ is assumed to be a cylinder centered on the turbine tower with a radius equal to the rotor radius of the turbine and a height equal to 200 meters. The model used is constrained to eagle use that occurred within the cylindrical hazardous area, and assumes that eagle flights occur only during daylight hours. The hazardous area for the Project was calculated for each of the two turbine types because their rotor radii differ (Table 2). The two hazardous areas were then converted to volumes and multiplied by the number of turbines of each type to calculate the total hazardous area. The units for ε are hour·km^3 per year (or season).

Calculation of Predicted Fatality Rates

To determine the distribution for the predicted annual fatalities, the exposure rate and collision probability distributions need to be multiplied by each other and expanded (Equation 1). The resulting distribution cannot be calculated in closed form so the model generates it through 100,000 simulations. Following the ECPG (USFWS 2013a), PGE used the Bayesian collision risk model to predict an annual fatality rate as the mean and upper 80 percent credible limit (CL) of the posterior distribution of F. Input variables are summarized below in Table 13. Except as noted above, all other inputs to the Bayesian collision risk model were unchanged from the baseline calculation as described in the ECPG.

Outputs of the Bayesian collision risk model for annual predicted fatalities over 1-year, 5-year, and 30-year periods are summarized in Table 14. Because the USFWS uses the upper 80 percent CL in their evaluation of take, these values are also presented.

Table 13. Data Inputs for Calculation of Estimated Mean Exposure Rate (λ) and Expansion Factor (ε) for Eagles at the Project by Species

Season	No. Counts	No. of Bald Eagle Observations	No. of Golden Eagle Observations	No. of Turbines and Respective Blade Radius in Feet (meters)		Bald Eagle Minutes	Golden Eagle Minutes
				Vestas V82	Siemens		
Winter	162	2	5	76 turbines 134.5 (41.0)	141 turbines 152.6 (46.5)	2	5
Spring	103	0	0			0	0
Summer	82	0	0			0	0
Fall	186	0	3			0	3
Annual Total	**533**	**2**	**8**	**217**		**2**	**8**

Table 14. Predicted Take for Eagles at the Project by Species

Species	Type of Total	Mean Predicted Fatalities per Period	Upper 80 Percent CL of Mean Fatalities Predicted per Period
Bald Eagle	Annual Project Total	0.44	0.65
	5-Year Project Total	2.22	3.25
	30-Year Project Total	13.31	19.47
Golden Eagle	Annual Project Total	0.93	1.27
	5-Year Project Total	4.66	6.37
	30-Year Project Total	27.93	38.23

5.1.2 Observed Annual Fatality Rates

An observed annual fatality rate for the Project was calculated for both eagle species using the number of eagle fatalities detected during the years of Project operations (see Section 4.3). This value represents a minimum fatality estimate because it does not account for detection bias; nonetheless, it provides an important bookend on the possible rate of fatalities during Project operations to date. Because the Project became operational in phases, the number of years that the entire Project was operational (i.e., all three phases) was used to provide an observed annual fatality rate. Each phase of the Project was subject to 2 years of standardized PCFM at 65 percent or more of turbines per phase, and incidental monitoring has occurred throughout the entire Project since operations began (see section 9.0).

All three phases together have been operational for 8.75 years (Table 2), during which time no bald eagle fatalities have been detected at the Project; therefore, the observed annual bald eagle fatality rate is 0.0 eagles/year at the Project.

Three golden eagle fatalities have been detected (during incidental monitoring, Section 4.3.3) during the 8.75-year period. Therefore, the observed annual golden eagle fatality rate is 0.34 eagles/year for the Project.

5.1.3 Comparison of Observed Fatalities to Predicted Fatalities

The observed (unadjusted) annual fatality rate is lower than the respective annual fatality rates predicted by the informed Bayesian collision risk model for both eagle species (Table 15). These values provide a range of fatality estimates, with the observed annual fatality rate representing the minimum Project fatality rate and the upper 80 percent CL of the mean Bayesian modeled fatality rate representing an intentionally conservative or reasonable maximum value. The true annual fatality rates for bald and golden eagles at the Project likely lie somewhere within these ranges.

Table 15. Comparison of Fatality Rates for Bald and Golden Eagles at the Project

Eagle Species	Observed Annual Fatality Rate[1]	Bayesian Mean Annual Fatality Prediction	Bayesian Upper 80 Percent CL of Mean Annual Fatality Prediction
Bald eagle	0.00	0.44	0.65
Golden eagle	0.34	0.93	1.27

1. Unadjusted value, does not account for imperfect detection of fatalities.

5.2 Electrocution

Utility lines, predominately distribution lines, can potentially result in electrocution of bald and golden eagles because their wing span is large enough to allow for circuit completion (i.e., flesh-to-flesh contact between energized parts or an energized and grounded part). PGE designed and constructed the Project's overhead collector lines and transmission lines in accordance with the recommendations provided by APLIC (2006) to minimize avian electrocutions; therefore, the risk to eagles of electrocution by the Project is expected to be low.

5.3 Disturbance/Displacement

Project operations may disturb bald and golden eagles if the presence of the operational turbines causes eagles to avoid using the Project area. The USFWS recommends calculating the mean inter-nest distance (MIND) for a given project when assessing the potential for disturbance impacts. USFWS assumes that eagle pairs nesting within ½ of the MIND have the highest likelihood of suffering disturbance impacts (USFWS 2013a). PGE calculated the MIND for the Project by averaging the nearest-neighbor distances between the nest locations of occupied golden eagle breeding areas that occur within a 10-mile buffer of the Project. This analysis was not performed for bald eagle nests because there was only one historic bald eagle nest within this distance and it is no longer present (PGE 2017). For golden eagles, this analysis was done in two different ways due to the incompleteness of the available survey data: 1) nests from all occupied breeding areas since 2011, regardless of year of occupancy, were included, and 2) only those breeding areas known to be occupied in 2014 (year with the most complete dataset, Section 4.2) were included. The MIND values resulting from these two analyses are 1.38 miles (2.22 kilometers) and 1.88 miles (3.03 kilometers), respectively. There are no known eagle breeding areas that fall within ½ of either MIND value from the Project (0.69 miles [1.11 kilometers) and 0.94 miles [1.52 kilometers], respectively). Therefore, the risk of disturbance is likely to be low. Additionally, the nearest golden eagle breeding areas to the Project (OR_GE_1130 and OR_GE_1080; Figure 6) have been occupied subsequent to Project construction and operation (see Section 4.2.4), suggesting that Project operations have not disturbed eagles near the Project. PGE will continue to perform long-term raptor nest monitoring every 5 years per the Site Certificate conditions for the Project. The results of these surveys will help improve PGE's understanding of the sensitivity of neighboring eagle breeding areas to disturbance related to the Project (see Section 9.3).

6.0 PROJECT PLANNING AND DESIGN AVOIDANCE AND MINIMIZATION MEASURES (ECPG STAGE 4)

This section identifies impact avoidance and minimization measures that were incorporated into planning and design for the Project through associated permitting documents. Many of these measures were commitments specified in the Biglow Canyon EFSC Site Certificate (Orion 2005). The siting report by WEST (WEST 2005b) provides additional measures that were implemented by Orion and later PGE; measures relevant to eagles are summarized below. Avoidance and minimization measures summarized here include macro- and micro-siting as well as specific facility design measures in order to avoid and minimize impact to eagles and other wildlife. Parallel measures implemented during construction and operations are described in Sections 7 and 8, respectively.

6.1 Macro- and Micro-siting

Measures provided here are those relevant to the landscape-scale siting of the facility (i.e., macro-siting), as well as specific instances of relocating turbines or turbine strings (i.e., micro-siting), in order to minimize impacts to eagles and associated habitats.

1. The Project site was selected to comply with the USFWS Interim Guidance on Avoiding and Minimizing Wildlife Impacts from Wind Turbines (USFWS 2003). Specifically, project layout was designed to minimize the destruction or alteration of grasslands and other native habitats which support prey species used by golden eagles and other raptors.
2. Setback allowances of approximately 3 miles (4.8 kilometers) from the centerline of the Columbia River (Measure A in Figure 8) and 1 mile (1.6 kilometers) from the centerline of the John Day River (Measure B in Figure 8) were used to constrain the Project area. These setbacks were implemented to greatly minimize or eliminate the potential for impacts to wintering bald eagles and other wildlife.
3. Turbine string corridors (500 feet [152 meter] wide corridors developed to accommodate turbine locations; numbered 1 – 11 in Figure 8) nearest the John Day River were shortened and/or shifted to maintain a minimum 250.0 foot (76.2 meters) buffer between native habitats (e.g., grasslands, shrub-steppe) and ends of turbine corridors to eliminate direct impacts to native habitat[1] (Measures C and D in Figure 8).
4. Turbine string corridors nearest the John Day River were shortened 200.0 to 500.0 feet (61.0 – 152.4 meters) to avoid steep slopes which are associated with higher raptor fatality levels (Measure C in Figure 8).
5. Turbine string corridors were sited generally parallel to the most likely bird movement corridors (i.e., canyons and ridgelines) in order to simultaneously minimize bird collision risk while also taking advantage of prevailing wind conditions.
6. Turbine strings were spaced at least 0.5 miles (0.8 kilometers) apart and turbine towers were spaced approximately 2 rotor diameters apart to avoid creating a "wind wall" or continuous space of collision risk.

[1] Habitat depicted in Figure 8 was digitized from aerial photographs and used during micrositing. Some areas depicted as native habitat had been converted to agriculture in the recent past, but were undistinguishable from an aerial photo. The turbines in string 8 and string 11 shown in native habitat were in actuality located in disturbed habitat.

7. A portion of turbine string corridor 8 was eliminated in order to increase the distance from native habitat but also to avoid crossing a potential bird movement corridor (Measure E in Figure 8).
8. Turbine string corridor 9 was shortened to avoid native habitat and an area with documented raptor flight paths (Measure F in Figure 8).
9. Turbines were sited generally on top of ridges and not on the west (i.e., upwind) side of ridges to minimize collision risk with raptors. Raptors are known to concentrate flight paths on the upwind side of ridges.

6.2 Facility Design Measures

This section describes specific design measures implemented to reduce impacts to eagles and other raptors and wildlife.

1. Located ends of all turbine strings on topography with ≤ 12 percent slope to minimize raptor collision risk and construction costs.
2. Used newer generation wind turbines which are believed to reduce wildlife impacts, such as low-rpm turbines and smooth steel tubular towers.
3. Limited above ground segments of the power collection system to 7.0 miles (11.3 kilometers); buried all other collector electrical systems between turbine strings underground outside of native habitats.
4. Installed unguyed permanent met towers to minimize risk of avian collision with guy wires.
5. Designed overhead collector lines and transmission lines in accordance with the recommendations of APLIC for raptor protection on power lines, including the use of minimum conductor spacing and anti-perch guards.

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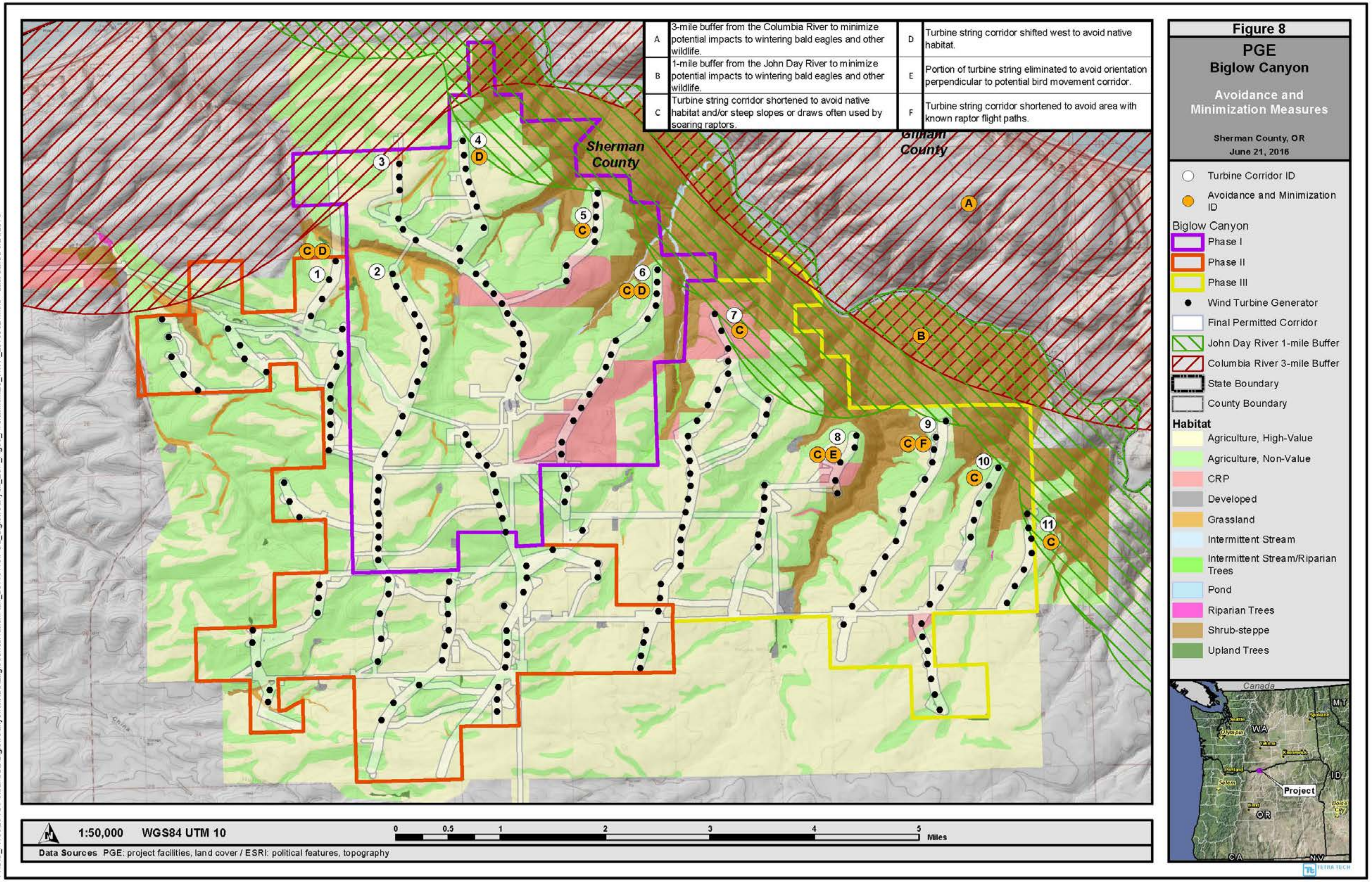

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7.0 CONSTRUCTION PHASE AVOIDANCE AND MINIMIZATION MEASURES (ECPG STAGE 4)

This section identifies impact avoidance and minimization measures that were implemented by PGE during the construction of all three phases of the Project. The majority of these measures were permitting conditions specified in the Biglow Canyon Site Certificate (ODOE 2006). Parallel measures implemented during planning and design and operations are described in Sections 6 and 8, respectively.

1. During construction of the facility, PGE had an on-site assistant construction manager qualified in environmental compliance to ensure compliance with all construction-related Site Certificate conditions.
2. PGE did not construct any facility components within areas of high quality wildlife habitat and avoided temporary disturbance of high quality wildlife habitat.
3. A qualified biologist flagged sensitive resource areas on the Project site before construction occurred and visited the site periodically to inspect construction activities for compliance.
4. PGE conducted pre-construction surveys for threatened and endangered plant and wildlife species at the Project site including surveys for active eagle nests within a half-mile (1.6 kilometers) of any area that would be disturbed during construction.
5. PGE minimized permanent construction disturbance by flagging the limits of the construction zone to avoid sensitive areas. Active golden eagle nests were to be avoided by a 0.25-mile (0.40-kilometer) buffer during nesting periods (February 1 – August 31); this measure was unnecessary because no known nests were within the Project area or 1-mile buffer.
6. To determine whether nesting bald eagles had been documented to occur within 2.0 miles (3.2 kilometers) of the facility, PGE reviewed the ORNHIC and USFWS databases annually and consulted with an expert designated by ODFW before beginning construction of each of the Project phases. PGE reported the results of the database review and consultation to the ODOE and ODFW.
7. PGE implemented a waste management plan that included good housekeeping measures such as minimization and proper disposal of solid waste to prevent attraction of raptors or their prey.
8. PGE implemented a WIRHS for responding to and handling bird and bat casualties found by construction personnel during construction of the Project.
9. PGE committed to immediate reporting to USFWS and ODFW, respectively, in the event that eagle species or any federal or state endangered or threatened species were killed or injured during construction of the Project; however, no injuries or fatalities to threatened or endangered species occurred.

8.0 OPERATIONAL PHASE AVOIDANCE AND MINIMIZATION MEASURES (ECPG STAGE 4)

Evidence on the effectiveness of operational avoidance and minimization measures is lacking and, as such, operational avoidance and minimization measures will be implemented on an experimental basis and as a part of PGE's adaptive management strategy (Section 11). Specific measures incorporated into this strategy are anticipated to be developed in coordination with USFWS and included in the eagle take permit conditions.

9.0 ONGOING MONITORING AND REPORTING (ECPG STAGE 5)

9.1 Systematic Fatality Monitoring

PGE will adaptively manage the implementation of systematic fatality monitoring over the life of the Project. In the event that a 30-year eagle take permit is issued for the Project, PGE will work with the USFWS to develop and perform systematic monitoring in compliance with Federal regulations issued in December 2016 at a level sufficient to demonstrate compliance with permitted take.

9.2 Incidental Fatality Monitoring

PGE will continue to perform incidental fatality monitoring (i.e., WIRHS) for the life of the Project. Both PGE turbine technicians and turbine technicians contracted from Vestas and Siemens regularly visit turbines as part of their routine operation and maintenance (O&M) of the Project. On average, approximately 7-8 turbines are visually inspected by technicians per day. For the Project as a whole, each turbine is visited on average once every 30 days; however, due to various maintenance factors, a given turbine may be visited more or less frequently. All technicians are trained 1-2 times each year on bird and bat awareness and reporting procedures.

If an injured or dead eagle is found during incidental monitoring, it will be recorded and reported to the PGE biologist per the Project WIRHS and following the conditions from PGE's Special Purpose - Utility permit (No. MB117979-1) from the USFWS Region 1 Migratory Bird Permit Office. The reporting and data collection details specific to eagles are described below.

9.2.1 Reporting

If an injured eagle is detected, this will be immediately reported to a PGE Wildlife Biologist via the PGE Bird Reporting Line. A PGE Wildlife Biologist will then contact USFWS OLE in Wilsonville (Phone: 503-682-6131) immediately, if possible, but no later than 48 hours after discovery or the beginning of the next business day, to coordinate for capture and transfer to a nearby wildlife rehabilitation center (either the Blue Mountain Wildlife Rescue Center in Pendleton, Oregon or a veterinarian, depending upon direction provide by the PGE Wildlife Biologist or wildlife rehabilitation expert). If the PGE Wildlife Biologist is unable to reach someone at USFWS OLE, they will contact ODFW State Police (Phone: 800-452-7888) as previously instructed by OLE.

If a dead eagle or unidentified large bird is detected, this will be reported to a PGE Wildlife Biologist. In the case of a confirmed or suspected eagle fatality, the PGE Wildlife Biologist will then report the incident to USFWS OLE in Wilsonville (Phone: 503-682-6131) immediately, if possible, but no later than 48 hours after discovery, or the beginning of the next business day. The carcass will be collected and placed in the freezer on-site per the pre-arranged agreement with USFWS OLE. The PGE Wildlife Biologist will work with USFWS OLE to arrange carcass transference.

9.2.2 Data Collection

If an injured or dead eagle is detected, the eagle will be photographed including a close-up of the bird and a wider view of the location found, including any nearby facilities/equipment/landmarks. The following information will be recorded on the Wildlife Collection Data Sheet:

- Date detected
- Name of observer and company employed by
- Eagle species if known
- Age if known
- Condition of the eagle and type of injury if apparent or known
- Specific location in relation to wind farm facilities (turbine number, road name, distance to project features, etc.)
- Global positioning system (GPS) location if possible

9.3 Nest Monitoring

Long-term raptor nest surveys out to at least 2 miles from the Project boundary are scheduled every 5 years following completion of the last post-construction raptor nest survey (2012) per the Site Certificate conditions for the Project. The next project-wide raptor nest survey will be conducted in 2022. Raptor nest surveys will continue at this frequency until 2036 when the Site Certificate conditions expire (i.e., 30 years from date of issuance of final order on June 30, 2006).

9.4 Reporting

PGE is committed to immediate reporting to USFWS and ODFW, respectively, in the event that any eagle species or federal or state endangered or threatened species are killed or injured at the Project. If a 30-year take permit is issued, PGE will comply with Federal regulations (USFWS 2016a) and submit annual reports each year the permit is valid. PGE will work with USFWS to develop a template for the report and the required information to be included in the report. Additionally, Annual Monitoring Reports are submitted in April of each year to the ODOE documenting all significant monitoring and mitigation activities performed. Annual Compliance Reports are also submitted to the ODOE documenting any instances of noncompliance with Site Certificate conditions during the previous year. Lastly, in accordance with the Special Purpose Utility Take permit from USFWS, all bird carcasses that are collected are reported to USFWS on an annual basis with copies of the annual report also submitted to ODOE.

10.0 MITIGATION (ECPG STAGE 4)

Eagle fatalities caused by wind facilities in operation prior to September 11, 2009 are accounted for in the baseline conditions which were analyzed in the Final Environmental Assessment (EA; USFWS 2009b) associated with the Final Eagle Rule (USFWS 2009a) and in the Programmatic Environmental Impact Statement (PEIS) for the Eagle Rule Revision (USFWS 2016b). As such, eagle fatalities caused by these facilities do not count toward the Eagle Management Unit (EMU) take limits established under the Eagle Rule Revision and associated PEIS, and compensatory mitigation is not required.

Projects operational after September 11, 2009 are held to the eagle preservation standard under the Eagle Rule Revision, which is defined as "consistent with the goals of maintaining stable or increasing breeding populations in all eagle management units and the persistence of local populations throughout the geographic range of the species". In order to meet this standard, USFWS has established take limits and compensatory mitigation requirements for bald and golden eagles at the regional level (i.e., eagle management unit; Table 16) and the local area population (LAP) level. No compensatory mitigation is required for take of bald eagles below thresholds within the respective eagle management unit for the Project except when USFWS determines it necessary to maintain the persistence of local eagle populations throughout their geographic range. (Table 16). In contrast, the take threshold for golden eagles equals zero, which requires that every golden eagle taken be replaced (i.e., save or create a golden eagle) as a ratio of 1.2:1 within the respective EMU.

Table 16. Allowable Take and Mitigation Requirements for Bald and Golden Eagles Under the Eagle Rule Revision

Eagle Species	Regional Allowable Take Limit	Local Area Population Take Limit	Compensatory Mitigation Requirements[1]
Bald eagle	6 percent of EMU population	5 percent of the LAP[2]	For take that exceeds regional take limits, required at 1:1 ratio for every bald eagle taken
Golden eagle	No net loss	5 percent of the LAP[2]	For take that exceeds regional take limits, required at a 1.2:1 ratio for every golden eagle taken

1. Exceptions may occur if USFWS determines that compensatory mitigation is necessary to maintain the persistence of local eagle populations throughout their geographic range.
2. Unless additional analysis demonstrates that permitting take over 5 percent of the LAP is compatible with preservation of eagles.

Phase I and II of the Project were operational prior to September 11, 2009, making them part of baseline conditions. Therefore, bald and golden eagle fatalities associated with these phases do not count toward the regional or local take limits, and quantifiable offsetting compensatory mitigation is not required. Phase III began operations in August 2010 and is considered post-baseline. As a result, bald and golden eagle fatalities associated with Phase III count toward the regional take thresholds and require quantifiable offsetting compensatory mitigation for predicted take that exceeds these thresholds. In order to provide a conservative estimate of the predicted take associated with Phase III, USFWS recommended that the mean predicted take from Phases I and II combined be subtracted from the upper 80 percent CL predicted take for the entire Project. The modelling to estimate the predicted take associated with Phase I and II of the Project incorporated the FCMR value for Analysis Period 3 (Table 12), the inputs from Table 13, and the updated collision priors for each eagle species. The updated collision prior for Analysis Period 3 was Beta (α = 2.88, β = 413.19) for bald eagles and Beta (α = 2.92, β = 459.63) for golden eagles. The mean annual fatality predictions for Phase I and II combined and the estimate of predicted annual take attributed to Phase III are presented in Table 17.

The Project lies within the Pacific Flyway, North (north of 40^0 to Canada) bald eagle management unit. Population size is estimated as 14,792 bald eagles with an EMU annual take limit of 798 (6 percent of EMU population) bald eagles per year (USFWS 2009b). The conservative estimate of the annual predicted take of bald eagles associated with Phase III is 0.43 bald eagles (Table 17) which falls well below the regional allowable take threshold. Unless USFWS concludes in their analysis of cumulative take at the LAP level that permitting take at the Project would cause the total authorized take to exceed 5 percent of the LAP size, compensatory mitigation for bald eagle fatalities at Phase III is not required (USFWS 2013a).

The Project lies within the Pacific Flyway golden eagle management unit. The USFWS has set the regional take limit at zero golden eagles (i.e., no-net-loss; USFWS 2016b). Therefore, quantifiable offsetting compensatory mitigation at a 1.2:1 ratio would need to save or create 0.864 golden eagles per year in order to reach the no-net-loss standard.

Table 17. Project Phases and Respective Annual Estimates of Eagle Take

Predicted Take Value	Bald Eagles	Golden Eagles
Upper 80 Percent CL of Mean Annual Fatality Prediction for the Project (All Phases)	0.65	1.27
Mean Annual Fatality Prediction for Phases I and II combined	0.22	0.55
Conservative Estimate of Predicted Annual Take Attributable to Phase III	**0.43**	**0.72**

10.1 Power Pole Retrofits

PGE will self-perform retrofits of power poles in order to provide quantifiable offsetting compensatory mitigation for the take of golden eagles attributable to Phase III of the Project during the first 5 years of the permit term. If the levels of take over the initial 5-year period are less than anticipated, PGE will apply any excess mitigation to the next 5-year period of the permit term or evaluation period. Similarly, if the levels of take are higher than anticipated, PGE will reinitiate negotiations with USFWS to complete additional retrofits or other compensatory mitigation measures or adaptive management (see Section 11.0). Once retrofitted, PGE will monitor and maintain the power-poles every 3 years. Collisions and electrocutions of eagles, should these occur, will be reported using PGE's Avian Reporting System. PGE's monitoring, maintenance, and reporting efforts will document the effectiveness of the retrofits. The details of PGE's proposed mitigation plan are included as Appendix A.

10.2 Other Compensatory Mitigation Options

The ECPG states that "any compensatory mitigation that directly leads to an increased number of [golden eagle] and [bald eagle] (e.g., habitat restoration) or the avoided loss of these eagles (e.g., reducing vehicle/eagle collisions, making livestock water tanks 'eagle-safe', lead ammunition abatement, etc.) could be considered for compensation". Many of these options have been evaluated in recent years (e.g., Allison et al. 2017).

10.2.1 Roadside Carcass Removal

A roadside carcass removal program could be implemented as a mitigation option in order to reduce vehicle-golden eagle collisions. Golden eagles are regularly struck and killed by vehicles while foraging on road-killed prey carcasses such as deer or jackrabbits (Phillips 1986, Tetra Tech 2011). The underlying assumption of such a program is that by moving large carcasses out of the path of oncoming vehicles, the vehicle collision rate of golden eagles foraging on roadside carrion will decrease. The American Wind Wildlife Institute (AWWI) has worked with Hawkwatch International to investigate the effectiveness of pilot carcass removal programs in Oregon, Utah and other states (Slater and Maloney 2015). The reduction in the rate of vehicle-collisions quantified in the study is approximately 25 percent. The 4-year study by Slater and Maloney is still ongoing.

PGE will consider funding a carcass removal program to reduce the vehicle-collision rate of golden eagles within the Pacific Flyway golden eagle management unit, and within the LAP (i.e., within 108 miles of the Project), if possible. Lonsdorf et al. (2018) provide a quantitative model to estimate vehicle collision rates as a function of eagle densities, road traffic volume, and animal carcass abundance. Under this mitigation option PGE would evaluate the rate of golden eagle-vehicle collisions within a given plan area to quantify how many carcasses need to be moved off the road per year to save or create 0.864 golden eagles per year.

10.2.2 Lead Abatement

A lead abatement program could be implemented to reduce the numbers of golden eagles killed directly or indirectly as a result of lead poisoning. Lead poisoning is a known cause of golden eagle mortality, and a primary source of lead in the environment is hunting ammunition which is ingested by golden eagles when foraging upon gut piles left by hunters or un-retrieved shot animals (Allison 2012, Allison et al. 2017). To use a voluntary lead abatement program as a mitigation strategy, toxic lead ammunition could be replaced by non-toxic ammunition to remove the lead source from the environment. This type of program has successfully reduced lead levels in eagles and condors (Sieg et al. 2009, Kelly et al. 2011). A model to quantify the number of eagles saved as a result of a lead abatement program has been developed by AWWI (Cochrane et al. 2015).

PGE will consider providing funds towards existing lead abatement efforts or will evaluate the development of a new voluntary lead abatement program that will benefit golden eagles within the LAP. PGE could use the model developed by Cochrane et al. (2015) or a similar model to quantify program components (e.g., numbers of gut piles removed) that would be necessary to save or create 0.864 golden eagles per year.

11.0 ADAPTIVE MANAGEMENT

PGE has developed an adaptive management framework in cooperation with USFWS that will be applied over the course of the permit term. The adaptive management framework calls for a combination of Enhanced Monitoring and specific conservation measures based on the rate at which carcasses are found, or the ability of PGE to meet the minimum compliance monitoring standard (i.e., overall carcass detection probability [g-value] of 0.30) during a specific 5-year monitoring period (Table 18). Specific conservation measures for implementation will be selected at the direction of PGE in coordination with the USFWS, will be based on best available science and practicability, and could include the following examples:

- Conduct detailed desktop analysis of existing data for patterns in fatalities (i.e., location, timing, age, etc.) to identify specific areas within the Project Area, weather conditions, or operational conditions that create higher collision risk.
- Perform updraft modeling to identify specific turbines with the highest collision risk under a suite of wind conditions.

- Test a conservation measure designed to reduce the number of eagles exposed to collision risk (i.e., deterrent). This measure would involve an automated video camera-based detection system coupled with an audible deterrent system such as those developed by DT Bird or BirdsVision to minimize the likelihood of future take. Modules will be installed at between 5 and 10 turbines using results of a desktop analysis of collision risk to prioritize those turbines of highest collision risk. Implementation of the conservation measure would incorporate a study designed to evaluate the effectiveness of the conservation measure.
- Test a conservation measure designed to reduce the source of collision risk (i.e., curtailment of turbines). This measure would involve an informed curtailment program wherein turbines would be feathered when eagles approach a turbine or group of turbines. The program would be implemented during specific seasons and times of day as informed from the results of previous studies. Triggering of curtailment would occur using either 1) biomonitors, or 2) an automated video camera-based detection system such as Identiflight. Implementation of the measure would incorporate a study designed to evaluate the effectiveness of the conservation measure.

Once triggered, a selected conservation measure will be implemented during the subsequent 5-year evaluation period. Implementation of a given measure for a longer period, if applicable, will be determined by PGE in coordination with USFWS based on the effectiveness of the measure at reducing risk of take, its practicability, and the availability of potentially more effective measures. Each subsequent threshold triggers more extensive monitoring or specific conservation measures. PGE will use this framework to adaptively manage Project-related eagle fatalities and address the underlying uncertainty in collision risk to bald and golden eagles posed by the Project. Bald and golden eagles have different thresholds or triggers based upon their respective permitted take as estimated by the USFWS Bayesian collision risk model (Table 17); however, the proposed conservation measures are expected to benefit both species. Note that thresholds are designed using the metric of the average rate of eagle fatalities detected or a discrete number of eagle fatalities detected rather than the estimated number of eagle fatalities. The USFWS will assess permit compliance using estimated eagle fatality rates, but PGE will use the cumulative number of eagle fatalities detected (both during compliance monitoring and incidentally) to trigger adaptive management actions over the course of the permit term. PGE, in coordination with the USFWS, may adjust adaptive management thresholds and implementation of triggered conservation measures based on the results of 5-year evaluations.

Table 18. Adaptive Management Table

Tier	Adaptive Management Measure	Triggers: Rate of Carcasses Found During Standard Monitoring	Triggers: Rate of Carcasses Found During Enhanced Monitoring (or During Standard Monitoring subsequent to Enhanced Monitoring Performed in a Previous 5-Year Evaluation Period)
Tier 1.1 (applies only after Year 5 of permit term)	Perform Enhanced Monitoring during the next 5-year Evaluation Period (i.e. achieve an average g-value of 0.5 over the subsequent 5-year Evaluation Period)	≥ average of 0.50 GOEA remains found per year ≥ 5 BAEA remains found in 20 years	Not applicable
Tier 1.2 (applies only after Year 10 of permit term)	At the beginning of the next 5-year Evaluation Period: a) Perform a specific conservation measure, or perform another measure not listed here if agreed upon by the USFWS. b) Perform Enhanced Monitoring (i.e. achieve an average g-value of 0.5 over the subsequent 5-year Evaluation Period)	Not applicable	≥ average of 0.60 GOEA remains found per year
Tier 1.3 (applies only after Year 15 of permit term)	At the beginning of the next 5-year Evaluation Period: a) Perform a new specific adaptive management measure or enhance an existing adaptive management measure, or perform another measure not listed here if agreed upon by the USFWS. b) Perform Enhanced Monitoring (i.e. achieve an average g-value of 0.5 over the subsequent 5-year Evaluation Period)	Not applicable	≥ average of 0.66 GOEA remains found per year
Tier 2 (applies only within 5 years of the end of permit term)	Immediately upon achievement of this trigger: a) Perform a new, more drastic, specific adaptive management measure or enhance an existing adaptive management measure, or perform another measure not listed here if agreed upon by the USFWS. b) Perform Enhanced Monitoring (i.e. achieve an average g-value of 0.5 over the subsequent 5-year Evaluation Period or remainder of permit term)	≥ average of 0.50 GOEA remains found per year ≥ 5 BAEA remains found in 20 years	≥ 17 GOEA remains found in first 25 years ≥ 7 BAEA remains found in first 28 years
Tier G (may apply during any 5-year period of the permit term)	Perform Enhanced Monitoring during the next 5-year Evaluation Period (i.e., achieve an average g-value of 0.5 over the subsequent 5-year Evaluation Period)	The 5-year minimum g-value of 0.30 is not achieved in any 5-year period during the permit tenure, as determined by the USFWS. OR Enhanced Monitoring, if required through this adaptive management table, does not achieve a g-value of 0.5 during the required 5-year period, as determined by the USFWS.	

1. There are two sets of triggers proposed in this table. This format is proposed because, as more rigorous fatality monitoring is conducted, more eagle remains can be discovered without causing concern that the authorized/permitted take will be exceeded. So, as more rigorous monitoring is required through this Adaptive Management table (called "Enhanced Monitoring"), the triggers are designed to increase to give credit for that Enhanced Monitoring effort.
2. The term "Evaluation Period" refers to each defined 5-year period during the permit term between the 5-year check-ins. Over a 30-year permit, there will be 6 such periods (years 1-5, 6-10, 11-15, 16-20, 21-25, and 26-30).
3. This framework is written for a 30-year eagle take permit. When a trigger in Tier 1 is reached, the associated adaptive management measure will be implemented at the beginning of the following 5-year Evaluation Period. If Tier 2 is triggered, the adaptive management measures must be implemented as soon as practicable because there is no longer much of a margin between the total estimated fatalities and authorized take. Tier G will be triggered in any 5-year period for which the minimum average g-value is not met for the given monitoring type (Standard or Enhanced).
4. Triggers refer to and will be achieved using "rate of eagle carcasses found," during fatality monitoring and incidentally and are not estimated rates of fatalities.
5. The values for the rate of detected eagle remains used in each trigger were determined based on the permitted take limits (1.27 golden eagles and 0.65 bald eagles per year) and the anticipated average 5-year g-value for the given fatality monitoring type (Standard or Enhanced).
6. Upon achievement of any trigger, Enhanced Monitoring will only be required for the subsequent 5-year evaluation period, at which point Standard Monitoring can resume as initially prescribed (i.e. g-value of ≥ 0.30), unless another trigger is achieved.
7. Upon achievement of any trigger, and the requirement of Enhanced Monitoring (assuming a minimum average g-value of 0.5 is achieved), the triggers are permanently altered (increased) until the permit expires or until additional Enhanced Monitoring is performed (if required). In other words, once Enhanced Monitoring achieves a g-value of 0.5 over a 5-year period, the adaptive management table will not return back to the triggers titled "Rate of Carcasses Found During Standard Monitoring".
8. If the 5-year minimum g-value of 0.30 is exceeded in the first 5 years, and instead a minimum g-value of ≥ 0.35 was achieved and will be achieved over the permit term (as determined by the USFWS), the triggers under Enhanced Monitoring for Tier 1.2 may be used for the duration of the permit until Enhanced Monitoring is performed (if required).
9. Upon achievement of a trigger, a given conservation measure will only be required for the subsequent 5-year evaluation period, unless another trigger is achieved. Implementation of a given conservation measure beyond the first 5 years, if applicable, will be at the discretion of PGE in coordination with the USFWS based on the effectiveness of the measure at reducing risk of take, its practicability, and the availability of potentially more effective measures.

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APPENDIX A. PROPOSED MITIGATION PROGRAM FOR THE BIGLOW CANYON WIND FARM

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APPENDIX A

PROPOSED MITIGATION PROGRAM FOR THE BIGLOW CANYON WIND FARM

1.0 INTRODUCTION

Portland General Electric (PGE) proposes to provide quantifiable offsetting compensatory mitigation for the take of golden eagles attributable to Phase III of the Project by retrofitting high-risk power-poles. Power-pole retrofitting was selected as the preferred mitigation option primarily based on its 1) acceptability by the US Fish and Wildlife Service (USFWS) as a form of mitigation with quantifiable benefits to golden eagles, and 2) the feasibility with which PGE can implement the mitigation. This plan includes a summary of the proposed retrofitting program including PGE's rationale for the number of retrofits needed, identification of candidate poles to be retrofitted, implementation, monitoring, reporting, and adaptive management. Additionally, PGE's pole selection and risk categorization methods are provided, as well as the quantification of assumed eagle benefits for a given retrofit method. Finally, the plan describes the baseline conditions and the uplift that the mitigation program will provide above the baseline conditions in order to achieve the necessary offsetting compensatory mitigation.

2.0 PGE'S PROPOSED POLE-RETROFIT PROGRAM

2.1 Calculation of Retrofits Needed

PGE calculated the number of pole retrofits needed using the USFWS Resource Equivalency Analysis (REA; USFWS 2013). These calculations are limited to take due to collision as no take due to disturbance is expected. PGE used the conservative estimate of take attributable to Phase III per year of 0.72 golden eagles (PGE 2019). This value was then multiplied by 1.2 based on the compensatory mitigation standard established in the 2016 Eagle Rule Revision (USFWS 2016), to produce a debit input of 0.864 golden eagles per year. PGE assumed that the retrofits would be completed within a 12-month period of permit issuance. Based on these input values, the estimated debit without foregone reproduction for a 5-year period was 24.61 bird-years. PGE assumed that their retrofits would be effective for a minimum of 30 years based on the monitoring and maintenance commitments included in this mitigation program (Section 2.4). Under this assumption, 0.426 bird-years were estimated to be saved per retrofitted pole. As a result, the number of retrofitted high-risk poles needed to save 0.864 golden eagles per year for a 5-year period was estimated as 58 poles.

2.2 Identification of Candidate Poles

PGE will self-perform the necessary retrofits, and has developed specific criteria to identify high-risk power-poles for retrofitting from those owned by PGE. PGE adapted the risk assessment methods in its Avian Protection Plan (APP; PGE 2015) to be specific to eagles using publicly available information and the risk assessment approach developed by EDM International (2015) to select candidate poles for retrofitting. The primary risk factors chosen by PGE included pole proximity to selected habitat variables including known eagle nesting and use areas (Section 3.2.1), and pole configuration (Section 3.2.2).

PGE identified at least 80 candidate poles in the vicinity of the Pelton Round Butte Hydroelectric Project (hereafter, Subject Area) that includes Lake Billy Chinook and Lake Simtustus, Oregon where there is known to be a high density of nesting bald and golden eagles (Isaacs 2015; Figure 1). Lake Billy Chinook and Lake Simtustus occur in the same eagle management unit as the Project (Great Basin; Figure 2), one of the USFWS criteria for compensatory mitigation. The Subject Area lies outside of PGE's service territory, and therefore is not prioritized under PGE's APP for proactive retrofits (Section 3.4). None of the candidate poles for retrofitting are known to have caused the injury or death of a bald or golden eagle. Further details of PGE's candidate pole selection methods are provided in Section 3.2.

2.3 Implementation Schedule

PGE commits to completing the retrofits within a 12-month period of permit issuance such that the estimated take from the first 5 years of the permit term is mitigated up front. The final implementation schedule will depend on the final selection of poles to be retrofitted. Most likely, groups of poles will be identified and retrofitted in batches to enable a cost-effective strategy for retrofitting. This technique is recommended in the recently published Avian Electrocution Risk Assessment Predictive Model (EDM 2015).

2.4 Monitoring, Maintenance, and Reporting

Once retrofitted, PGE will conduct a complete inspection to ensure all retrofits were installed properly. PGE will commit to routine monitoring and maintenance of the 58 power-poles every 3 years for a period of 30 years. Reactive monitoring will also occur in response to incidents which are reported using PGE's Avian Reporting System (ARS; Section 2.5). This internal reporting system and associated Avian Protection Database enables PGE to track avian mortalities, nest management issues, and remedial actions taken. Company wildlife biologists also periodically monitor the Company's Outage Management System to detect any outage-related avian issues that are not otherwise reported within the ARS.

The monitoring and maintenance procedures will be specific to the pole characteristics and retrofit methods (Section 3.3). For example, poles that are retrofitted by reframing to create adequate spacing between conductors are expected to require no additional maintenance over the life of the pole to remain eagle-safe as long as the pole integrity remains intact. Based on informal discussions with other utilities, other retrofitting methods (e.g., installing phase covers) when properly installed are expected to have a minimum effectiveness ranging from 5 to 10 years after which wind and sun exposure may begin to compromise the components or installation. Retrofitted poles will be inspected to ensure that the pole and associated equipment is intact and functioning properly to minimize eagle electrocution risk. If components on a retrofitted pole appear to be deteriorating to the point where the pole may pose electrocution risk to eagles, they will be repaired or replaced. Reactive monitoring as described above will also occur for the retrofitted poles and help ensure any incidents with eagles are detected and the causes remedied.

PGE is confident that these programs and procedures are sufficient to maintain the retrofitted poles in a state that poses minimal electrocution risks to bald and golden eagles. In this manner, the retrofitted poles are assumed to pose no electrocution risk to eagles for a minimum of 30 years. This type of long-term maintenance of retrofits by the utility is recommended by USFWS in the ECP Guidance (USFWS 2013).

In addition to internal reporting within PGE and the annual report submitted to USFWS as required by PGE's Special Purpose - Utility permit (SPUT), an annual report documenting whether or not there were any eagle incidents in associations with the retrofitted poles will be submitted to USFWS. These reports will also provide the details of any monitoring and maintenance performed in the reporting year.

2.5 Adaptive Management

The effectiveness of a given retrofit method will be evaluated using information gathered during the monitoring and maintenance program and through PGE's Avian Reporting System. If data suggest that a given retrofit method is not sufficient to minimize electrocution risk to eagles, PGE will revisit their chosen retrofit methods and will either modify previously retrofitted poles or perform additional retrofits using updated methods.

If the levels of take over the first 5 years of the permit are less than anticipated, PGE will apply any excess mitigation to the next 5-year period of the permit term or permit renewal. Similarly, if the levels of take are higher than anticipated, PGE will complete additional retrofits or reinitiate discussions with USFWS to select an alternative compensatory mitigation measure or adaptive management method.

3.0 EVALUATION OF PROPOSED MITIGATION

3.1 Rationale

As described above, PGE proposes to use power-pole retrofitting for compensatory mitigation partly based on its acceptability to USFWS. Retrofitting of high-risk power poles has a quantifiable benefit to bald and golden eagles based on published data (i.e., 0.0036 eagle electrocutions prevented per retrofitted pole per year; Lehman et al. 2010, USFWS 2013). Additionally, PGE meets the recommendation of the Avian Power Line Interaction Committee (APLIC) to have power-pole retrofits performed by a utility that has an APP in place (APLIC 2014); PGE recently revised their

APP (PGE 2015). Furthermore, the candidate poles proposed by PGE for retrofitting are located within the same eagle management unit as the Project and have not been documented to cause injury or death to a bald or golden eagle. As a utility, PGE has the existing resources to self-perform the retrofits in an effective manner as well as perform long-term monitoring and maintenance. The proposed retrofits are not prioritized under PGE's APP (Section 3.4), and would be in addition to any retrofits necessary to meet PGE's mitigation obligations associated with their existing transmission and distribution system. Details of the quantification of uplift for mitigation purposes can be found in Section 4.

3.2 Pole Risk Assessment

As mentioned previously, PGE has an established risk assessment methodology within their APP. PGE uses their existing data as well as information collected by company biologists to determine areas where high avian use has the potential to result in relatively high avian risk. Information that PGE evaluates in assessing risk includes structure configuration, level of avian use, avian mortality, nesting problems, established flyways, adjacent wetlands, prey populations, perch availability, effectiveness of existing procedures, remedial actions, and other factors that affect bird interactions with utility facilities. PGE's risk assessment approach is similar to that developed by EDM (EDM 2015) which focuses primarily on 1) habitat as a surrogate for eagle use, and 2) pole configuration. Additionally, PGE has knowledge of eagle nest locations in the region of their facilities. Therefore, PGE used their existing information as well as publically available information on eagle habitat and eagle-specific electrocution risk to perform a risk assessment of poles specific to eagles.

3.2.1 Habitat

PGE fatality and nesting data indicate that higher risk areas may occur in proximity to river and stream corridors, agricultural areas, and areas with active and productive bald eagle nests (PGE 2015). Published studies indicate that eagle electrocution rates may also be related to consistent use of the area by golden eagles, high prey availability, scarcity of trees, low levels of human disturbance, and unforested unpaved areas (Cartron et al. 2000, Lehman et al. 2010, Dwyer et al. 2014). Using these sources of information, PGE examined their poles for the following habitat variables specific to bald and golden eagles in order to select candidate poles:

1) Nest occurrence and presence of suitable breeding habitat
2) Presence of suitable foraging habitat
3) Undeveloped areas (i.e., rural)

As stated above, the Subject Area has a high density of nesting bald and golden eagles (Figure 1). Additionally, the large lakes and shrub-steppe habitat in this area provide suitable foraging habitat for both eagle species, and the area is largely undeveloped; therefore, this area meets all of the habitat criteria.

3.2.2 Pole Configuration

Eagle electrocutions are more frequent at certain pole configurations. In general, poles where the energized conductors or grounded hardware and energized conductors are separated by less than the wrist-to-wrist or head-to-foot distance of a bird pose electrocution risk to that bird (APLIC 2006). For eagles, APLIC recommends that energized and/or grounded parts be spaced 60 inches apart horizontally and 40 inches vertically to allow sufficient clearance for an eagle's wrist-to-wrist span (APLIC 1996). Observations at other western utilities with vast golden eagle habitat present in their territories have found that there is no one type of pole that poses the greatest electrocution risk to golden eagles. Additionally, PGE's analysis of avian fatality data collected within their service territory since 2006 indicates that over 80 percent of all bird electrocutions occur on poles with various types of equipment, particularly transformer poles (PGE 2015). Equipment poles typically have additional wires (such as transformer tap wires and jumper wires over crossarms) in proximity to energized and/or grounded equipment, posing higher electrocution risk for birds. This conclusion is consistent with findings from Harness and Wilson (2001) and Lehman et al. (2010). PGE examined the poles within the Subject Area for 1) inadequate separation of phases or of grounded and energized hardware, 2) presence of equipment, and 3) high-risk configuration types. Poles that met one or more of these criteria were considered high-risk to eagles and, therefore, candidates for retrofitting. PGE identified at least 80 candidate poles within the Subject Area (Figure 1).

3.3 Retrofit Methods and Quantified Benefits to Eagles

Retrofit methods may include a combination of reframing or replacing a structure to achieve adequate spacing of conductors; covering jumper wires, conductors, and equipment; installing perch guards to discourage perching in unsafe locations; and other modifications as appropriate. Table 1 presents photos of four representative examples of the candidate poles identified by PGE in the Subject Area along with a description of their respective electrocution risk and retrofitting options. The specific retrofit method for each selected pole will depend upon the specific configuration and equipment present on the pole. However, regardless of PGE's chosen retrofit method, the retrofitted poles will be monitored and maintained as described in Section 2.4 in such a fashion as to be considered eagle-safe. Thus, all retrofitted candidate poles will have the same benefit to eagles (i.e., 0.0036 eagle electrocutions prevented per retrofitted pole per year; Lehman et al. 2010).

3.4 Baseline Conditions

PGE's APP includes commitments to proactively perform retrofits of power poles identified as high risk to birds as practical and feasible, particularly when work can coincide with routine maintenance activities or when significant system reliability improvements may result (PGE 2015). PGE's distribution service territory covers portions of six counties in northwest Oregon and includes the Portland and Salem metro areas (Figure 2). The range of PGE's system, especially its electrical distribution lines, over a variety of habitats creates substantial potential risk for bird and power line interactions (PGE 2015). Proactive work is prioritized within PGE's service territory in order to focus efforts in a cost-effective manner on areas that pose the greatest risk to migratory birds. To date, PGE's efforts specific to eagles under their APP have been limited to bald eagles because golden eagles are not known to occur within the service territory. Previous proactive work in 2011 – 2013 included retrofits in proximity to known bald eagle nest sites west of the Cascade Range (PGE 2015). Other proactive measures related to pole retrofitting listed in PGE's 2015 APP (PGE 2015) include:

1) Retrofit additional adjacent poles as appropriate at bird mortality and nest sites;
2) Conduct proactive retrofit measures on other identified high risk areas as practical and feasible;
3) Install appropriate bird safe protection on equipment poles as practical and feasible.

No golden eagle electrocutions have been recorded within PGE's system, and bald eagle incidents have been limited to west of the Cascade Range until a recent occurrence on March 17, 2016. On that date a first-year bald eagle flew into and collided with a section of the distribution line associated with the Pelton Round Butte Hydroelectric Project and immediately caused an outage. PGE's investigation of the incident the same day revealed that the eagle was electrocuted upon colliding with the lines while in flight, and not as the result of pole configuration. An operational feature associated with the hydroelectric facility potentially played a role in the incident and has since been remedied by PGE. Additionally, PGE plans to install line markers to minimize future collision risk.

The Subject Area is outside of PGE's service territory. The candidate poles identified within the Subject Area are associated with the Pelton Round Butte Hydroelectric Project which is one of PGE's generation facilities. Because of the size of PGE's service territory and the known areas identified therein posing high risk to birds, poles within the Subject Area are not currently prioritized by PGE for proactive retrofits, and are unlikely to be prioritized for proactive mortality reduction measures.

4.0 MITIGATION UPLIFT QUANTIFICATION

PGE's proposed retrofitting program goes above PGE's existing commitments under its current APP (PGE 2015) in the following ways:

1) Poles within the Subject Area will be retrofitted despite being less practical and feasible than retrofits of poles within PGE's service territory.
2) Poles within the Subject Area will be retrofitted despite this area not being prioritized by PGE for proactive retrofits;
3) Poles posing high risk to eagles will be prioritized over poles posing high risk to other bird species, or birds in general;

5.0 REFERENCES

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TABLES

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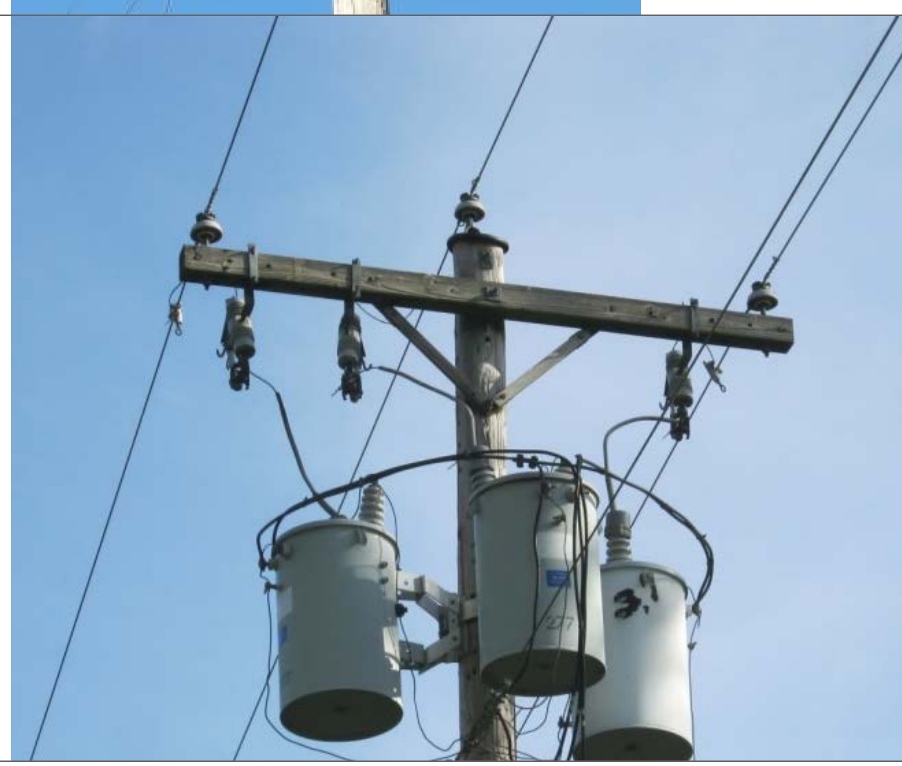
Table 1. Representative Examples of Candidate Poles in the Subject Area

Candidate poles in the Subject Area generally pose electrocution risk to eagles as a result of inadequate spacing (i.e., energized and/or grounded parts are spaced <60 inches apart horizontally and <40 inches vertically; APLIC 1996). Some possible retrofit options are described below and include covering exposed energized hardware and altering the middle phase location to achieve adequate spacing. Several factors will influence the determined retrofit and include pole and line design constraints, topography, and current design standards. Schematics referenced from APLIC 2006 are for visual reference and do not necessarily match the exact configuration of the example pole.

Example No.	Photo	Pole Description	Electrocution Risk Description	Retrofit Options and Descriptions	APLIC Manual Reference
1		Three phase dead-end design with exposed jumper wires, dead-end phases, and cut-outs	Inadequate spacing of energized equipment, specifically jumpers, dead-end phases and cut-outs.	Option 1: Cover all three jumpers, and cut-outs and add dead-end covers (i.e., type of phase cover). PGE's approach would replace existing wire with covered wire because it is known to last longer and provide better coverage than hose or tubing. APLIC recommends only covering center jumper, phase, and cutout to create adequate spacing. PGE's practice is to cover all cutouts and jumpers. Each dead-end phase would also be covered. Option 2: Invert (i.e., lower under crossarm) the middle or outer two jumpers on the existing pole to achieve adequate horizontal spacing. Cover the jumpers, cutouts, and dead-end phases using methods in Option 1.	See schematic in APLIC 2006 Figures 5.15 and 5.16

Example No.	Photo	Pole Description	Electrocution Risk Description	Retrofit Options and Descriptions	APLIC Manual Reference
2		Three phase double dead-end design with exposed jumper wires and dead-end phases.	Inadequate spacing of energized equipment, specifically jumpers and dead-end phases.	Option 1: Cover all three jumpers and add dead-end covers. PGE's approach would replace existing wire with covered wire because it is known to last longer and provide better coverage than hose or tubing. APLIC recommends only covering center jumper, phase, and cutout to create adequate spacing. PGE's practice is to cover all cutouts and jumpers. Each dead-end phase would also be covered. Option 2: Invert the middle or outer two jumpers on the existing pole to achieve adequate horizontal spacing. Cover the jumpers, cutouts, and dead-end phases using methods in Option 1.	See schematic in APLIC 2006 Figures 5.15 and 5.16
3		Three-phase design with transformer bank, cut-outs and jumpers	Inadequate spacing of energized equipment, specifically jumpers, bushings, and phases.	Option 1: Cover all three jumpers and high side bushings, add cut-out covers, and add phase cover to middle phase. Option 2: Install a longer crossarm or pole-top extension to obtain adequate horizontal spacing between phases. Cover the jumpers, high side bushings, and cut-outs using methods in Option 1.	See schematic in APLIC 2006 Figures 5.11 and 5.12, and also Figures 5.44 and 5.46 For Option 2, see Figure 5.13

Example No.	Photo	Pole Description	Electrocution Risk Description	Retrofit Options and Descriptions	APLIC Manual Reference
4		Three-phase design	Inadequate spacing of energized phases.	Option 1: Add phase cover to middle phase. Option 2: Install a longer crossarm or pole-top extension to obtain adequate horizontal spacing between phases.	See schematic in APLIC 2006 Figures 5.11 and 5.12 For Option 2, see Figure 5.13

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FIGURES

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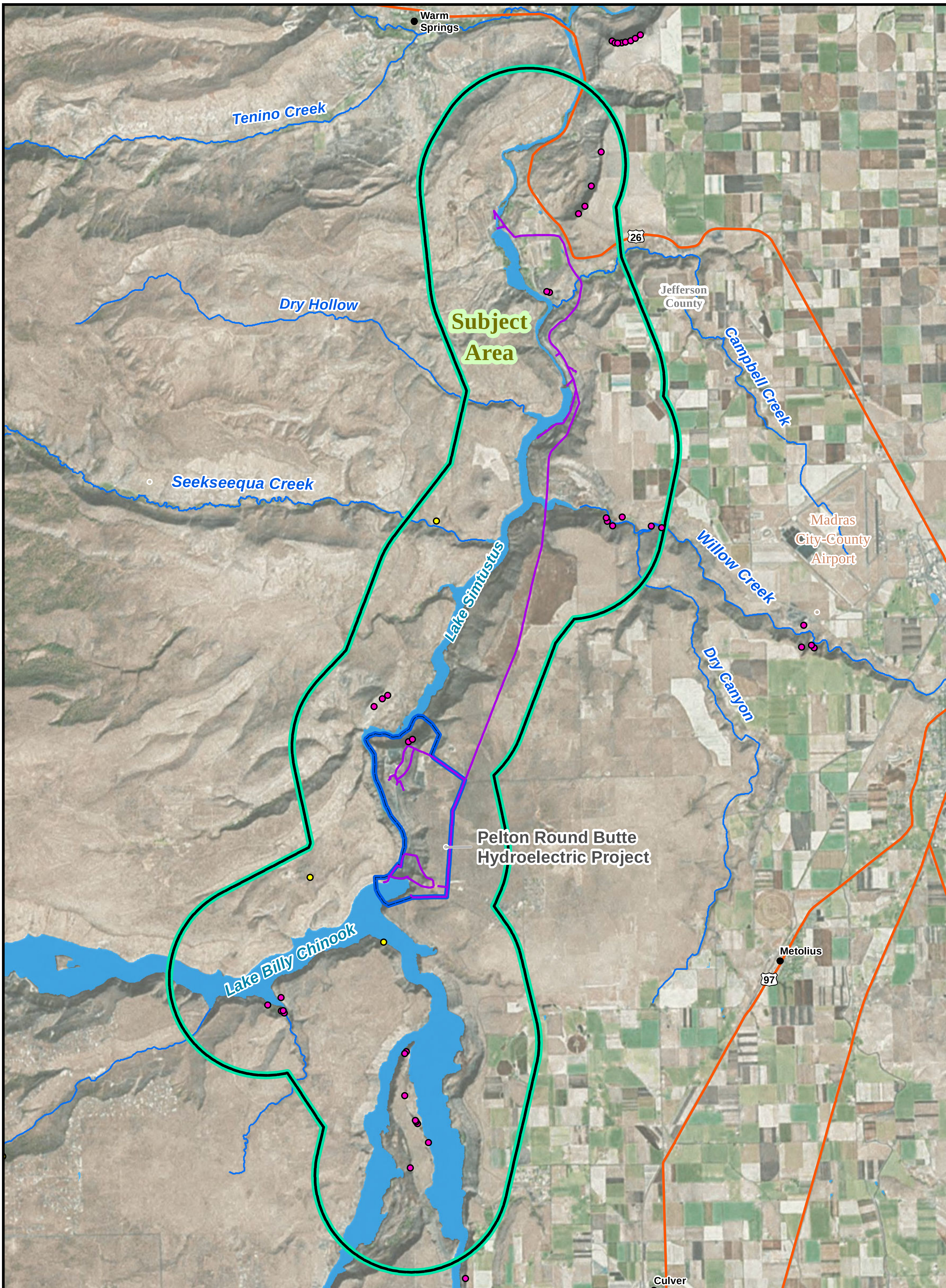


Figure 1

PORTLAND GENERAL ELECTRIC
Biglow Canyon Wind Project

Location of Distribution Line with Candidate Poles

Jefferson County, OR
June 2016

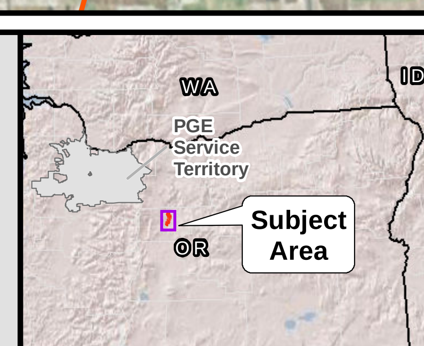
- Bald Eagle Nest
- Golden Eagle Nest
- PGE Distribution Line - from 05/27/2016
- Pelton Round Butte Hydroelectric Project
- Subject Area
- City
- Federal Highway
- River/Stream
- Lake/Pond
- County Boundary

1:76,000

WGS84 UTM Zone 10N

Data Sources -
PGE: project facilities
ESRI: roads, boundaries, cities, imagery

0 1 2 4 Miles



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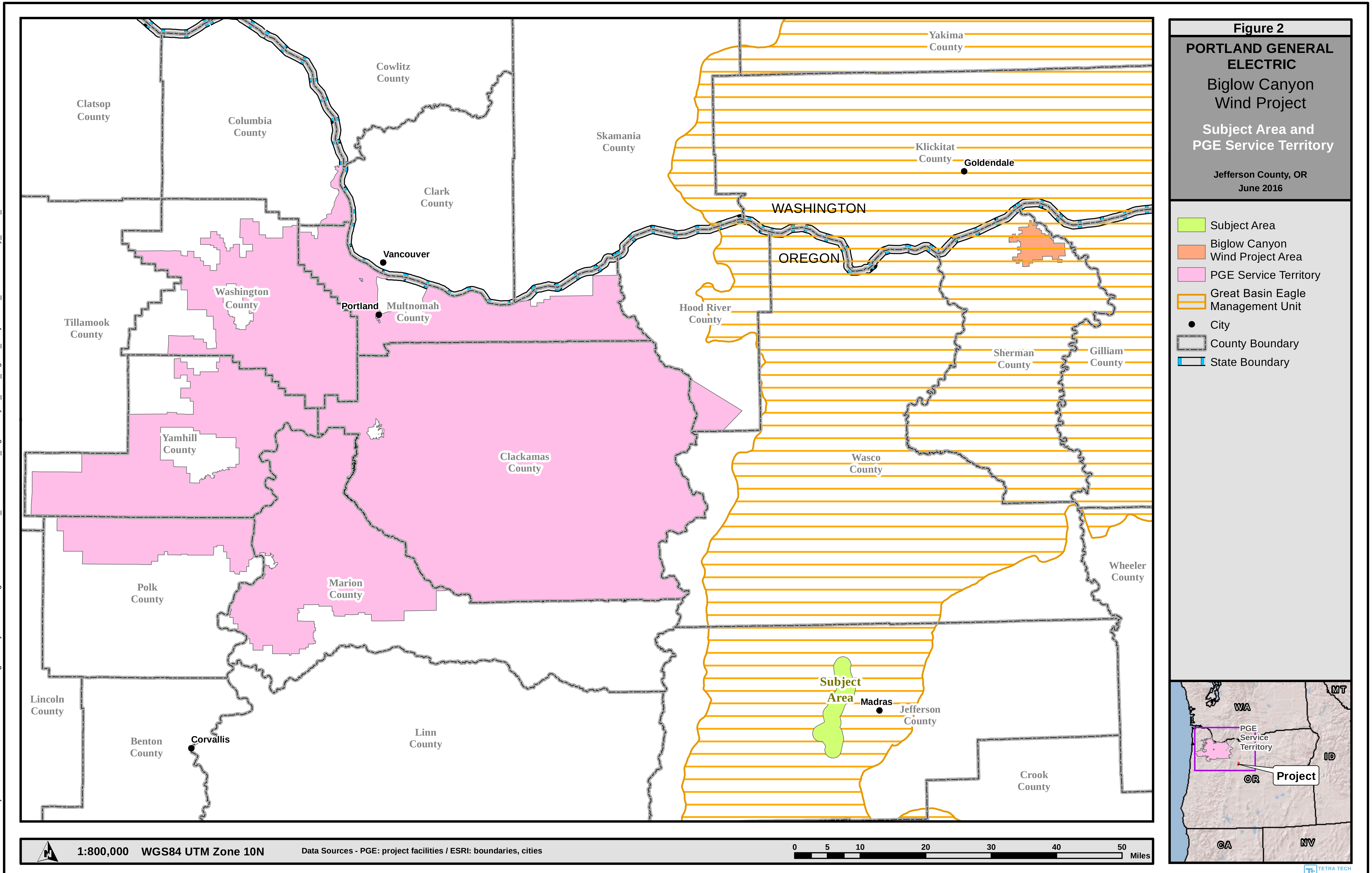
Figure 2
PORTLAND GENERAL ELECTRIC
Biglow Canyon Wind Project
Subject Area and PGE Service Territory
Jefferson County, OR
June 2016
Subject Area
Biglow Canyon Wind Project Area
PGE Service Territory
Great Basin Eagle Management Unit
City
County Boundary
State Boundary
WASHINGTON
OREGON
Yakima County
Cowlitz County
Clatsop County
Columbia County
Skamania County
Klickitat County
Goldendale
Clark County
Vancouver
Washington County
Portland
Multnomah County
Hood River County
Tillamook County
Sherman County
Gilliam County
Yamhill County
Clackamas County
Wasco County
Wheeler County
Polk County
Marion County
Subject Area
Madras
Jefferson County
Lincoln County
Benton County
Corvallis
Linn County
Crook County
WA
MT
PGE Service Territory
ID
OR
Project
CA
NV
1:800,000 WGS84 UTM Zone 10N
Data Sources - PGE: project facilities / ESRI: boundaries, cities
0 5 10 20 30 40 50 Miles
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