Appendix 3.4-5
Skookumchuck Wind Energy Project Habitat Conservation Plan

The FEIS is a stand-alone document and includes and incorporates by reference the HCP in the form and content as included in this Appendix. The HCP satisfies the requirements of the Lewis and Thurston counties critical areas ordinances. Except as required pursuant to WAC 197-11-600, future changes to the HCP will not affect considerations related to issuance of any permits and authorizations issued by Lewis and Thurston counties or any agency relying on this FEIS for purposes of compliance with the Washington State Environmental Policy Act, RCW Ch. 43.21C.

SKOOKUMCHUCK WIND ENERGY PROJECT
HABITAT CONSERVATION PLAN

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ACRONYMS AND ABBREVIATIONS

Term	Definition
ABR	Alaska Biological Research, Inc.
agl	above ground level
APLIC	Avian Power Line Interaction Committee
Applicant	Skookumchuck Wind Energy Project, LLC
BBCS	Bird and Bat Conservation Strategy
BBS	breeding bird survey
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
COD	Commercial Operation Date
DDT	dichloro-diphenyl-trichloroethane
DPS	Distinct Population Segment
ECPG	Eagle Conservation Plan Guidance
EIS	Environmental Impact Statement
EMU	eagle management unit
ESA	Endangered Species Act
FPA	Forest Practices Application
FR	Federal Register
GPS	Global Positioning System
HCP	Habitat Conservation Plan
HIP	Horizontal Interaction Probability
HRSC	high resolution stereo cameras
IPCC	Intergovernmental Panel on Climate Change
ITP	Incidental Take Permit
km	Kilometer
km^2	square kilometers
LAP	local area population
MBTA	Migratory Bird Treaty Act
MV	medium voltage
MW	Megawatt
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
NMFS	National Marine Fisheries Service
NRHP	National Register of Historic Places
NWFP	Northwest Forest Plan
NWI	National Wetlands Inventory
O&M	Operations and Maintenance
PEIS	Programmatic Environmental Impact Statement
PSE	Puget Sound Energy
PVA	Population Viability Analysis

ACRONYMS AND ABBREVIATIONS

Term	Definition
RCW	Revised Code of Washington
REA	resource equivalency analysis
ROD	Record of Decision
ROW	right-of-way
rpm	rotations per minute
SEPA	State Environmental Policy Act
SHPO	State Historic Preservation Office
SOSEA	Spotted Owl Special Emphasis Area
UAV	unmanned aerial vehicle
U.S.	United States
USC	US Code
USEPA	US Environmental Protection Agency
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
VIP	Vertical Interaction Probability
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WEG	Wind Energy Guidelines
Weyerhaeuser	Weyerhaeuser Company
WFOV	wide field of view
WFPA	Washington Forest Practices Act
WRCC	Western Regional Climate Center

CHAPTER 1.0 – INTRODUCTION

1.1 OVERVIEW AND BACKGROUND

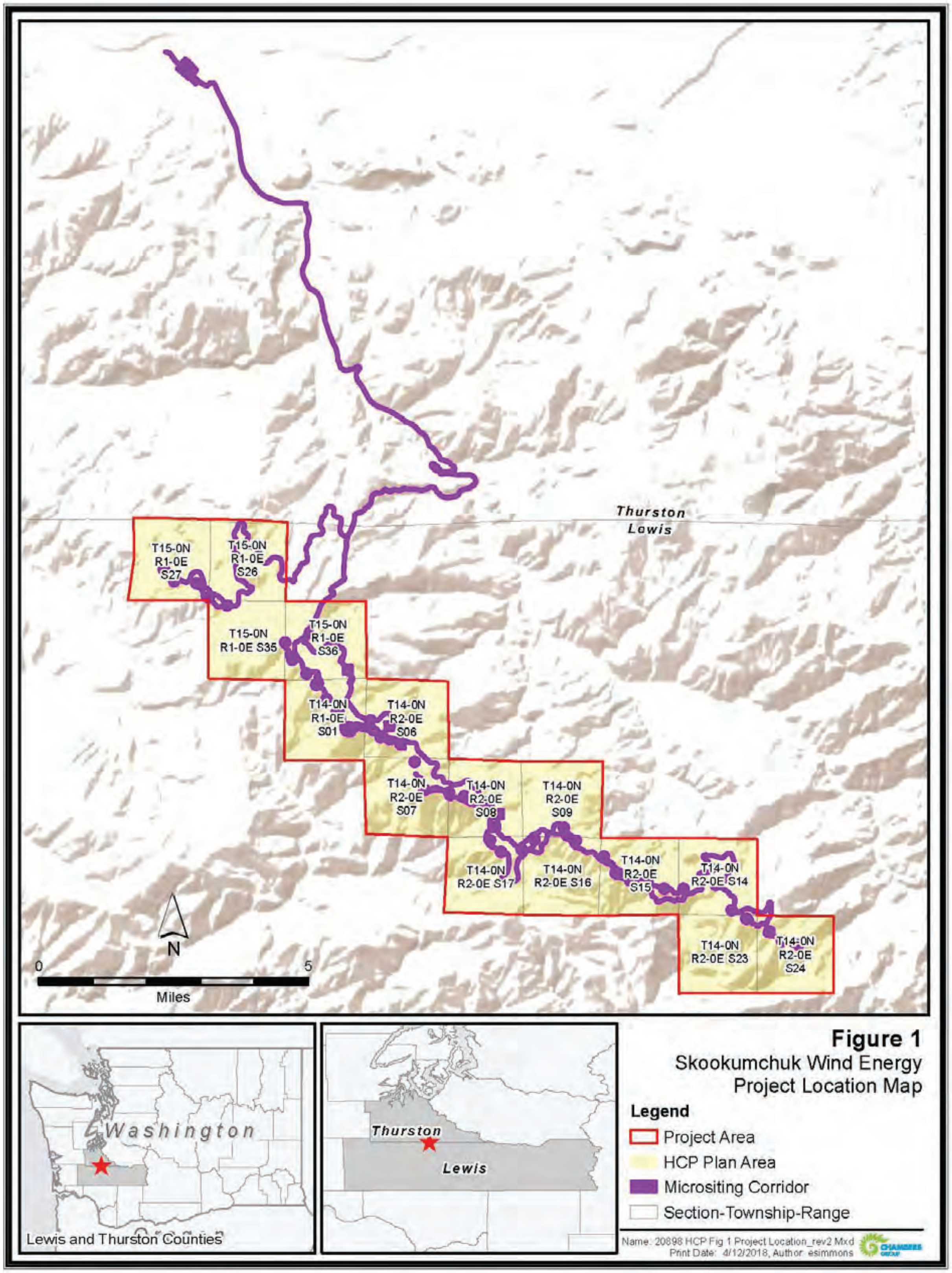
Skookumchuck Wind Energy Project, LLC (Applicant) proposes to operate the Skookumchuck Wind Energy Project (Project) within Lewis and Thurston Counties in Washington State; however, considering all proposed turbines will be located within Lewis County, this Habitat Conservation Plan (HCP) and requested Incidental Take Permit (ITP) cover approximately 9,697 acres within Lewis County (**Figure 1**). The Applicant has entered into a development lease with Weyerhaeuser Company (Weyerhaeuser) for the development of the wind energy resources. Activities associated with the proposed Project will include clearing for construction of turbine pads, access roads, underground medium voltage (MV) collection cables, a substation, overhead high voltage transmission line, and other necessary infrastructure; installation of turbines and other infrastructure; and ongoing operations and maintenance of the proposed Project. The "Covered Activities" (Operations and Maintenance) for which the Applicant is seeking coverage are described in detail in **Section 2.3.**

The Plan Area is located outside areas of suitable habitat for the federally listed threatened murrelet (*Brachyramphus marmoratus*; however, the Applicant has determined that the operation of the Project could potentially result in take of murrelet. The Endangered Species Act (ESA) prohibits take of an endangered or threatened wildlife species unless authorized by the by the federal agency with jurisdiction over the endangered or threatened species. The United States (U.S.) Fish and Wildlife Service (USFWS) is the federal agency with jurisdiction over murrelet. The USFWS may authorize incidental take for non-federal actions (such as the proposed Project) by issuing an ITP under Section 10(a)(1)(B) of the ESA. In accordance with Section 10(a)(1)(B), this HCP supports an application to the USFWS for an ITP for the potential take of murrelet. Additionally, the operation of the Project could potentially take bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*). The Bald and Golden Eagle Protection Act (BGEPA) prohibits the take of bald eagles and golden eagles unless authorized through an incidental take permit issued in accordance with regulations (50 Code of Federal Regulations [CFR] 22.26). Therefore, this HCP also supports an application to USFWS for an ITP in accordance with BGEPA regulations. This HCP document establishes the methods and measures of success required to meet the conservation needs of the listed species and other covered species potentially impacted by the Project. It also provides a stable and predictable operating and regulatory environment and preserves the Applicant's ability to pursue their development objectives with assurances from the USFWS that incidental take of Covered Species is authorized.

1.2 APPLICANT'S PROJECT PURPOSE AND NEED

The purpose of the Project is to generate renewable electricity to meet future energy demand in the Pacific Northwest and help meet the requirements of the Washington Energy Independence Act, (Revised Code of Washington [RCW] 19.285) and renewable portfolio standards as dictated by the States of Washington and Oregon. The Applicant's objective in proposing the Project is to develop and operate an economically viable commercial wind energy facility of up to approximately 137 megawatts (MW) in southwest Washington that would contribute to meeting the energy needs of the region. The Applicant has entered into a power purchase agreement that would make electricity generated by the Project available to utilities and other wholesale energy suppliers for sale to retail electric customers. In so doing, the Project would help utilities meet energy policy objectives to obtain a share of total electricity supplies from renewable energy sources and reduce greenhouse gas emissions associated with energy production.

Figure 1: Project Location



Further, the quality of wind resource, proximity to the bulk power transmission system, and availability of land are the primary factors driving the site selection of this wind power project. To satisfy the purpose and need, the project has chosen 3.6-MW turbines to produce sufficient power to provide an economic return for this project. The manner in which these turbines are operated also affects a wind facility's economic viability.

1.3 PROJECT HISTORY

The Project has been in development since 2011. The Applicant met with federal and state wildlife agencies throughout development beginning in 2011. Initial review of regional land use and land management constraints, as well as wind resources, led the Applicant to select a site on active logging/forest management lands. The initial Project layout, based upon the available wind resource at the selected site, included 98 turbines. After further screening of the site based upon publicly available natural resource information, the Applicant reduced the original 98-turbine Project to 61 turbines. This reduced footprint allowed the Applicant to avoid the potential of take of the ESA-listed northern spotted owl (*sp.*) and four ESA-listed aquatic species. The reduced footprint also helped minimize impacts to the murrelet, golden eagle, and bald eagle. The Applicant then conducted studies to gather additional information regarding the site and the potential impacts of the Project on wildlife. Results from additional studies conducted between 2013 and 2017 led the Applicant to remove two turbines nearest the Skookumchuck Reservoir, thereby further reducing risk to eagles. Finally, in 2017 the Applicant reduced the Project to 38 turbines, further minimizing Project impacts to wildlife, including the murrelet, golden eagle, and bald eagle. A more detailed description of survey efforts is provided in **Section 2.2**.

1.4 PLAN AREA/PERMIT AREA

The Permit Area for this HCP and the permit area for the ITP includes 9,697 acres, as shown on **Figure 1**, and the mitigation lands described in greater detail in **Chapter 6**. While the Permit Area includes the entirety of leased parcels proposed for the Project, only a portion of the area (approximately 15 percent) will be permanently disturbed by Project development; the remainder will remain active timber land.

1.5 PERMIT DURATION

The Applicant anticipates implementing the Covered Activities (**Section 2.3**) for a duration of 30 years. Therefore, the Applicant seeks an ITP for both murrelets and eagles with a term of 30 years from the date of issuance. It is possible, but not certain, that the Applicant would decommission the Project, remove their facilities, and restore disturbed areas within this duration. It is also possible that the Applicant would re-power the Project to align with impending technological advances in equipment at or before the 30-year life of the Project. If the Applicant has a need to continue Covered Activities for a longer period, the Applicant may request a renewal of the ITP term or re-apply for take authorization in accordance with the applicable regulations.

1.6 ALTERNATIVES TO THE TAKING

Section 10(a)(2)(A)(iii) of the ESA requires that alternatives to the incidental take of listed species be considered and that reasons such alternatives are not implemented be discussed. The following section describes curtailment and mitigation alternatives that were evaluated for operation of the proposed Project.

1.6.1 Alternatives Considered

The turbine curtailment program described in **Section 6.1.1** is the Applicant's primary proposed method for minimizing take of murrelets.

1.6.1.1 No Curtailment

The Applicant evaluated an alternative operating scenario from the program described in **Section 6.1.1** that would involve no curtailment of turbine operation (No Curtailment Alternative). While the additional operating hours would increase the amount of power generated by the proposed facility, the increase in operations would also increase the amount of take and mitigation. This alternative would result in a predicted annual take of 2.496 murrelets or 75 murrelets for the 30-year permit term (2.496 murrelets/year × 30 years = 74.88 individuals). The Applicant determined that the potential for additional power generation was insufficient to balance the additional costs of mitigation and therefore economically infeasible. Therefore, the Applicant rejected the No Curtailment Alternative.

1.6.1.2 Year-Round Curtailment (10 Turbines)

Under the Year-Round Curtailment of 10 turbines, operational adjustments would be maximized to reduce take of murrelets. Ten turbines would be curtailed during morning hours throughout the entire year, which would also likely minimize the risk of take of eagles. This alternative was considered because it met the biological objective of minimizing take of murrelets. Based on the modeling described in Chapter 5, this alternative would reduce the predicted annual take to 1.908 murrelets/year or 58 murrelets for the 30-year permit term, which is a 24-percent reduction in take.

This alternative would result in a significant reduction in energy production, and an 80-percent decrease in net value to the Project; therefore, this alternative did not meet the purpose and need to generate ample clean and renewable energy and allow for an economically viable Project. For these reasons, this alternative was not selected as the preferred method to reduce take of murrelets.

1.6.1.3 Year-Round Curtailment (All Turbines)

Under the Year-Round Curtailment Alternative, operational adjustments would be maximized to reduce take of murrelets. All 38 turbines would be curtailed during morning hours throughout the entire year, which would also likely minimize the risk of take of eagles. This alternative was considered because it met the biological objective of minimizing take of murrelets. Based on the modeling described in Chapter 5, this alternative would reduce the predicted annual take to 0.971 murrelets/year or 30 murrelets for the 30-year permit term, a 61-percent decrease in take.

Due to the significant reduction in energy production, which would result in a 310-percent decrease in net value to the Project, this alternative did not meet the purpose and need to generate ample clean and renewable energy and allow for an economically viable Project. For these reasons, this alternative was not selected as the preferred method to reduce take of murrelets.

1.6.1.4 No Action

The Applicant evaluated an alternative in which the Project did not seek or obtain an ITP. Under this scenario, the Applicant would curtail its turbines in a manner that would reduce the risk of take of the

Covered Species such that potential take of Covered Species would be unlikely to occur. Based on the take modeling that has been conducted, achieving a "take is unlikely to occur" threshold for the Covered Species would require curtailment of the Project turbines to such a significant degree that the Project would not be able to meet its power production obligations. Further, recouping the capital investment in the Project would not be feasible if implementing curtailment at a level where take is unlikely to occur. Under this scenario, the Project would not continue to operate; therefore, Applicant rejected this alternative.

1.7 SUMMARY OF RELEVANT LAWS AND/OR REGULATIONS

1.7.1 Endangered Species Act

Section 9 of the ESA prohibits take of federally listed species. The ESA defines take as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (16 United States Code [USC] 1532(19)). Harm is defined by USFWS regulations as "an act which actually kills or injures wildlife and may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding or sheltering" (50 CFR 17.3). Harass is defined by USFWS regulations as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (50 CFR 17.3). Section 10(a)(1)(B) of the ESA authorizes the USFWS to issue permits allowing take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity."

Section 10(a)(2)(A) of the ESA provides that the USFWS shall not issue an ITP unless the Applicant provides a conservation plan that specifies:

(1) the impact that will likely result from the taking;

(2) the steps the Applicant will take to minimize and mitigate the impacts and the funding available to implement those steps;

(3) the alternative actions to the taking that were considered and the reasons the alternatives were not chosen; and

(4) other measures that the USFWS may require as necessary or appropriate for purposes of the conservation plan.

The USFWS will evaluate an HCP to ensure it meets the issuance criteria for an ITP. The issuance criteria are [16 USC §1539(a)(2)(B)]:

(i) the taking will be incidental;

(ii) the Applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking;

(iii) the Applicant will ensure that adequate funding for the plan will be provided;

(iv) the taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild; and

(v) the measures, if any, required 'as determined by USFWS to be necessary or appropriate' will be met.

The Habitat Conservation Planning and Incidental Take Permit Processing Handbook (HCP Handbook) also provides guidance on the elements of a habitat conservation plan (USFWS and National Marine Fisheries Service [NMFS] 2016).

1.7.2 National Environmental Policy Act

The National Environmental Policy Act (NEPA) is the basic national charter for protection of the environment; it establishes policy, sets goals, and provides means for carrying out the policy, and contains "action-forcing" provisions to make sure that federal agencies act according to the letter and spirit of NEPA. The purpose of NEPA is to ensure that federal agencies consider the environmental impacts of their actions and decisions. NEPA requires that the federal government use all practicable means and measures to protect environmental values and make environmental protection a part of the mandate of every federal agency and department. To accomplish this goal, NEPA establishes a process and approach to determine the environmental impacts associated with proposed federal actions that significantly affect the quality of the human environment.

The issuance by the USFWS of an ITP for the Project is a major federal action triggering NEPA review. NEPA requires preparation of an Environmental Impact Statement (EIS) prior to any major federal action significantly affecting the quality of the human environment. "Major federal action" is defined to include "actions with effects that may be major and which are potentially subject to Federal control and responsibility" (40 CFR § 1508.18). USFWS has determined that issuance of an ITP for the Project would be a major federal action with the potential for significant environmental effects; therefore, preparation of an EIS is appropriate. After completion and public review of a draft EIS, USFWS will prepare a final EIS and then issue a Record of Decision (ROD) documenting its decisions and findings.

1.7.3 National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966 was created to preserve historical and archaeological sites as well as form the National Register of Historic Places (NRHP), the list of National Historic Landmarks, and the State Historic Preservation Offices (SHPO). Section 106 of the NHPA establishes a review process that federal agencies must undergo for all federally funded and federally permitted projects that will impact historical sites, particularly those listed on or eligible for listing on the National Register of Historic Places (16 USC 470). As the Applicant seeks to receive an incidental take permit from the USFWS, the proposed Project is considered an undertaking covered by the NHPA and must comply with Section 106 of the NHPA. As part of the ongoing environmental studies, the Applicant is currently conducting studies to evaluate the effects of the proposed Project on historic and cultural resources; and this evaluation will then be sent to USFWS and SHPO for concurrence. The potential impacts on prehistoric and historic resources are discussed in detail in the USFWS's NEPA document.

1.7.4 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA) of 1940 was established to protect bald and golden eagles, their nests, eggs, and parts. BGEPA states that no person shall take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner any bald eagle or golden eagle (*Aquila chrysaetos*), alive or dead, or any part, nest, or egg thereof without a valid permit to do so. Although the bald eagle was removed from the Endangered Species List in June 2007, it is still federally protected under BGEPA and the Migratory Bird Treaty Act (MBTA). The USFWS has promulgated regulations by which USFWS can issue incidental take permits under BGEPA (50 CFR §22.26). The USFWS (USFWS 2016a) revised 50 CFR. §22.26 (Eagle Rule), and it is considered the current regulation for eagle take permits for wind energy facilities. Incidental take of bald and golden eagles may also be authorized through preparation of an HCP. Migratory Bird Treaty Act

The Migratory Bird Treaty Act of 1918 (MBTA), as amended (16 USC 703-712) implements the United States' commitment to four international treaties (with Canada, Japan, Mexico, and Russia) for the protection of a shared migratory bird resource. Each of the treaties protects most species of birds that are common to both countries. Under the MBTA, it is illegal for anyone to take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory bird or the parts, nests, or eggs of such a bird unless authorized under regulations or by a permit. Murrelets as well as both bald and golden eagles are protected under the MBTA and the Project will develop and implement a Bird and Bat Conservation Strategy (BBCS) to minimize impacts to migratory birds. The USFWS does not currently have a comprehensive program under the MBTA to permit take that is incidental to otherwise lawful activities. On December 22, 2017, the Department of the Interior Office of the Solicitor issued a memorandum opinion concluding that the MBTA does not prohibit incidental take.

1.7.5 Northwest Forest Plan

The Northwest Forest Plan (NWFP) is a landscape approach to public land management designed to protect threatened and endangered species in late successional and old-growth habitats, while also contributing to social and economic sustainability in the region. The NWFP was completed in 1994 and amended 19 National Forest and 7 Bureau of Land Management (BLM) resource management plans. These plans provide guidance for how public lands and resources will be managed for a period of time, usually 10 to 15 years. The NWFP initiated a new approach to public land management, encompassing 24 million acres of land across California, Oregon, and Washington. The mission of the NWFP is to adopt coordinated management direction for the lands administered by the U.S. Department of Agriculture (USDA) Forest Service (USFS) and the U.S. Department of the Interior (USDI) Bureau of Land Management (BLM) and to adopt complimentary approaches by other federal agencies within the range of the northern spotted owl. The management of these public lands must meet dual needs: the need for forest habitat and the need for forest products (USDA 2018).

1.7.6 Relevant State Laws and Regulations

1.7.6.1 Washington State Environmental Policy Act

Enacted in 1971, the State Environmental Policy Act (SEPA) (Chapter 43.21C RCW) provides the framework for Washington State agencies to consider the environmental consequences of a proposal before taking action. It also gives these agencies the ability to condition or deny a proposal due to identified likely significant adverse impacts. SEPA provides a way to identify possible environmental impacts that may result from governmental decisions. These decisions may be related to issuing permits for private projects, constructing public facilities, or adopting regulations, policies, or plans. Information provided during the SEPA review process helps agency decision-makers, applicants, and the public understand how a proposal would affect the environment. This information can be used to change a proposal to reduce likely impacts, or to condition or deny a proposal when adverse environmental impacts are identified. SEPA applies to decisions by every state and local agency within Washington State, including state agencies, counties, cities, ports, and special districts (such as a school or water district). The Applicant has undertaken an independent review under SEPA for the Project.

1.7.6.2 Washington Forest Practices Act

The Washington Forest Practices Act (WFPA) and its corresponding rules are administered by the Washington Department of Natural Resources (WDNR). Forest practice is any activity conducted on or directly pertaining to forest land and relating to growing, harvesting, or processing timber or removing forest biomass (Washington Administrative Code[WAC] 222-16-010). The WFPA and its corresponding rules regulate these activities on state and private timber lands in the state of Washington. A forest practice permit must be obtained for activities on forest lands involving harvesting, road construction, rock pits, and installation or change of culverts and/or bridges. Conversion of forest lands from commercial production must be disclosed and authorized. While the Project is compatible with silvicultural operations, it will necessarily require the conversion of forest lands; and, as such, the Applicant will comply with the Forest Practices Act and requisite General Forest Practice Permits in consultation with DNR.

CHAPTER 2.0 – PROJECT DESCRIPTION AND COVERED ACTIVITIES

2.1 PROJECT DESCRIPTION

The Applicant is proposing to operate a utility-scale wind energy generation facility located in both Lewis and Thurston Counties in southwestern Washington. The proposal to develop the Project is in response to increasing demands for electricity and the requirement under Washington law that utilities meet a defined portion of their customer demand from clean, renewable sources of energy.

The Project is a renewable energy generation facility that would consist of 38 wind turbines with a nameplate capacity of up to 137 MW and a proposed Commercial Operation Date (COD) by July 2019; however, permitted take (ITP) is to begin spring 2019. The majority of the Project would be located within Lewis County, with the remainder of the Project in Thurston County (**Figure 1**). The wind turbines would be located on private land owned by Weyerhaeuser and currently used for active silvicultural operations.

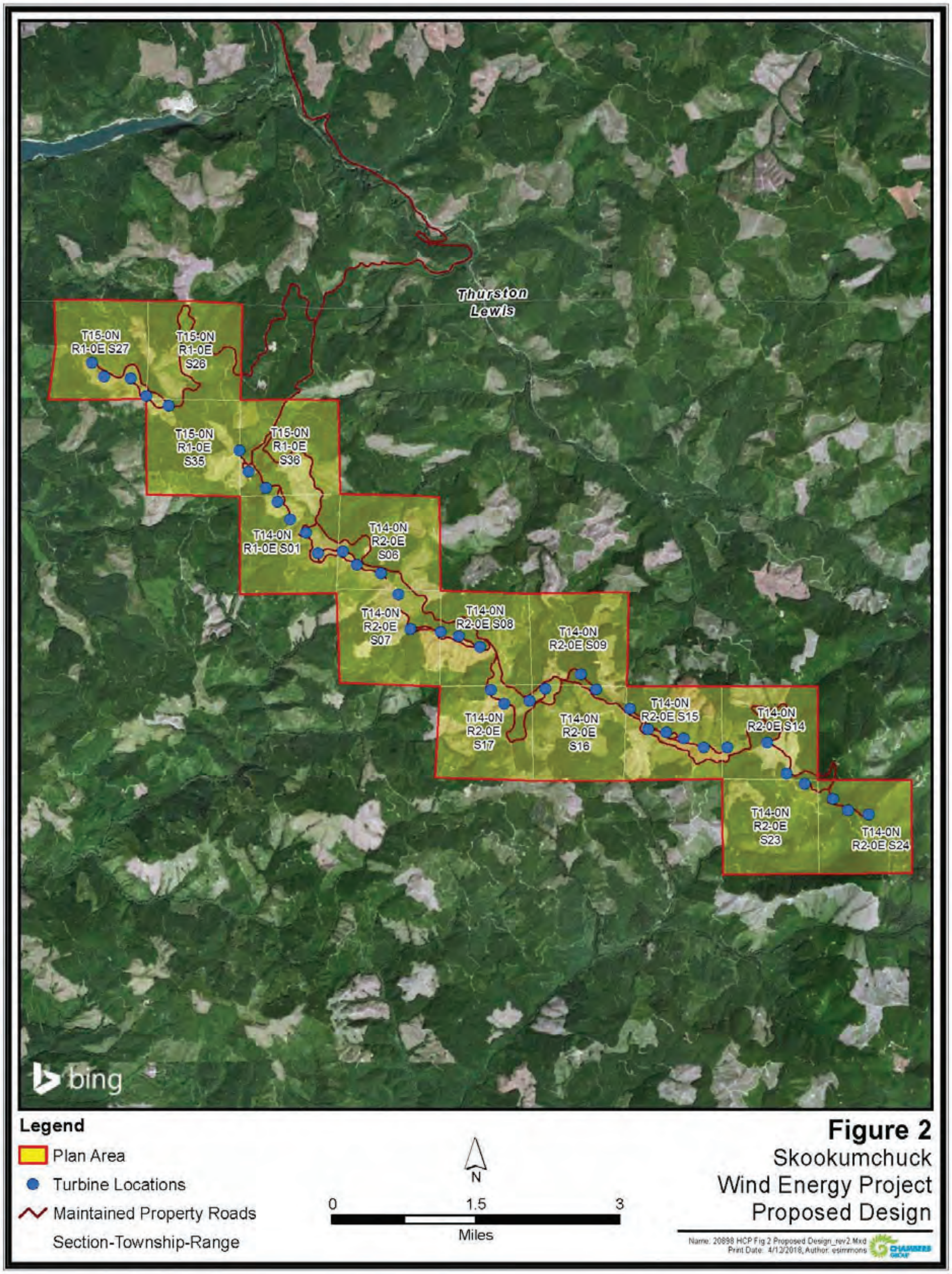
The Applicant will install 38 wind turbine generators capable of generating 2.4 to 3.6 Megawatts (MW) each within the Plan Area (**Figure 1**). The Applicant anticipates that turbines will have a 136-meter (446-foot) rotor diameter and an 82-meter (269-foot) hub height. The towers are mounted on a reinforced concrete foundation. The tower foundations may be either a spread footing or pier-type footing. The tower is tapered from the base to the hub, with a base diameter of approximately 4.3 meters (14 feet). The tower is hollow and houses a ladder to access the nacelle and electrical components. A controller box is situated at the base within the tower. Regardless of the footing type, a cleared area consistent with monitoring requirements will be permanently maintained around each turbine.

Medium voltage (MV) collection cables will collect power generated by the turbines. The Applicant will clear collecting line rights-of-way (ROWs) to maintain a ROW of approximately 4.88 meters (16 feet) in width to allow for continued access. Where reasonably possible, the Applicant will place MV collection cables under and/or along access roads so that the workspaces overlap.

The Applicant will use existing private access logging roads within the Plan Area to the extent practical. However, the Applicant will need to upgrade some existing roads and construct new roads to provide sufficient access to the Plan Area. The Applicant will use approximately 27 miles of improved or new access roads within the Plan Area. The MV collection cables will not exceed 17 miles and will transport power from turbines to a substation that the Applicant will construct within a fenced area of no more than 5 acres. The Applicant will permanently clear the area within the substation fence and will install a medium voltage electrical bus, electrical protection equipment, metering, communication equipment, and a main power transformer (**Figure 2**).

The Applicant has proposed a turbine curtailment regime as a part of standard operations of the Project to minimize potential collisions with murrelets during Project operation. Seasonal turbine curtailment will be applied to turbines that had the highest murrelet passage rate during pre-construction radar surveys. During the first three years of operation, the maximum curtailment at the facility will include seasonal curtailment from May 1 to August 9 at 10 turbines (T1 through T5 and T34 through T38) located at the eastern and western ends of the Project for a period of three hours each morning (i.e., 1.75 hours before dawn and 1.25 hours after dawn). This time period corresponds to the high-use flight

Figure 2: Plan Area and Design Limits



period when murrelets travel between their marine foraging habitats and inland nesting habitat (see **Chapter 3**). Modifications to the curtailment program (e.g., duration and location of turbine curtailment) after the first three years of operations will be based on results collected during post-construction compliance monitoring (see **Section 6.3**) and will be triggered through the Adaptive Management strategy (see **Section 6.4**). Furthermore, reduced seasonal curtailment could occur if alternative take reduction strategies, such as radar, are demonstrated to be effective (see **Section 7.1.1**).

As part of the proposed Project and in accordance with the Land-based Wind Energy Guidelines (WEG; USFWS 2012a), the Applicant will develop and implement a Bird and Bat Conservation Strategy (BBCS) prior to commencement of operations. The BBCS will be a living document and, where its provisions overlap the Covered Activities in the HCP (see **Section 2.3),** it will be designed to be consistent with this HCP.

2.2 ADHERENCE TO LAND-BASED WIND ENERGY GUIDELINES

The USFWS issued its voluntary Land-based WEG in 2012 and its Eagle Conservation Plan Guidance (ECPG) – Module 1 Land-based Wind Energy Version 2 in 2013. While both the WEG and ECPG are voluntary, it is the Applicant's policy to adhere to both sets of guidance. Project planning began prior to the finalization of both the WEG and ECPG; however, the Applicant's evaluation of the Plan Area was consistent with the approaches recommended in the WEG and ECPG. The ECPG recognizes that its "Stages" overlap with the WEG's "Tiers." Provided below, organized by Tiers and Stages, is a description of the actions the Applicant took to evaluate, avoid, and minimize impacts to protected wildlife to inform Project siting.

2.2.1 Tier 1/Stage 1 – Preliminary Site Evaluation (Landscape Scale Screening)

The intent of the Tier 1 analysis of the WEG is to identify landscape scale factors that could be important to wildlife such as large blocks of intact native habitat or intact ecological communities. Further, the analysis considers if a wind project is proposed in designated critical habitat for sensitive species. Similarly, Stage 1 of the ECPG is a landscape scale analysis where a developer considers the potential occurrence of breeding, wintering, or migrating eagles. The Applicant conducted a landscape level assessment of habitat for species of concern and requested existing information and literature from the USFWS and the Washington Department of Fish and Wildlife (WDFW) and met with both agencies in May of 2011. This information informed the Applicant's site selection and ultimately led to a site located on active logging/forest management lands, which aligns with the Tier 1/Stage 1 objectives of selecting a Project area that would avoid and minimize impacts to wildlife and other ecological values. Additionally, the Applicant's turbine layout limited turbines to the ridgeline, which does not contain habitat for species of concern. The Applicant also evaluated at other options near the current Project area within Weyerhaeuser lands, but these other sites could not meet other economic and environmental constraints affecting the economic viability of the Project.

2.2.2 Tier 2/Stage 1 – Site Characterization (Broad Characterization of One or More Potential Project Sites/Desktop Surveys)

Based on the information received and decisions made during Tier 1/Stage 1, the Applicant conducted desktop surveys of the Plan Area and prepared a Site Characterization Study. Desktop surveys concluded that the Project could potentially support two ESA-protected listed avian species (murrelets and northern spotted owl), four ESA-protected aquatic species (bull trout, Chinook salmon, coho salmon, and steelhead), and the two BGEPA-protected eagle species. The Applicant determined that it could avoid all impacts to the four protected aquatic species. The Project was originally intended to be 98 turbines. However, upon completion of desktop surveys, the Applicant discovered that preliminary turbine layouts overlapped with murrelet nesting areas and would be proximate to Spotted Owl Special Emphasis Areas (SOSEAs). The Applicant then decreased the size of the Project from 98 turbines to 61 turbines. This reduction moved the Project away from Skookumchuck Reservoir (with known eagle activity) and away from known SOSEAs and murrelet nesting areas to the southeast. This move allows the Applicant to further reduce impacts and risk of take of the Covered Species. The Applicant communicated the results of its Tier 1 and 2 site characterizations to the USFWS and WDFW in June of 2012. The Applicant then communicated the current layout during the 2013 and 2014 discussions regarding survey approaches, described below. In 2017 the Applicant reduced the Project to 38 turbines, further minimizing Project impacts to wildlife, including the murrelet, golden eagle, and bald eagle.

2.2.3 Tier 3/Stage 2,3,4 – Field Studies to Document Site Wildlife and Habitat and Predict Project Impacts

The Applicant presented its initial survey protocols to the USFWS and WDFW, and the agencies supported the presented approach. General avian use studies and murrelet-specific studies started in 2013 and continued in 2014 (further detail on the murrelet studies is provided in **Chapters 3 and 5** and Appendix A). The Applicant conducted eagle use surveys in 2015 through 2017 and added IdentiFlight® Scout units for survey support in 2017 (further detail on the eagle use surveys and use of IdentiFlight® is provided in **Chapters 3 and 5**). The results of the general avian studies and greater detail about survey methodology are described in the Project's BBCS. The Applicant conducted bat acoustic surveys in 2015 and again in 2017. The Applicant added the second round of bat acoustic surveys in response to USFWS and WDFW recommendations of August 26, 2016, and September 1, 2016, respectively. These surveys are described in more detail in the BBCS.

In response to the Tier 3 surveys, the Applicant removed the two turbine locations nearest to Skookumchuck Reservoir in the northwest portion of the Plan Area. The eagle use surveys indicated higher eagle use in the vicinity of these two turbines in comparison to the rest of the Project. Throughout this time, the Applicant continued to coordinate with the USFWS and WDFW with respect to potential impacts to murrelets and bald and golden eagles in efforts to develop this HCP.

2.2.4 Tier 4/Stage 5 – Post-Construction Studies

The Applicant's approach to post-construction monitoring is provided in **Section 6.3**.

2.2.5 Tier 5/Stage 5 – Other Post-Construction Studies and Research

Additional post-construction monitoring and/or responsive actions to be taken are provided in **Section 6.3**.

2.3 COVERED ACTIVITIES

The Covered Activities are the operation and maintenance of the Project (including emergency repairs and responses). These are the Project activities that the Applicant has determined have a reasonable potential to take murrelets, bald eagles, or golden eagles. The Applicant has determined that take is not reasonably certain to occur during the construction or decommissioning of the Project (including for example, road construction) nor during the operation of the Project's generation tie line (gen-tie line). As such, the Applicant is not requesting take coverage for these activities, and they are excluded from Covered Activities. The Applicant would assume all legal liability for take resulting from construction of the Project or other activities excluded from Covered Activities.

CHAPTER 3.0 – COVERED SPECIES

3.1 COVERED SPECIES

3.1.1 Murrelets

The murrelet is a small seabird of the Alcidae family that inhabits nearshore marine environment in western North America. It has the unusual behavior among seabirds of flying considerable distances inland during the breeding season to establish nest locations. Murrelets forage in the marine environment and may fly up to 55 miles inland, where they nest and rear a single young on large tree limbs in mature and old conifer forests. Except where indicated, information included in this section was transcribed primarily from the Periodic Status Review for the Murrelet for Washington State (Desimone 2016).

3.1.1.1 Status and Distribution

The species was listed as threatened under the ESA in 1992 in Washington, Oregon, and California, primarily due to loss of old forest nesting habitat from commercial timber harvesting and mortality associated with net fisheries and oil spills, and was subsequently listed by the Washington Fish and Wildlife Commission as threatened in 1993.In October 2016, the Washington Department of Fish and Wildlife released the Periodic Status Review for the murrelet and recommended the up-list of the murrelet to endangered; the murrelet is now listed as a State Endangered Species (Desimone 2016).

Figure 3: Murrelet Conservation Zones

In 1997, Washington enacted State Forest Practices Rules to address impacts to murrelet from timber management on non-federal lands. The murrelet is considered threatened south of its Alaskan breeding range by federal and state agencies and Canada (Burger 2002; Piatt et al. 2007).

Murrelets are found in coastal marine areas (generally within 5 to 8 kilometers [km]) of shore) from the Aleutian Islands of Alaska south along the Pacific coast to central California (Ridgley et al. 2007; Nelson 1997). Six murrelet Conservation Zones have been designated for the ESA-listed population. Five of the murrelet Conservation Zones (1-5) are monitored by the Northwest Forest Plan (NWFP) Effectiveness Monitoring Program (**Figure 3**). Two of these zones are located in Washington: Zone 1 includes the Strait of Juan de Fuca, Hood Canal, Puget Sound, and the San Juan Islands; and Zone 2 includes the Washington outer coast.

Examination of population trends by conservation zone suggests a clear decline in Washington's inner waters (Zone 1) and a possible decline in coastal waters of Zone 2 (Lance and Pearson 2016). The overall Washington murrelet population declined 4.4 percent per year from 2001 to 2015 (Lance and Pearson 2016).

Falxa et al. (2016) did not find evidence of a declining trend in California or Oregon. Over all zones, Falxa et al. (2016) estimated that the population declined 1.2 percent per year over the period from 2001 to 2013; but it should be noted that the evidence for a population decline at the scale of the entire NWFP is inconclusive. The NWFP area trend for this period differs from the population decline previously observed for the 2001 through 2010 period (Falxa et al. 2016). This difference was the result of higher population estimates in Oregon and northern California for 2011 through 2013 compared to previous years (Falxa et al. 2016).

In Washington, the current and historical marine distribution of murrelets includes the southern Salish Sea (Puget Sound, Strait of Juan de Fuca) and the outer coast. The known terrestrial nesting habitat distribution includes western Washington coniferous forest within about 55 miles of marine waters, which is the extent of the habitat analysis area as defined in the federal Northwest Forest Plan (Raphael et al. 2016). Nest locations in Washington have been documented from near sea level to 4,200 feet elevation and inland to about 47 miles from nearest marine water. An audio detection 70 miles from marine waters has been recorded (USFWS 2016b). Analyses of genetic samples from Washington (Bloxton and Raphael 2009), Oregon, and California helped confirm an earlier finding that murrelets from mainland Alaska to northern California (the main genetic unit) are genetically distinct from peripheral populations in the central and western Aleutian Islands and from central California (Friesen et al. 2007).

The highest densities of murrelets in Washington waters during the breeding season are found on the northern outer coast, northern Puget Sound, and the Strait of Juan de Fuca (Miller et al. 2006; Lance et al. 2013; Lance and Pearson 2016; Falxa et al. 2016; **Figure 3**). Larger areas of mature and old forests adjacent to those areas provide high quality potential nesting sites for murrelets. In Washington, straight-line distance from a known nest to the nearest marine shoreline ranged from 4 to 58 kilometers (km) (2.5 to 36.5 miles; WDFW 2016). There is considerable variation in home range size and movement behavior across the species' range (Hull et al. 2001; Bloxton and Raphael 2009; Barbaree et al. 2014). In Washington, movements of radio-marked birds between the outer coast, Puget Sound, and Strait of Juan de Fuca were all observed within a season, indicating that some individuals incorporate substantial movements to secure food resources and may use portions of multiple marine regions in a single year. Several murrelet radio-tagged in Washington waters were later located along Vancouver Island to Desolation Sound (Bloxton and Raphael 2009). A bird nesting in the Hoh River drainage of the Olympic Mountains regularly foraged in the San Juan Islands, making daily flights of about 112 km (70 miles) from the nest and sometimes visiting the Washington outer coast. A murrelet nesting in the Cascade Range foraged in the San Juan Islands more than 120 km (75 miles) from the nest (Bloxton and Raphael 2009). The mean home range of adults over five breeding seasons varied from 944 to 1802 square kilometers (km^2) (range 13 to 7,816 km^2) including marine water, land area, and travel corridors (Bloxton and Raphael 2009). Northern California breeding season marine foraging areas (land excluded) were 505 ±75 km^2 (Hebert and Golightly 2008).

In the Bloxton and Raphael study (2009) conducted in the Pacific coast of northwestern Washington, nest-to-sea commuting distances were found to be greater than previously recorded and at a maximum of 145.3 km. Four of twenty breeders in that study traveled greater distances than the previously reported maximum distance (124 km) from nests to sea. Further, Lorenz et al. (2017) determined marine ranges of murrelets for breeding and nonbreeding murrelets were greater than reported previously at 708 km^2. These results may indicate "poor marine habitat in this region, or at least marine habitat that is less productive than other parts of the murrelet's range" (Lorenz et al. 2017).

3.1.1.2 Habitat Characteristics and Use

Murrelets exhibit strong site fidelity to nesting areas, and can nest consecutive years, but appear to nest in alternate years, on average, and have a naturally low reproductive rate (Hull et al. 2001; Bloxton and Raphael 2009). The species is unusual among Alcids in that it does not nest in colonies at the marine-terrestrial interface. In the central and southern parts of its range, including Washington, the murrelet nests in coastal forests (Bradley and Cooke 2001; Barbaree et al. 2014).). During April to mid-September, breeding murrelets make daily flights from marine foraging areas to tend inland nest sites.

In Washington, murrelets usually nest in older forests dominated by western hemlock (*Tsuga heterophylla*), Sitka spruce (*Picea sitchensis*), Douglas-fir (*Pseudotsuga menziesii*), and western red cedar (*Thuja plicata*) trees that have large branches that support substantial moss, epiphytes, and debris to form platforms on which a single egg is laid (Hamer and Nelson 1995; Ralph et al. 1995; Nelson 1997; Wilk et al. 2016). While most nests are on large limbs (e.g., 30 to 75 centimeters in width) of trees that are greater than 150 years old (Hamer and Nelson 1995; Burger 2002; Wilk et al. 2016), relatively younger patches of predominantly western hemlock (70 to over 100 years old) with mistletoe infection, moss, and epicormic branching have been used for nesting in southwestern Washington (Hamer and Nelson 1995). Nesting habitat includes forest structure of sufficient height and depth to provide vertical and horizontal cover to the nest and nest tree. This structure appears to enhance microclimate conditions and minimizes predation risk by providing hiding cover (Raphael et al. 2002; Meyer et al. 2004; Huff et al. 2006).

3.1.1.2.1 Foraging (Marine) Habitat and Diet

Murrelets forage in marine waters, usually within 2 to 8 km of shore (Nelson 1997; Hebert and Golightly 2008). Murrelets prey primarily on forage fish such as Pacific herring (*Clupea pallasii*), northern anchovy (*Engraulis mordax*), eulachon (*Thaleichthys pacificus*), Pacific sand lance (*Ammodytes hexapterus*), surf smelt (*Hypomesus pretiosis*), juvenile rockfish (*Sebastes* spp.), and juvenile salmon (*Oncorhynchus* spp.). Fish regularly comprise 60 to 100 percent of the diet; and larger zooplankton, such as krill (Euphausiacea) and Mysiids, are also taken (Ralph et al. 1995; Nelson 1997; Carter and Sealy 1986; Hobson 1990; Piatt et al. 2007). Murrelet have occasionally been observed using larger freshwater lakes in close proximity to marine areas for limited resting and foraging (Carter and Sealy 1986; WDFW 2016).

3.1.1.2.2 Breeding and Nesting Habitat

The murrelet breeding season in Washington covers a period extending from late March to late-September with peak inland activity occurring from June to late September (Hamer and Nelson 1995; Huff et al. 2006; USFWS 2012a). During breeding season, flights by adults to inland nests occur at all times of day but most often at dawn and dusk (Hamer and Nelson 1995).

Murrelets do not construct a typical nest structure and instead lay a single egg in a small depression in moss or debris. As a result, nest trees must have large branches or other deformities that provide suitable structure for nesting (Nelson 1997). Nest stands are generally composed of low-elevation conifers; and, of 51 nests found in Oregon and Washington, 35 (68.6 percent) were in Douglas-fir, 14 (27.4 percent) in western hemlock, and 1 each (2.0 percent each) in Sitka spruce and western red cedar (Nelson 1997).

Both sexes incubate eggs in alternating 24-hour shifts, and chicks are fed an average of four times daily (Desimone 2016). Although less common, murrelets may also visit inland breeding sites during the winter, presumably to visit previous nest sites or prospect for new nest sites (Desimone 2016).

3.1.1.3 Occurrence in the Permit Area

Suitable nesting habitat for murrelets is not present within the Plan Area; however, WDFW data indicate a known occupied site on Weyerhaeuser property approximately 0.4 mile from the closest wind turbine. Data from WDFW show a cluster of murrelet detections dating from 1995 through 1997. Murrelets also likely nest in the adjacent Critical Habitat on Gifford Pinchot National Forest and Mount Rainier National Park, as some occupied sites have been documented there.

A Radar and Visual Study of murrelets was conducted in the summers of 2013 and 2014 (Sanzenbacher et al. 2015; Appendix A) to quantify and characterize flight patterns of murrelet at the Project and assess potential risk of murrelet collision fatalities at proposed turbines. The specific objectives were to collect information on the number, flight paths, and flight altitudes of murrelet flying over the proposed Project during the summers of 2013 and 2014 and use those data to (1) calculate an exposure rate estimating the frequency that murrelets would pass within the airspace occupied by the proposed turbines, and (2) estimate the annual number of potential collision fatalities.

Surveys were conducted at 10 different point count locations during the summer breeding period of murrelets (mid-May to early August) during the morning activity period for murrelets (i.e., from 105 minutes before sunrise to 75 minutes after sunrise). Each survey included concurrent surveillance and vertical radar sampling and also a dedicated audiovisual observer. A total of 50 surveys were conducted in 2013, and 70 surveys were conducted in 2014. A total of 26 murrelet radar targets (pre-sunrise landward and seaward targets) were observed in 2013 (0 to 7 targets per station), and 47 murrelet targets were observed in 2014 (2 to 7 targets per station). The mean pre-sunrise murrelet passage rate (landward + seaward targets per day) was 0.52 plus or minus (±) 0.11 targets per day in 2013 and 0.70 ± 0.06 targets per day in 2014. The overall passage rate averaged across both seasons was 0.61 ± 0.09 targets per day.

Flight directions of murrelet targets were variable at each station, but the percentage of landward flying versus seaward flying murrelet targets was 38 percent landward and 62 percent seaward in 2013 and 40 percent landward and 60 percent seaward in 2014. Vertical radar was used to measure flight altitudes of 21 murrelet targets concurrently detected on surveillance radar. The mean flight altitudes of these targets, measured relative to the elevation of the Project ridgelines where turbine strings are proposed, was 219.3 ± 34.6 meters above ground level (agl). A Weibull distribution was fit to the observed flight heights in the radar study. Based on the fitted distribution, the proportions of flights below turbine height (150 meters) was 0.402.

3.1.2 <u>Eagles</u>

3.1.2.1 Bald Eagle Status and Distribution

Bald eagles are thought to have declined with the loss of habitat and persecution associated with early European settlement in North America. In 1940, recognizing the accumulating threats to bald eagles, Congress enacted the Bald Eagle Protection Act, which was amended in 1962 to become the BGEPA with the addition of protection for the golden eagle (Millsap et al. 2007). Continued population decline of bald eagles, primarily attributed to the use of dichloro-diphenyl-trichloroethane (DDT), resulted in bald eagles being listed under the Endangered Species Conservation Act in 1967 and later under the ESA as threatened or endangered everywhere in the United States except Alaska (Millsap et al. 2007; 43 Federal Register [FR] 6230, February 14, 1978). In the four decades since registration of DDT was cancelled by the U.S. Environmental Protection Agency (USEPA) in 1972, bald eagle numbers have rebounded (Buehler 2000). By 1999, the USFWS proposed to remove the bald eagle from the list of threatened and endangered species; and in July 2007, USFWS completed that action (72 FR 37346-37372). The species is currently protected by BGEPA, MBTA, and the Lacey Act.

Bald eagles are distributed widely across North America where aquatic habitats are found, including marine coasts (oceans, bays, and estuaries), rivers, and lakes. The breeding distribution extends from Alaska across northern Canada and south throughout the lower 48 states, with largest populations along the coasts and larger inland waterways. During the non-breeding season, bald eagles are primarily associated with aquatic areas that remain unfrozen and support an abundance of food. They can form large aggregations during the winter and migratory periods.

3.1.2.2 Bald Eagle Habitat Characteristics and Use

Bald eagles range over large geographic areas and use a variety of habitats. Bald eagles are typically found near bodies of water such as the shorelines of lakes, rivers, and coastal areas (USFWS 2016c). Bald eagles may adjust habitat use based on the time of year (e.g., breeding, migration, wintering), prey availability, nesting territory availability, and disturbance (Buehler 2000; Kochert et al. 2002).

Bald eagles generally nest in mature trees or snags in forested areas near bodies of water that offer foraging opportunities (Buehler 2000). They do rarely nest on cliffs, in short trees/shrubs, and on the ground in areas where there are no trees. They also nest with increasing frequency on human-made structures such as power poles and communications towers (Millsap et al. 2004). Forest size and structure, quality of foraging areas (distance, prey diversity and availability), and low human disturbance are generally key habitat factors that influence the selection of nesting territories (Buehler 2000; Livingston et al. 1990).

Migrating and wintering bald eagles can be highly social, frequently gathering in large numbers in areas near open water or other areas rich in food resources such as freshwater and saltwater fishes, waterfowl, turtles, rabbits, snakes, and other small animals and carrion (Buehler 2000; Mojica et al. 2008; USFWS 2016c). Recent studies show that bald eagles use networks of communal roosts strategically associated with foraging areas, and individuals may move daily between regional roosts (Watts and Mojica 2012).

3.1.2.3 Golden Eagle Status and Distribution

Golden eagles are distributed throughout the Northern Hemisphere primarily between 20 degrees and 70 degrees North latitudes (Watson 1997). In North America, the species is most abundant west of 100 degrees West longitude from the arctic slope to central Mexico (Kochert et al. 2002). The golden eagle is a permanent resident and migrant throughout much of Washington. Golden eagle habitat typically includes rolling foothills, mountain areas, sage-juniper flats, and desert. Golden eagles prey mostly on hares, rabbits, and rodents but will eat other mammals, birds, reptiles, and some carrion. This species needs open terrain for hunting such as grasslands, deserts, savannahs, and early successional stages of forest and shrub habitats (Zeiner et al. 1988-1990). Golden eagles breed west of the Cascades in Washington, often on cliffs or in trees where logging has created early successional stages of forest. At several nests monitored in western Washington, mountain beavers appeared to make up a relatively large percentage of their diet (Hansen 2017). Nests/territories in these areas are difficult to locate and monitor since nests are often in very remote areas with dense tree growth, and the eagles also can move relatively frequently.

USFWS (2016c) updated estimates of golden eagle population size and trend for the western United States for the period 1967 through 2014, using a model that integrated data from a late summer aerial transect survey of golden eagles conducted annually since 2006 with Breeding Bird Survey (BBS) counts; see Millsap et al. (2013) for more details on this approach. The updated analysis indicated a late summer population averaging 31,000 (20th quantile = 29,000) over the most recent decade (Figure 3-13 in the PEIS (USFWS 2016d) and Figure 7 in USFWS 2016a), and total coterminous western United States population of 30,000 (20th quantile = 27,000) for 2009. Population trends for this species across its range appear to be slightly negative (i.e., populations declining). As such, the USFWS has set the threshold for authorized take of this species at zero throughout the country unless compensatory mitigation is provided at a rate of 1.2 :1.

The species is currently protected by BGEPA, MBTA, and the Lacey Act.

3.1.2.4 Golden Eagle Habitat Characteristics and Use

Golden eagles range over large geographic areas and use a variety of habitats and tend to occupy the more mountainous terrain and open, arid areas typical of the western United States (USFWS 2016c) when compared to bald eagles. Both eagle species may adjust habitat use based on the time of year (e.g., breeding, migration, wintering), prey availability, nesting territory availability, and disturbance (Buehler 2000; Kochert et al. 2002). When combined, the habitat used by bald and golden eagles includes most of the United States (USFWS 2016c).

Golden eagles in the western United States breed in open or semi-open areas in a wide variety of habitats (e.g., tundra, shrubland, grassland, desert rimrock) but generally avoid urban and heavily-forested areas (Kochert et al. 2002). Golden eagles usually nest on rock ledges and cliffs but also in large trees, steep hillsides, or rarely on the ground (Kochert et al. 2002). Nesting territories are often associated with rugged terrain in suitable vegetation types with limited human development and healthy prey populations (Baglien 1975; Craig and Craig 1984; Millsap and Vana 1984; Bates and Moretti 1994). Golden eagles no longer breed in the eastern United States (Palmer 1988) but continue to breed in northeastern and north-central Canada and migrate from there to wintering areas in the forested Appalachian Mountains and coastal bays and estuaries in the eastern United States (Katzner et al. 2012).

When migrating, golden eagles are associated with geographic features such as cliff lines, ridges, and escarpments, where they take advantage of uplift from deflected winds. They often forage over open landscapes, using lift from heated air (thermals) to move efficiently (USFWS 2016a). Golden eagles can be found throughout much of the United States in the winter in a variety of habitats (sagebrush, riparian, grassland, and cliff areas), including grazed areas (Kochert et al. 2002; Marzluff et al. 1997). In the eastern United States they frequent areas that support large concentrations of waterfowl (Millsap and Vana 1984; Wingfield 1991) as well as relatively densely forested mountainous areas (Katzner et al. 2012).

3.1.2.5 Occurrence of Eagles in the Plan Area

Alaska Biological Research, Inc. (ABR) conducted a full year of pre-construction studies of avian use of the Plan Area from winter 2014 through fall 2015. Results are provided in Appendix B. The primary goal of the study was to obtain information on the annual spatial and temporal use of all birds in the Plan Area. The specific objective was to conduct avian use surveys using point count methods to describe the relative abundance, distribution, and flight characteristics of birds in the Plan Area and derive standard exposure indices for estimating potential risk of collision. ABR made a total of 36 visits to the site and conducted a total of 291 individual 20-minute point count surveys at nine survey stations. A total of 68 species were detected on surveys.

Large avian use studies were conducted by Chambers Group, Inc. (Chambers Group) from January 2016 through March 2017 and were conducted by Western EcoSystems Technology, Inc. from April through December 2017 (**Figure 4**). Large avian species including those that are generally larger than the size of an American crow (*Corvus brachyrhynchos*) were recorded during surveys. Species and number of individuals were documented during surveys. Data were collected during two-hour intervals during the 2016 use studies (Year 1) at point count locations 5, 6, 7, 8, 9 (**Figure 5)**. Surveys were conducted twice monthly for a total of 20 hours of observation monthly in Year 1. In 2017 (Year 2) point count locations 12 and 13 were added, totaling seven point count locations. Beginning in April of Year 2, methodology was updated to better conform to data standards in the revised eagle rule. Specifically, eagle-minutes (i.e., flying within 800 meters of the observer and below 200 meters above ground level) were recorded from April – December 2017 but not from January 2016 – March 2017. Each station was surveyed for one hour each month in Year 2, totaling seven hours of observation monthly.

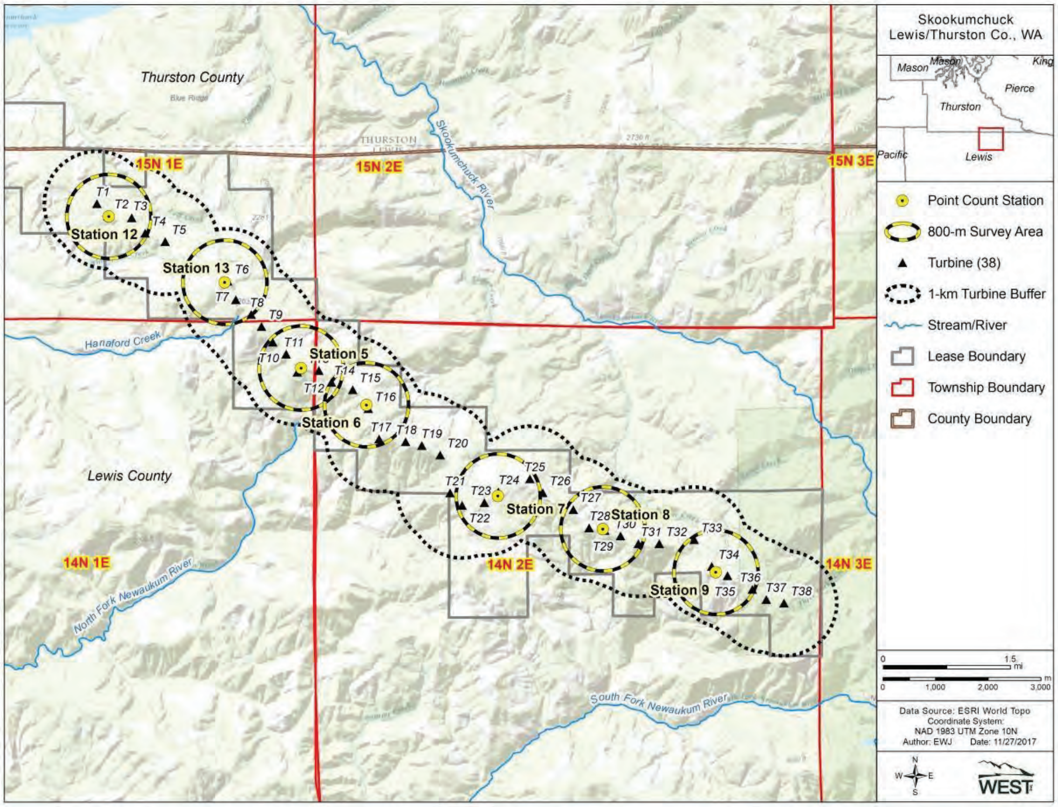


Figure 4: Point Count Locations for Large Avian Use Surveys Used in 2016-2017 at the Skookumchuck Wind Project Plan Area
(Stations 12 and 13 were sampled in 2017 only)

Bald Eagles – January 2016 – March 2017: A total of 51 bald eagle observations were recorded during the Year 1 survey period; and, on average, 0.20 bald eagles per hour were observed (**Table 1**). Bald eagles were observed most frequently in the spring and winter compared to other seasons (**Table 1**). Bald eagle use among seasons was driven by high use during October, February, June, and January; and these months have higher use than all other months (**Figure 5**). Bald eagle use was lowest in August and December when no observations were recorded. Bald eagles were detected at all stations, with the highest use recorded at stations 5 and 6 (**Table 2**). Station 13 was added in January 2017, and two bald eagles were observed during four survey hours. Approximately 35 percent of the observations occurred at station 5 (n = 18) while 29 percent occurred at station 6 (n = 15). Use varied widely among points, with the highest value (station 5) being 4.2 times higher than the lowest value (station 7; **Table 2**).

Bald Eagles – April – December 2017: A total of 19 bald eagle observations were recorded during the partial Year 2 survey period (**Table 3**). Bald eagle use was highest in spring and winter compared to other seasons; however, data from the winter season were collected only during the month of December (**Table 3**). Bald eagle use among seasons was driven by high use during May, June, September, and December; these months have higher mean use than all other months (**Figure 6**). No bald eagles were recorded in April, July, October, and November. Bald eagles were detected at all point count locations, with the highest use recorded at station 8 with higher use relative to the other stations. At each of the remaining point count locations, use was represented by one or two bald eagle observations. Bald eagles were recorded flying for a total of 89 minutes during which they were flying below 200 meters above ground level in height and within 800 meters of the observer (cylinder of risk) for 63 minutes (43.8 percent) during 63 hours of survey. Time (minutes) spent flying in the cylinder of risk was highest in May, June, and September and highest at point count location 8.

Table 1: Seasonal Detection Rates of Eagles at the Plan Area, January – December 2016

Season	Number of 60-minute Surveys	Observations			Seasonal Mean Use (observations/hr of survey)		
		Golden Eagle	Bald Eagle	Unid[a] Eagle	Golden Eagle	Bald Eagle	Unid Eagle
Winter (Dec 1–Feb 29)	65.00	10	19	6	0.15	0.29	0.09
Spring (Mar 1–May 31)	73.83	3	16	1	0.04	0.22	0.01
Summer (June 1–Aug 31)	60.00	1	7	1	0.02	0.12	0.02
Fall (Sept 1–Nov 30)	60.00	8	9	0	0.13	0.15	0.00
Total	258.83	22	51	8	0.08	0.20	0.03

[a] Unid = unidentified

Golden Eagles – January 2016 – March 2017: A total of 22 golden eagle observations were recorded during the survey period, and on average 0.08 golden eagles per hour were observed (**Table 1**). Use was highest in fall and winter compared to summer and spring (**Table 1**), and use showed limited variation among months where eagles were detected (**Figure 5**). Golden eagles were detected at all points except station 7 and station 12 and, although use varied among points, it was highest at point 8 (**Table 2**). Station 13 was added in January 2017, and two golden eagles were observed during four survey hours.

Table 2: Overall Mean Eagle Use by Survey Location at the Plan Area, January 2016 – March 2017

Locations	Number of 60-minute Surveys	Observations			Observations per Hour		
		Golden Eagle	Bald Eagle	Unid[a] Eagle	Golden Eagle	Bald Eagle	Unid Eagle
5	54.00	4	18	2	0.07	0.33	0.04
6	50.00	1	15	2	0.02	0.30	0.06
7	50.83	0	4	2	0.00	0.08	0.04
8	50.00	11	8	1	0.22	0.16	0.02
9	46.00	4	4	0	0.09	0.09	0.00
12	4.00	0	0	0	0.00	0.00	0.00
13	4.00	2	2	0	0.50	0.50	0.00
Unrecorded[b]	NA	0	5	1	NA	NA	NA
Total	**258.83**	**22**	**51**	**8**	**0.08**	**0.20**	**0.03**

[a] Unid = unidentified
[b] Eagles at unrecorded locations are not included in the total

Unidentified Eagles – January 2016 – March 2017: A total of eight eagle observations that could not be identified to species were recorded during the survey period, and 0.03 unidentified eagles per hour were observed (**Table 2**). Use was highest in winter compared to the other seasons (**Figure 5**), and use varied widely for months where eagles were detected. Unidentified eagles were detected at all points except stations 9, 12, and 13; and, although use varied among points, it was below 0.1 observations per hour for all points.

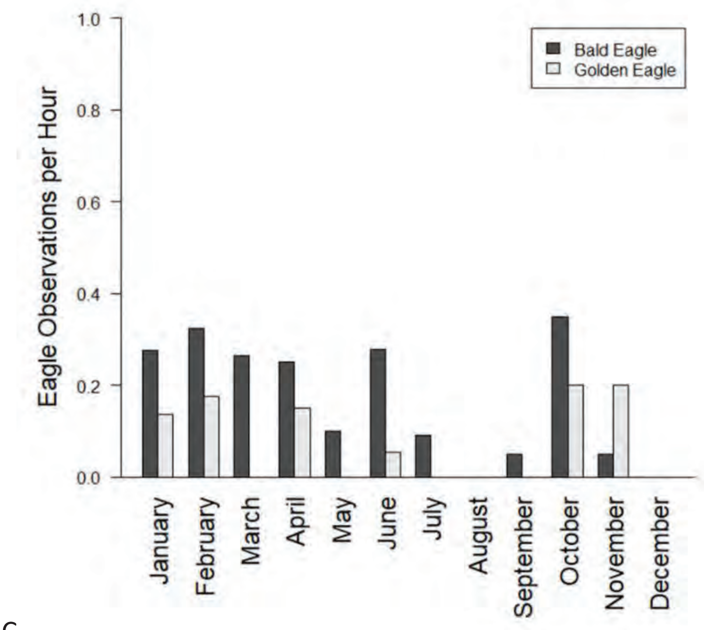


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Figure 5: Monthly Mean Bald Eagle and Golden Eagle (observations per hour) Plan Area, January 2016– March 2017

Golden Eagles – April – December 2017: One golden eagle observation was recorded during the partial Year 2 survey period, occurring in the fall season at station 13; and 0.02 golden eagles per hour were observed (**Table 3**). The single golden eagle was recorded flying for a total of 10 minutes during which it flew below 200 meters above ground level in height and within 800 meters of the observer (cylinder of risk) for six minutes (60.0 percent).

Table 3: Overall Mean Use by Survey Station at the Plan Area, April – December 2017

Station	Number of 60-min Surveys	Observations[1]		Seasonal Minutes of Eagle Observations			
				Golden Eagle		Bald Eagle	
		Golden Eagle	Bald Eagle	Total min	Min w/in 800 m & b/l 200 m[2]	Total min	Min w/in 800 m & b/l 200 m[2]
5	9	0	3	0	0	14	9
6	9	0	1	0	0	3	2
7	9	0	3	0	0	10	6
8	9	0	6	0	0	35	10
9	9	0	2	0	0	6	4
12	9	0	3	0	0	17	8
13	9	1	1	10	6	4	0
Total	63	1	19	10	6	89	39

[1] Data for winter season will be added upon study completion.

[2] Minutes of flying within 800 meters of the observer and below 200 meters in height.

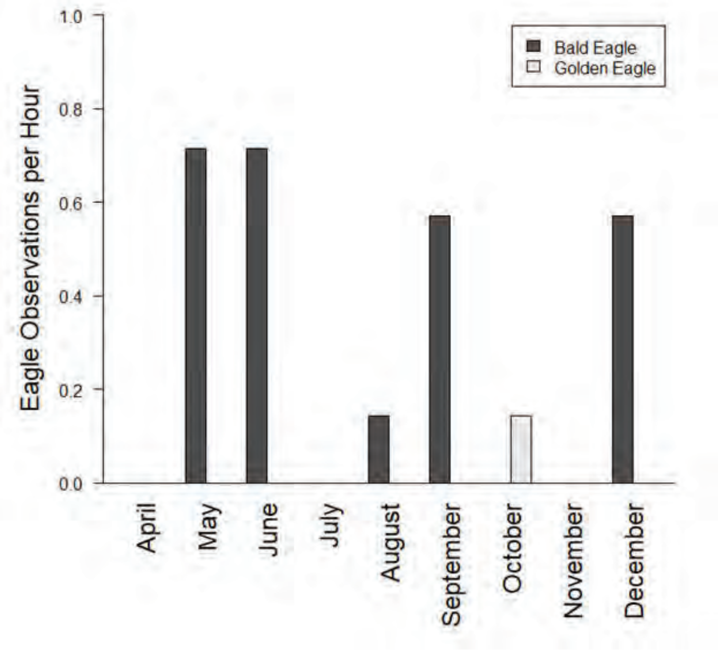


Figure 6: Monthly Mean Bald Eagle and Golden Eagle (observations per hour) Plan Area, April – December 2017

CHAPTER 4.0 – ENVIRONMENTAL SETTING AND BIOLOGICAL RESOURCES

4.1 ENVIRONMENTAL SETTING

The Project is located on land privately owned and operated by Weyerhaeuser and used for commercial silvicultural practices. The Plan Area for this HCP and the permit area for the ITP includes 9,697 acres within Lewis County, as shown on **Figure 1** and **Figure 2**. The following sections describe the general environmental setting of the Plan Area.

The Plan Area generally occurs within the Cascades Ecological Region (Tier III ecoregion), which stretches from the central portion of western Washington and south through the Cascade Range of Oregon, and includes a disjunct area around Mount Shasta in northern California (USEPA 2016a). The terrain of this ecoregion is characterized by steep ridges and river valleys with elevations ranging from 250 to 4,390 meters (820 to 14,402 feet). The Columbia River and associated tributaries is the dominant riverine system in this ecoregion. Vegetation within the ecoregion is characterized by highly productive coniferous forests with Douglas-fir, western hemlock, western red cedar, big leaf maple (*Acer macrophyllum*), and red alder (*Alnus rubra*) at lower elevations within the range of the Plan Area. A large portion of this ecoregion is federal land managed by the USFS and Bureau of Land Management (BLM) with the remainder held in state or private ownership.

4.1.1 Climate

The region experiences moderate temperatures throughout the year with maximum temperatures ranging from 4.4 to 26 degrees Celsius (°C) (40 to 78.8 degrees Fahrenheit [°F]) and minimum temperatures ranging from 1.1 to 11.2 °C (34.0 to 52.2 °F). Average annual precipitation is 118.1 centimeters (46.5 inches) with 15.2 centimeters (6 inches) of snowfall at lower elevations and greater snowfall at higher elevations (WRCC 2017).

4.1.2 Topography / Geology

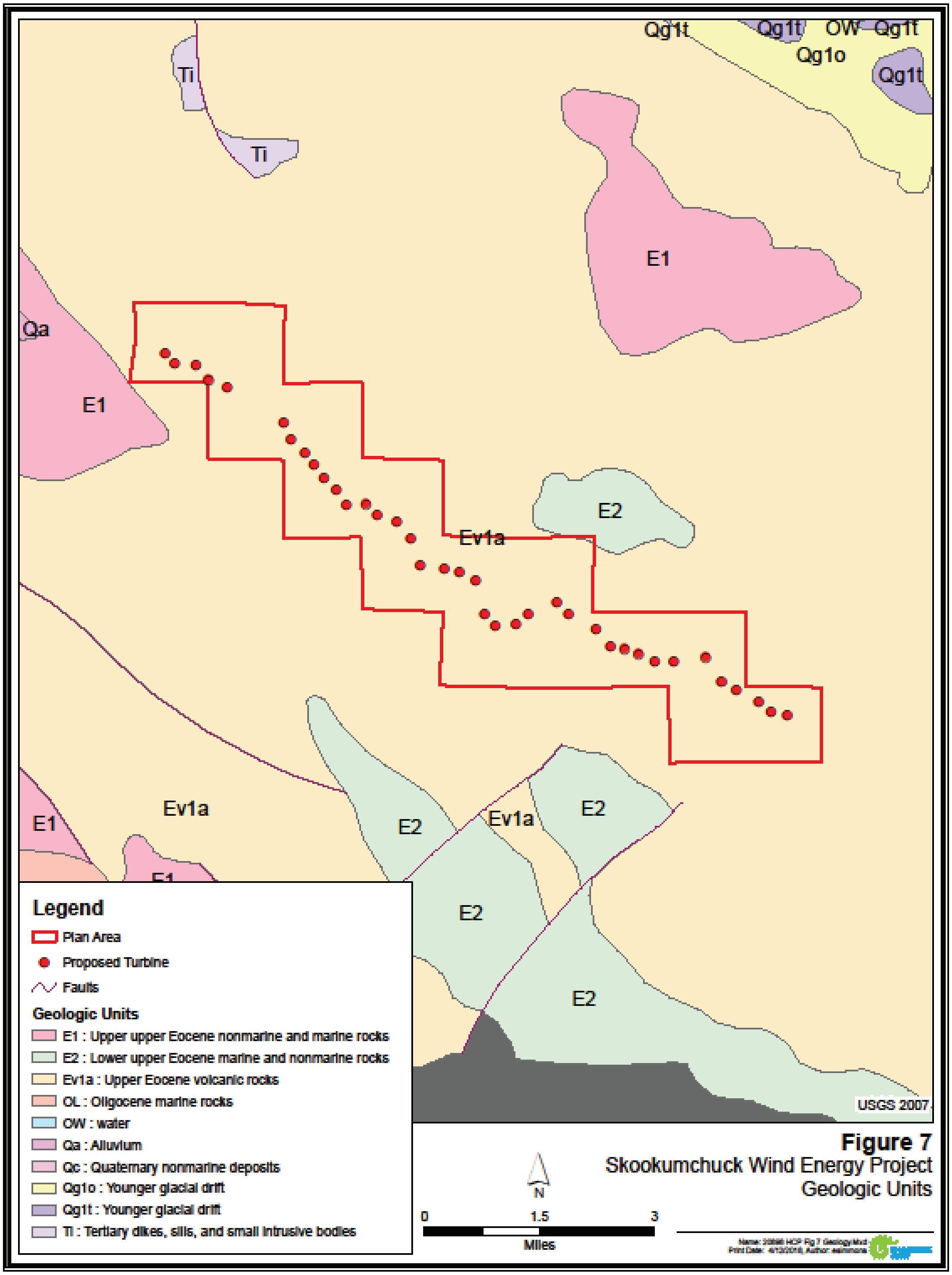
The Plan Area comprises a series of ridgelines that range in elevation from approximately 450 meters (1,476 feet) to 1,050 meters (3,445 feet) and are separated by lower elevation, stream-lined valleys. The Plan Area varies in steepness and slope, with turbines located on 1.5-percent to 12-percent slopes.

Geologic Units within and adjacent to the Plan Area are shown on **Figure 7**, and **Table 4** summarizes the representation of each geologic unit in the Plan Area.

Table 4: Geologic Units in the Plan Area

Geologic Unit & Composition	Geologic Age	Acres of the Plan Area	Percent of the Plan Area
Ev1a: Upper Eocene volcanic rockseading (basalt)	Late Eocene to Oligocene	9,542	99.9%
E1: Upper Eocene nonmarine and marine rocks (sandstone)	Middle Eocene	6	0.1%

Figure 7: Geologic Units in the Plan Area



General types of soils found in the Plan Area include Pheeny Baumgard complex, Baumgard-Rock outcrop complex, Schneider-Baumgard complex, Pheeny-Jonas complex, Schneider-Rock outcrop complex, Stahl-Reichel complex, Stahl-Rock outcrop complex, Baldhill very stony sandy loam, Baumgard loam, Mukilteo muck, Wilkeson silt loam, Chehalis silt loam, Mal clay loam, Jonas gravelly silt loam, Pheeny gravelly loam, Vailton silt loam, Centralia loam, Zynbar variant silt loam, Buckpeak silt loam, Cinebar variant silty clay loam, Winston gravelly loam, Stahl very gravelly silt loam, Melbourne loam, Schneider very gravelly silt loam, Reichel loam, Zynbar gravelly silt loam, Galvin silt loam, Stalcar variant muck, Godfrey silty clay loam, and McKenna gravelly silt loam, among others.

4.1.3 Water Quality / Water Quantity

Small areas of isolated wetlands and associated riparian habitats are located within the Plan Area. Wetlands identified by the National Wetland Inventory (NWI) and National Land Cover Database (NLCD) classifications cover less than 1 percent of the Plan Area. Larger water bodies within 300 feet of the Plan Area include Baumgard Creek, Bloody Run, Fall Creek, Hospital Creek, Hull Creek, Johnson Creek, Pipeline Creek, Run Creek, and various tributaries to other water bodies including Fall Creek, Mitchell Creek, Pheeny Creek, Skookumchuck Lake, Skookumchuck River, Thompson Creek, Deschutes River, and Laramie Creek.

4.1.4 Existing Land Use

The Project is located on land privately owned and operated by Weyerhaeuser and used for commercial silvicultural practices. The Plan Area is managed for timber extraction and consists of a series of private logging roads and stands of timber in the various stages of harvest. The timber extraction management will continue in the same manner during the life of the wind energy Project, except within the areas immediately around the turbines, which will be managed consistent with the Applicant's lease rights, and in accordance with monitoring plan conditions.

4.2 BIOLOGICAL RESOURCES: WILDLIFE, FISH, AND VEGETATION

4.2.1 Wildlife

Table 5 provides a list of species protected by the ESA or that are candidates for future protection and that may occur within Lewis or Thurston Counties, Washington. The Applicant evaluated the habitat requirements and known distribution of each of these species and assessed their likelihood of occurrence within the Plan Area.

Table 5: Federal Special Status Species Occurring in Lewis and Thurston Counties, Washington

Taxon Species	Status	Potential Occurrence in Plan Area
Birds		
murrelet	FT	Known – See **Section 3.1.1**
yellow--billed cuckoo	FT	Unlikely – This species has potential to pass through the Plan Area in migration. None were observed during avian surveys.
streaked horned lark	FT	Unlikely – This species has potential to pass through the Plan Area in migration. None were observed during avian surveys.
northern spotted owl	FT	Highly Unlikely – This species has potential to occur, although it is unlikely. No northern spotted owl was observed during avian surveys, and Plan Area lacks typical habitat.
bald eagle	BGEPA	Known – See **Section 3.1.2**.

Taxon Species	Status	Potential Occurrence in Plan Area
golden eagle	BGEPA	Known – See **Section 3.1.2**
Amphibians and Reptiles		
Oregon spotted frog	FT	Highly Unlikely - Highly unlikely that this species is located on the Project site or adjacent waterways due to the fact that the Project is on the fringe of its historic range. None were observed during the Site Characterization Surveys (Appendix C)
Invertebrates		
Oregon silverspot butterfly	FT	Unlikely – This species is unlikely to occur within the Plan Area due to the nature of active silvicultural operations. No observations have been made.
Taylor's checkerspot	FE	Unlikely – This species is unlikely to occur within the Plan Area due to the nature of active silvicultural operations. No observations have been made.
Fish		
bull trout / Dolly Varden	FT	Highly Unlikely – This species is unlikely to occur, as it is not documented in the waters in and around the Plan Area.
Chinook salmon	FT	None – The Plan Area does not support habitat for this species. However, spring Chinook salmon have been documented both spawning and rearing on the western end of the Skookumchuck Reservoir, less than 5 miles downstream from the Plan Area. Fall Chinook salmon have been documented for spawning and modeled to be present in waterways within 2 miles downstream of the Plan Area.
Coho	FT	Likely – Documented presence and spawning of coho have been observed in waters intersecting the Plan Area.
steelhead	T	Likely – Waters that intersect the Plan Area are documented to contain presence and spawning of the winter steelhead.
Mammals		
Mazama pocket gopher	FT	None – Although range maps may depict this species occurring in some areas of the Plan Area, this species is known to inhabit specific soil types, and those soil types are not found within the Plan Area. This species is not expected to occur within the Plan Area.
Canada lynx	FT	Potential – Canada lynx has potential to occur on site. Although WDFW states western Okanogan County is the only area in the state that supports a resident lynx population, Weyerhaeuser historically attempted to introduce the lynx to the Vail Tree Farm. One Canada lynx was observed within the Plan Area during large avian use surveys by Project surveyors.
fisher	-	Listing status is the subject of pending litigation; Unlikely – This species is unlikely to occur within the Plan Area. None were observed during the Site Characterization Surveys (Appendix C). The Plan Area is within the historical range, but the current range is pushed into Canada. The species was reintroduced in the Olympic National Park in 2008 and in Gifford Pinchot National Forest near Mount Rainier in 2015 through 2017.
grizzly bear	FT	Highly unlikely – Only a small population of grizzly bear is known to occur within the North Cascades mountains. This species is highly unlikely to occur within the Plan Area.

Taxon Species	Status	Potential Occurrence in Plan Area
wolverine	FC	None – The population of wolverine in Washington is still limited in its range. It is typically a species of elevations higher than the Plan Area and is known to be sensitive to human-related activities.

Federal Status under the U.S. Endangered Species Act (ESA) as published in the Federal Register:
FE = Listed Endangered. In danger of extinction.
FT = Listed Threatened. Likely to become endangered.
FPE = Proposed Endangered.
FPT = Proposed Threatened.
FC = Candidate species. Sufficient information exists to support listing as Endangered or Threatened.
BGEPA = Species protected by the Bald and Golden Eagle Protection Act.

While suitable murrelet habitat is not present within the Plan Area, impacts to murrelets are expected to occur from passage through the Plan Area. Except for bald eagle and golden eagle, the Plan Area generally lacks suitable habitat for the species in **Table 5**; and, with the exception of the coho and steelhead, their occurrence in the Plan Area is not expected. Coho and steelhead may utilize waters that intersect the Plan Area; however, the operation of the Project will not impact these species, and the Applicant is not seeking incidental take coverage for either of these species at this time.

4.2.2 Vegetation

The Multi-Resolution Land Characteristics Consortium created the National Land Cover Database (NLCD), last updated in 2011, as a resource for assessing land use and land cover in the United States. As mapped by NLCD (**Figure 8**; **Table 6**), the Plan Area comprises eight major land cover categories; and the dominant land cover is evergreen forest (4,714.0 acres; 49.5 percent of Plan Area total) followed by shrub/scrub (3,066.1 acres; 32.2 percent). All other categories each comprise less than 10 percent of the site.

Table 6: Land Cover Types Within the Plan Area

Land Cover Classification	Definition	Area (Acres)	Percent of Plan Area
Evergreen Forest Areas	Dominated by trees generally >5 m tall and >20% of total vegetation cover. Canopy is never without green foliage	4,714.0	49.5%
Shrub/Scrub Areas	Dominated by shrubs >5 m tall with shrub canopy typically >20% of total vegetation. Includes true shrubs, young trees in an early successional stage, or trees stunted from environmental conditions.	3,066.1	32.2%
Barren Land (Rock/Sand/Clay)	Barren areas of bedrock, scarps, talus, slides, gravel pits and other accumulations of earthen material. Generally, vegetation accounts for <15% of total cover.	712.1	7.5%
Developed	Includes buildings and other structures and also roads.	711.6	7.5%
Grassland/Herbaceous Areas	Dominated by graminoid or herbaceous vegetation comprising >80% of total vegetation.	201.7	2.1%
Mixed Forest	Areas dominated by trees generally >5 m tall and >20% of total vegetation cover. Neither deciduous nor evergreen species are >75% of total tree cover.	67.1	0.7%
Wetlands	Includes herbaceous march, fen, swale and wet meadow and also forested swamp or wetland shrub bog or wetland	26.4	0.3%

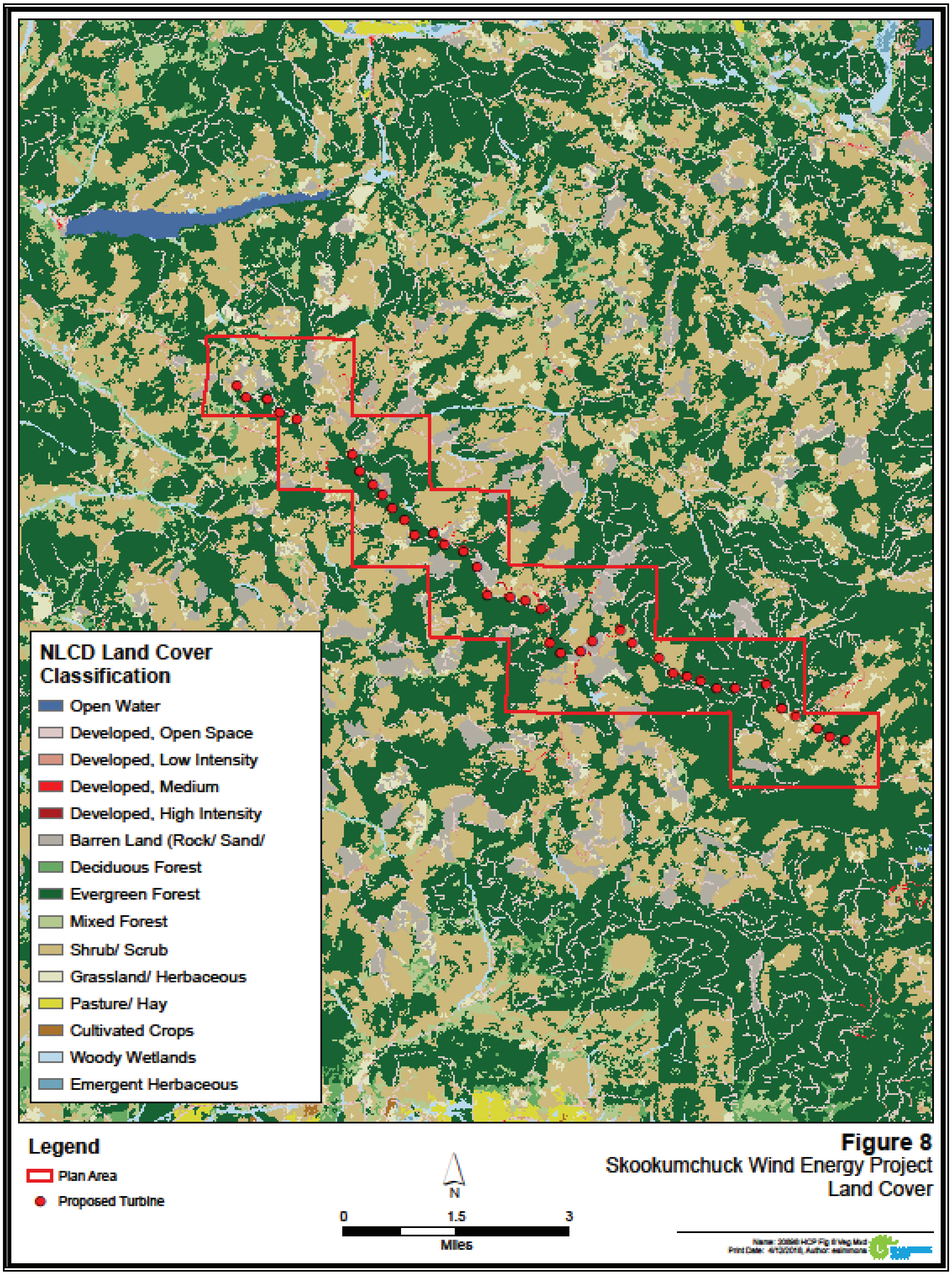
Land Cover Classification	Definition	Area (Acres)	Percent of Plan Area
Deciduous Forest	Areas dominated by trees generally >5 m tall and >20% of total vegetation cover. Also >75% of the tree species shed foliage simultaneously in response to seasonal change.	21.0	0.2%

> = greater than   < = less than   m = meter   % = percent

Based on the land cover definitions and surveys performed within the Plan Area, the evergreen forest habitat is characterized primarily by Douglas-fir, western hemlock, and western red cedar. Because the Plan Area and surrounding areas are heavily managed for timber extraction, it is evident that the majority of lands classified in the Shrub/Scrub and Grassland/Herbaceous habitat categories in reality represent the various stages of recently harvested lands and, in most cases, were previously evergreen forest habitat. These recently harvested areas are characterized by regrowth of Douglas-fir, colonizing red alder saplings, and shrub and undergrowth species such as Himalayan blackberry (*Rubus discolor*) and various grasses.

Data obtained from the USFWS indicate that four plant species federally listed as threatened or endangered occur in Lewis and Thurston Counties; however, further research indicates that suitable habitat for these species is not found within the Plan Area boundary (Burke Museum of Natural History and Culture 2011). These four species are golden paintbrush (*Castilleja levisecta*), Kincaid's lupine (*Lupinus sulphureus* ssp. *kincaidii*), Nelson's checker-mallow (*Sidalcea nelsoniana*), and water howellia (*Howellia aquatilis*). The distribution and habitat of these species includes the following: golden paintbrush occurs in meadows and prairies at low elevations in Thurston County; Kincaid's lupine occurs in moist to dry areas of prairies and openings in oak woodlands of Lewis County; Nelson's checker-mallow occurs in gravelly, well-drained soils at low elevations in Lewis County; and water howellia occurs in ponds and lakes in Thurston County.

Figure 8: NLCD Land Cover Categories in the Plan Area



CHAPTER 5.0 – POTENTIAL BIOLOGICAL IMPACTS AND TAKE ASSESSMENT

5.1 MURRELETS

5.1.1 Direct and Indirect Impacts

Direct impacts from the operation of wind turbines at the Project include the removal of individuals from the population as a result of collision with turbines. Although the leading cause of mortality is considered predation of young at nests (Nelson and Hamer 1995), anecdotal evidence suggests that collisions with stationary and moving objects may occur. One occurrence of a fatality was reported at the Cape Scott Wind Project in British Columbia, Canada, in spring 2015, nearly one-and-a-half years after commercial operations began in fall 2013 (Cooper Beauchesne and Hemmera Envirochem, Inc. 2016). Several additional anecdotal reports attribute the cause of mortality to collision with other anthropomorphic structures (Nelson 1997). The following sections describe the estimated direct take of murrelet that has the potential to result from collision with wind turbines.

An indirect effect of wind turbine operation on murrelets is the potential loss of one egg or chick if a nesting adult collides with a turbine, because the remaining adult could not successfully rear the nestling. This indirect impact is addressed in **Section 5.1.2.5**. Furthermore, loss of future generations of murrelets as a consequence of collision fatalities and its effect on the Washington murrelet population is explained in the Population Viability Analysis (**Section 5.1.3.1**). The proposed Project is located on industrial timberland that does not contain suitable-sized patches of nesting habitat within the leased boundary. Turbines are located approximately 0.4 mile from the nearest known occupied stand with a difference in elevation of approximately 875 feet. The potential for elevated sound levels from turbine operation to affect occupied habitat south of the Project was not found. Thus, indirect effects to murrelets are not anticipated, considering the distance and location of turbines to suitable nesting habitat.

5.1.2 Anticipated Take of Murrelets

A fatality model was developed to estimate the number of fatalities that may occur at the Project. Fatality predictions were calculated using a model previously developed for the Project by ABR with input from USFWS (Sanzenbacher et al. 2015), which was updated through further consultation with USFWS to account for the passage rates of murrelet-like targets observed during radar surveys conducted in 2013 through 2014, incorporated variable rates of seasonal occurrence (Nelson et al. 2013), avoidance probabilities, and turbine specifications. With these modifications, described in more detail below, the Applicant concludes the model better reflects murrelet behavior. Using the updated fatality model and relying on realistic assumptions, the anticipated impact of the Project on murrelets without minimization is predicted to be 0.981 individuals per year. However, based on more conservative model assumptions (**Section 5.1.2.2**), the requested take is 2.496 murrelets per year (**Section 5.1.2.4**).

5.1.2.1 Original ABR Collision Risk Model

A murrelet–wind turbine collision risk model was presented by ABR (Sanzenbacher et al. 2015). This model was developed as an adjunct to the analysis of radar surveys conducted at the Project and provided initial estimates of anticipated take (see **Section 3.1.1**). The ABR model is strictly deterministic, without random components; although in some cases, fixed alternatives are addressed – e.g., frontal and side approach angles and three alternative avoidance probabilities. The model posits a single wind turbine occupying the space surveyed by a radar unit during the time when surveys were conducted — early morning hours during the peak breeding season. Three model stages correspond to Tables 3, 4, and 5 in Sanzenbacher et al. (2015). First, based on estimated murrelet passage rates, predicted murrelet-turbine collision probabilities, and assumed avoidance probabilities, the model yields predicted daily number of fatalities for the early morning activity period in the peak breeding season. Second, adjustment factors are applied to the fatality estimate to account for additional murrelet flights at other times of day in the breeding season as well as flights in other seasons. In effect, these adjustment factors yield the predicted number of annual fatalities for a single turbine. In the third stage, the single-turbine value is multiplied by the number of turbines in the Project to yield the predicted number of annual fatalities for the entire Project.

5.1.2.2 Modifications to Original Model

Several modifications of the ABR model were implemented in coordination with USFWS to reflect more accurate biological conditions and collision scenarios while retaining the basic structure of the original model. The following sections compare these modifications with the original model developed by ABR. Appendix D addresses the modified model in greater detail.

5.1.2.2.1 Number of Wind Turbines

The ABR model assumed the Project would consist of 52 turbines on both the north and south ridges, while the modified model assumed 38 turbines only on the south ridge, as proposed in this HCP.

5.1.2.2.2 Turbine Design

The ABR model assumes that the wind turbine used at the Project will be a Vestas V110, with a 110-meter rotor diameter, an 80-meter tower, and maximum rotational rate of 12.1 rotations per minute (rpm). The currently proposed turbine design is a Vestas V136, with a 136-meter rotor diameter, an 82-meter tower, and maximum rotational rate of 15 rpm. The revised turbine design has consequences for both the “interaction probabilities” as defined in the ABR model and collision probability. All else being equal, the Vestas V136 presents greater risk than the V110, both in terms of interaction probability (the chance that a murrelet will encounter a turbine) and collision probability (the chance that a murrelet will collide with a turbine that it encounters). However, interaction and collision probabilities were modified further as discussed below.

The ABR model implicitly assumed that the wind turbine blade had a greatly simplified shape, namely a rectangular cuboid. In the modified model, the blade surface has a more realistic shape (**Figure 9**) based on Vestas turbine technical specifications.[1] This shape was used in calculating collision probabilities for the frontal approach, discussed in greater detail below. The blade used in the modified model is shown with the blue line; the corresponding implicit blade shape in the original model is shown as a dashed black rectangle, although the original model assumed the smaller blade of the V110 turbine.

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[1] Website for Vestas products.

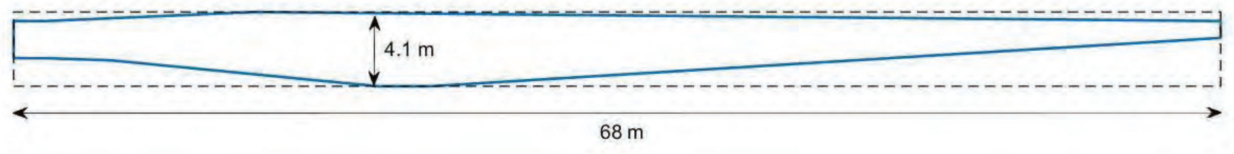

Figure 9: Two-Dimensional Representation of V136 Wind Turbine Blade

5.1.2.2.3 Approach Angle

In the ABR model, a murrelet is assumed to approach a wind turbine such that the angle between the flight path and the plane of the rotor is either perpendicular ("frontal approach") or parallel ("side approach"). Oblique approach angles are not addressed by the model, a strategy that is consistent with two primary mathematical models of collision risk (Tucker 1996; Band 2012). As a conservative measure, the modified model addresses only frontal approach because it yields higher overall collision risk, which is the product of interaction probability and collision probability (both addressed below).

5.1.2.2.4 Horizontal Interaction Probability

The horizontal interaction probability (HIP) represents the probability that a murrelet will encounter a wind turbine under the assumptions: (1) that a single wind turbine occupies the space within a rectangle with width equal to the radar survey diameter (3 km) and height equal to turbine height; (2) murrelet flights are perpendicular to the plane of that rectangle; and (3) murrelet flights are uniformly distributed within the rectangle, both with respect to width and height. Under these assumptions, the HIP equals the area presented by the turbine as a proportion of the total area within the rectangle. Thus, the HIP would have been changed in the modified model simply by changing the turbine design from the V110 to the V136 because the V136 was taller and because the area occupied by the turbine relative to the area of the radar survey rectangle was changed. However, in addition, the modified model subdivided vertical space into two zones, each with separate HIP: the rotor-swept zone (14 to 150 meters) and the space beneath the rotor (0 to 14 meters). Separate zones allowed a more detailed examination of encounter risk or "interaction probability" (both horizontal and vertical) and collision probability, as discussed below.

In the ABR model, HIP = 0.0240 for frontal approach. In contrast, in the modified model, for the rotor-swept zone, HIP_1 = 0.0358 for frontal approach. For the lower zone beneath the rotor, HIP_2 = 0.0014 (the tower presents the same area irrespective of approach angle; thus, HIP_2 would be the same at all approach angles).

5.1.2.2.5 Vertical Interaction Probability

The vertical interaction probability (VIP) was calculated from the empirical distribution of murrelet flight heights recorded in the ABR radar study. Thus, the proportion of these flights below turbine height (135 meters) yielded VIP = 0.38. In the modified model, a Weibull distribution was fit to the observed heights in the radar study, and then the probability was calculated from that distribution depending on the assumed height. Based on the fitted distribution, the proportion of flights below turbine height (150 meters) was 0.402. Furthermore, as mentioned above, the modified model subdivided vertical space into two zones: the rotor-swept zone (14 to 150 meters) with VIP_1 = 0.384, and beneath the rotor-swept zone (0 to 14 meters) with VIP_2 = 0.018. That is, based on the fitted distribution, 38.4 percent of flights were within the rotor-swept zone, and 1.8 percent of flights were beneath the rotor-swept zone where only the lower portion of the turbine tower could be encountered. This modification was more realistic because low-flying birds are only at risk of colliding with the tower, whereas the original model implicitly assumed that all birds within turbine heights (including those birds below rotor-swept heights) experience the composite collision risk of both tower and rotor.

5.1.2.2.6 Collision Probability

For an operational turbine, the ABR model assumed that the collision probability for a murrelet flying through the active rotor on frontal approach (i.e., parallel to the wind and perpendicular to the plane of the rotor) was 0.1625. The calculation of this value was based on the estimated residence time of a flying murrelet within the risk zone and the associated relative area of the rotor occupied by moving blades. However, no details were provided in the report. This estimate was considered to be unrealistically high in comparison to values typically generated by widely accepted models of active rotor collision risk (Tucker 1996; Band 2012). Therefore, the Tucker (1996) model was used to calculate the average collision probability for a murrelet flying through the active rotor of a Vestas V136 in both downwind and upwind flight. Model assumptions included 23.7 meters per second average air speed of murrelets (as in the ABR report), wind speed of 8.7 meters per second based on wind data from on-site meteorological towers at the Project, rotor diameter of 136 meters, blade dimensions consistent with **Figure 9,** including maximum chord length of 4.1 meters, and blade twist angles based on Thumthae (2015). The resultant collision probabilities were 0.0585 for upwind flight and 0.0414 for downwind flight. The average of these two values, 0.0500, was used in all subsequent calculations involving collision probability for frontal approach with operational turbines.

For a non-operational turbine, the ABR model assumed that the collision probability on frontal approach was 0.1059. While presumably based on areal calculation, namely, the area occupied by blades relative to the area of the rotor-swept zone, this appeared to be an overestimate. In the modified model, area occupied by the blades was calculated from the dimensions of the blade in **Figure 9**. This yielded relative area (collision probability) of 0.0428. This calculation conservatively assumed that blades were not feathered,[2] but instead that blade pitch was 0 degrees, such that approaching birds would encounter maximum blade area and thus would be subject to maximum collision risk.

In the modified model, collision probability for murrelets flying beneath the rotor-swept zone was 1, irrespective of approach angle and turbine operational status. While horizontal and vertical interaction probabilities for this zone were very low, a bird that encountered (and, implicitly, failed to avoid) the tower would necessarily collide with it.

5.1.2.2.7 Wind Turbine Operational Status Based on Wind Conditions

Wind turbines were assumed to operate 82.57 percent of the time in the ABR model; this value was based on an analysis of wind conditions at the Project site. Therefore, the higher collision probability associated with operating turbines was applied 82.57 percent of the time, while the lower collision probability associated with stationary rotors was applied 17.43 percent of the time. That is, the total expected number of fatalities was calculated as the sum of fatalities when: (1) the wind conditions were suitable for power generation and, consequently, rotors were active and collision risk was higher; and (2) the wind conditions were unsuitable for power generation and, consequently, rotors were not turning and collision

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[2] Feathered blades are pitched out of the wind, typically at 80 to 90 degrees. Consequently, when the blades are feathered, the rotor does not turn.

risk was lower. The ABR model did not address curtailment or its effect on collision risk; that is, the assumption about the proportion of time that turbines would be operational was based exclusively on wind conditions.

For the modified model, analysis was conducted on wind data from two on-site meteorological towers (data were available from one tower for the period from February 2012 through November 2016 and from the second tower for the period from February 2015 through November 2016). Wind speeds less than the nominal cut-in speed (3 meters per second) of the Vestas V136 or greater than the nominal cut-out speed (25 meters per second) were assumed to represent non-operational conditions. Wind speeds were analyzed for those periods when murrelets were assumed to be active, in particular, for a three-hour period near sunrise throughout most of the year (approximately 1.75 hours before sunrise to 1.25 hours after sunrise), along with day (11:00 a.m. to 5:00 p.m.) and evening periods (6:00 to 9:00 p.m.) during the peak breeding season (July 1 through August 9) (for additional details on seasons as defined in the modified model, see **Section 5.1.2.2.12**). Using these defined periods for murrelet activity, it was determined that turbines would be active 76.5 to 89.1 percent of the time, depending on season and time of day (**Table 7**). Otherwise, these results were used as in the ABR model; that is, collision probabilities appropriate for operational and non-operational turbines were applied according to the proportions in **Table 7**.

Table 7: Proportion of Time with Wind Conditions Suitable for Turbine Operation

Period	Proportion of Time
Mar (morning)	0.891
Apr 1 – Jun 30 (morning)	0.835
Jul 1 – Aug 9 (morning)	0.765
Jul 1 – Aug 9 (day)	0.807
Jul 1 – Aug 9 (evening)	0.810
Aug 10 – Sep 30 (morning)	0.845
Oct 1 – Nov 15	0.896
Nov 16 – Feb 28 (morning)	0.853

5.1.2.2.8 Avoidance Probability

In both the ABR and modified models, “avoidance” describes the active behavior of a murrelet on a flight path that would otherwise interact with or encounter a wind turbine. If active avoidance occurs, by definition there is no collision. On the other hand, if a murrelet on such a flight path does not avoid a turbine, then chance of collision exists. Avoidance probability is used to express the likelihood that a flying murrelet will make some maneuver such that collision will not occur. The ABR model considered three alternative avoidance probabilities of 0.90, 0.95, and 0.99. These probabilities were assumed to apply to a wind turbine in all conditions, irrespective of its operational status. The modified model added a fourth probability, 0.75, a more conservative value suggested by the USFWS, because of the lack of knowledge regarding avoidance rates. In addition, the modified model incorporated alternative avoidance probabilities of 0.95 and 0.99 for non-operational turbines, under the assumption that a stationary rotor would be more visible to a murrelet and, thus, would more likely be avoided. Similar assumptions about stationary rotors and the stationary components of wind turbines (tower and nacelle) have been made in other models of bird / turbine collision risk either explicitly (Band 2012; Smales et al. 2013) or implicitly (Bolker et al. 2006, 2014; Eichhorn et al. 2012). That is, these models have assumed that stationary structures have higher avoidance probability (in some cases, equal to 1) than active rotors. In brief, the modified model considered fixed avoidance probabilities, independent of operational status, but also considered combinations of low avoidance during operational periods with higher avoidance during non-operational periods. For instance, avoidance probability of 0.75 during operational periods was considered in combination with avoidance probability of either 0.95 or 0.99 during periods when rotors were not turning either due to wind conditions or curtailment.

5.1.2.2.9 Passage Rate

Based on data from radar surveys conducted at the Project, the estimated mean passage rate at the radar survey stations was 0.6083 murrelet-like radar targets per day during the peak activity period (a three-hour interval before sunrise in the morning from mid-May through early-August). This value was used as the baseline murrelet passage rate within the ABR model, though various adjustments were applied to account for flock size (due to limitations in radar resolution, two or more murrelets flying in close formation may appear as a single radar target) and additional post-sunrise (though still early morning) flights. The adjusted value was 1.84 murrelets per day for mornings during the peak breeding season. Further adjustments accounted for flights at other times of day during breeding season and flights in other seasons (see **Section 5.1.2.2.12**).

For the modified model, the radar data (Sanzenbacher et al. 2015; Appendices B and C) were reanalyzed for two reasons. First, because the more recent Applicant Project design specifies construction on the south ridge only, the data for analysis were restricted to the six radar stations located on the south ridge (stations 5 through 10, **Figure 10**). Second, initial review of radar survey results indicated that passage rates were higher at each of **stations 5 and 10 than any of the other stations**. Results showed that the mean passage rate across the south ridge was 0.653 murrelet-like targets per day, **approximately 7.3 percent higher** than the overall mean based on data from both ridges. Furthermore, the mean passage rate at stations 5 and 10 was 0.917 (standard error = 0.190), while the mean passage rate at the other four stations on the south ridge was 0.521 (standard error = 0.099). A two-sample, one-sided *t*-test indicated that mean passage rate was significantly higher at stations 5 and 10 than at the remaining stations ($t = 2.049$, $p = 0.022$). Additional details concerning passage rates along the south ridge are provided in Appendix D.

To examine the consequences of this difference in passage rates, some runs of the modified model were conducted in which the higher passage rate estimate (0.917 targets per day) was applied to 10 turbines, while the lower passage rate estimate (0.521 targets per day) was applied to the remaining 28 turbines. The allocation of number of turbines to these two groups was based on the assumption that approximately five turbines would be located within the area surveyed at each of radar stations 5 and 10. While the modified model applied different passage rates in some runs, there was no explicit spatial representation of turbine layout. As in the original ABR model, a certain set of assumptions was applied to an individual turbine and then the predicted total number of fatalities was calculated by multiplying by the appropriate number of turbines.

5.1.2.2.10 Curtailment

While wind turbine curtailment was not addressed by the ABR model, the modified model assumed that 10 of the 38 turbines in the Project could be curtailed (blades feathered, resulting in stationary rotors) during the peak morning flight period (a three-hour period beginning approximately 105 minutes before sunrise and ending 75 minutes after sunrise) in the breeding season (May 1 through August 9). More particularly, when curtailment was enabled, it was applied to the 10 turbines with higher passage rate (described above). In effect, curtailment increased the proportion of non-operational time during the specified season, and during that time collision probabilities for non-operational turbines were applied. The curtailment regime included in the modified model is one of the minimization strategies for the Project (**Section 6.1.2.2**).

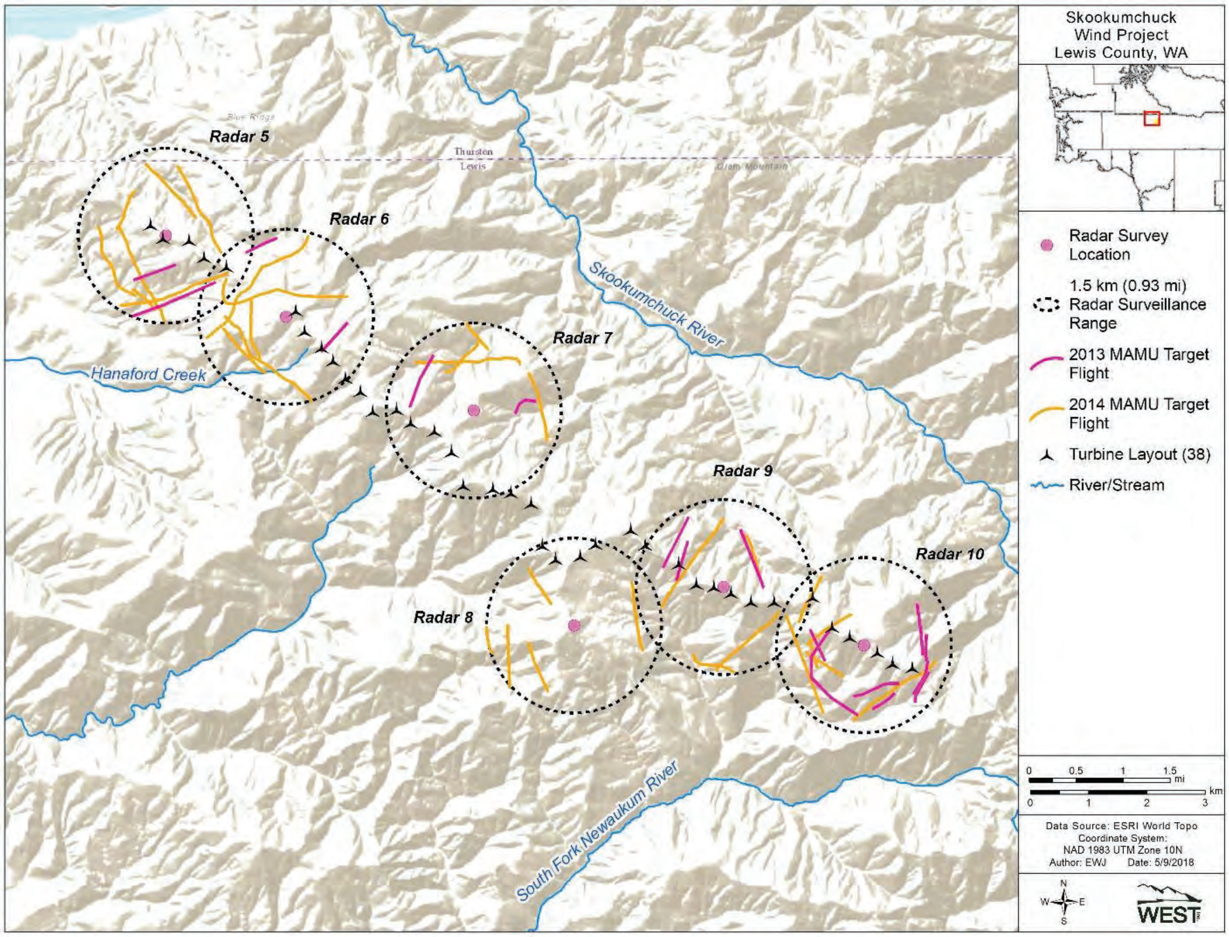

Figure 10: ABR Radar Survey Stations with Murrelet Flight Paths Recorded at Each Station

5.1.2.2.11 Interaction of Passage Rate, Avoidance Probability, and Curtailment

Selected runs of the modified model examined the combined effect of three factors discussed above: different passage rates within the Project; different avoidance probabilities for operational and non-operational turbines; and curtailment of selected turbines during mornings of the breeding season. In particular, it was assumed that: (1) 10 wind turbines in the Project experienced higher passage rate (baseline rate = 0.917 murrelet-like targets per day during mornings of the breeding season) than the remaining 28 turbines (baseline rate = 0. 521 murrelet-like targets per day); (2) these same 10 turbines were curtailed during mornings of the breeding season; and (3) avoidance probabilities for non-operational turbines were higher (either 0.95 or 0.99) than probabilities for operational turbines (either

0.75, 0.90, or 0.95). It was hypothesized that curtailment would be more effective in such settings than would curtailment in simpler settings where passage rate was uniform across the Project and avoidance probability was independent of turbine operational status.

Model results confirmed the hypothesized interaction effect. **Figure 11**shows example results for the case when the avoidance probability was 0.75 for operational turbines, and either 0.75 or 0.99 for non-operational turbines. It is clear that predicted annual fatalities were generally lower when the non-operational avoidance probability was 0.99. Furthermore, curtailing 10 turbines consistently led to lower predicted fatalities (In **Figure 11**, for each pair of bars, the bar on the right is lower than the bar on the left), and this effect was greater when those same 10 turbines had higher passage rates than the remaining turbines (compare "Non-Uniform" to "Uniform"). Finally, the greatest reduction in predicted annual fatalities was attributable to the combination of higher non-operational avoidance probability, non-uniform passage rates within the Project, and curtailment of the 10 turbines where passage rate was higher (the right-most bar in **Figure 11**). As noted above, wind turbines did not have an explicit spatial representation in the collision model; rather, different sets of assumptions (regarding passage rate, avoidance probability, and curtailment) were applied to individual turbines and then results were scaled up to account for project-wide fatalities.

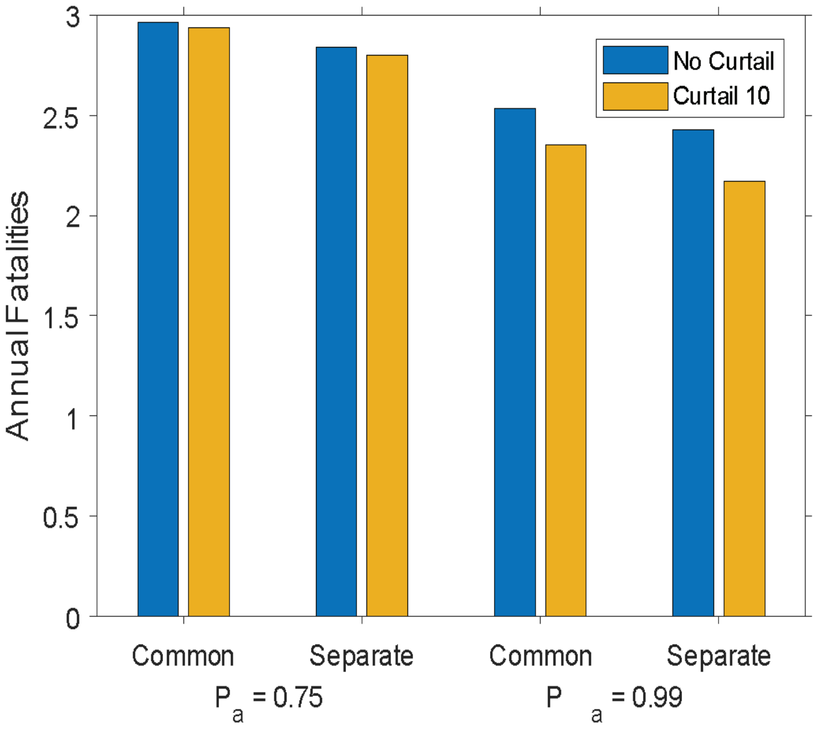

Figure 11: Fatality Dependence on Passage Rate, Avoidance Probability, and Curtailment

Example results from the modified model illustrating the interaction of passage rate, avoidance probability, and curtailment. In all cases, avoidance probability (P) for operational turbines was 0.75. Avoidance probability for non-operational turbines was P_a = 0.75 for the four bars on the left, and P_a = 0.99 for the four bars on the right. Passage rates were either "Uniform", i.e., the same for all 38 turbines in the Project, or "Non-Uniform", i.e., higher at 10 turbines than at the remaining 28 turbines. When separate passage rates were in effect and curtailment was enabled, curtailment was applied to the 10 turbines with higher passage rate.

As noted above, wind turbines did not have an explicit spatial representation in the collision model; rather, different sets of assumptions (regarding passage rate, avoidance probability, and curtailment) were applied to individual turbines and then results were scaled up to account for project-wide fatalities.

5.1.2.2.12 Seasonal Adjustments

In the ABR model, seasonal adjustment factors were employed to account for murrelet flights at times other than those when the radar surveys were conducted. These adjustments considered flights at other times of day during the peak breeding season and in other seasons of the year (Table 4 in Sanzenbacher et al. 2015), and these adjustments accounted for additional collision risk expected for murrelets flying through the Project. In discussions with the USFWS, it was agreed that modifying some of these adjustments and/or the relevant seasons in a manner consistent with murrelet biology would be appropriate. The modifications are shown in **Table 8**.

Regarding the date limits in **Table 8**, these represent a generalized timeline of biological chronology, recognizing that there may be variability in biological events among individuals as well as year-to-year variability. For instance, July 1 through August 9 represents the peak breeding season, but it is certain that all murrelets do not cease breeding on August 9 every year. Some murrelets may be maintaining a nest, and thus flying between nest and feeding grounds, later into August. By the same token, some murrelets may fledge their young in July. The date ranges in **Table 8** are intended to capture the typical timing rather than the extremes of any particular event. Furthermore, the way that **Table 8** is used in the modified model (as Table 4 of Sanzenbacher et al. is used in the ABR model) implicitly assumes that the main breeding period represents the baseline (maximum) number of flights. To the extent that the model allowed some (not all) birds to begin (and end) breeding earlier (or later) than most others, that would mean more flights occurring before and after the main breeding period and necessarily fewer flights occurring during the main breeding period. However, the total number of flights annually would not change by simply shifting the breeding season earlier or later for a subset of birds. Wind turbine operational time is slightly higher from April through June and in late-August through September than in the peak breeding season (**Table 8**), so collision risk would be slightly higher for flights in those periods.

Note that row B1 in **Table 8** was implicit in Table 4 of Sanzenbacher et al. and incorrectly collapsed into both the "daytime flight" and "evening flights" rows (corresponding to rows B2 and B3 of **Table 8**, respectively). (Furthermore, Table 4 of Sanzenbacher et al. incorrectly labeled each of these rows as a "proportion." Neither were proportions, and neither of rows B2 and B3 in **Table 8** are treated as proportions in the modified model.) Row C of **Table 8** is similar to the next-to-last row in Table 4 of Sanzenbacher et al.; it represents the expected number of flights in each season relative to flights in the peak breeding season. For instance, for each daily flight in the morning in the peak breeding season, 0.24 daily flights are expected in March and 0.07 daily flights are expected in the molting period (October 1 – November 15). Regarding the latter adjustment, individual birds are flightless while molting (implying an adjustment value of 0), though an individual's flightless period is typically less than six weeks; thus, the 0.07 value accounts for the fact that not all birds are flightless for this entire period. The cumulative adjustment factor (row D of **Table 8**) represents the number of expected flights in a particular season relative to a single predicted flight in the morning of the peak breeding season. For instance, a total of 7.44 flights are expected in the month of March for each flight in the morning in the peak breeding season.

Table 8: Seasonal Adjustment Factors for Modified Model

Adjustment Factors	March	Apr 1 – Jun 30	Jul 1 – Aug 9	Aug 10 – Sep 30	Oct 1 – Nov 15	Nov 16 – Feb 28
A) Number of days per period	31	91	40	52	46	105
B1) Morning flights (baseline rate)	1	1	1	1	1	1
B2) Daytime flights (# flights relative to baseline)	0	0	0.86	0	0	0
B3) Evening flights (# flights relative to baseline)	0	0	0.285	0	0	0
C) Number of flights relative to main breeding period	0.24	1	1	0.225	0.07	0.24
D) Cumulative adjustment factor*	**7.44**	**91.00**	**85.80**	**11.70**	**3.22**	**25.20**

* The cumulative adjustment factor (row D) was calculated as: D = A × (B1 + B2 + B3) × C

5.1.2.3 Conservative Features of Modified Model

The model parameters used to predict take were evaluated to determine where options existed to select a conservative value or approach which would result in an increased number of predicted murrelet fatalities. The paragraphs below explain each parameter and why the approach used is conservative in the context of predicting murrelet fatalities.

The ABR model addresses two alternative approach angles: frontal approach, in which the murrelet flight path is parallel to the wind and perpendicular to the rotor plane; and side approach, in which the flight path is perpendicular to the wind and parallel to the rotor plane. Presumably, these two approach angles were intended to bracket a range of possible approach angles, though the ABR model provides no mechanism for estimating risk associated with any angle other than the two extremes. Furthermore, there is no meaningful way to combine the estimates from the two extremes.[3] Therefore, as a conservative measure, the modified model focuses on the frontal approach, which yields greater numbers of predicted fatalities than the side approach.

Both the ABR model and the modified model assume turbine rotors are turning at maximum speed whenever they are operational. While modern turbines reach maximum rotational speed over a fairly narrow range of wind speeds, conditions may occur in which rotational speed is less than the maximum. By assuming maximum rotor speed, these models assume collision probability is always at a maximum during operational periods.

In the modified model, the collision probability associated with non-operational turbines on frontal approach assumes that the rotor is stationary. However, the model also assumes that the blades are not feathered (i.e., are not pitched out of the wind), but rather present maximum area and thus maximum

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[3] While oblique approach angles may have greater conditional collision probability (i.e., conditioned on encounter or “interaction”) than frontal approach, the risk of encounter (i.e., the horizontal interaction probability) is progressively lower with progressively shallower approach angles (i.e., tending toward “side approach”). Both functions are non-linear, and the conditional collision probability may be non-monotonic (Holmstrom et al. 2011) depending on static and dynamic characteristics of both the wind turbine and the bird. Therefore, the unconditional collision probability is non-trivial to calculate.

collision probability to birds flying through the rotor. This is a conservative assumption since blades would likely be feathered at least some of the time during non-operational periods.

Both models assume murrelet flight heights are uniformly distributed within the rotor-swept zone. This is a conservative assumption because the empirical distribution of flight heights, and the Weibull distribution that was fitted to the observed data, indicate that a greater proportion of flights are in the upper portion of the rotor-swept zone. Both encounter probability and collision probability decrease progressively from hub height to maximum rotor-swept height. That is, birds flying within the upper portion of the rotor-swept zone are less likely to encounter the rotor (blades sweep through a narrower space than at hub height), and those birds that do encounter the rotor are less likely to collide with it (because collision probability decreases with distance from the hub in both the Tucker [1996] and Band [2012] models). Thus, assuming a uniform height distribution, in contrast to the observed data, overestimates the number of collisions.

In both models, the total number of predicted fatalities for the Project is calculated by multiplying the single-turbine fatality rate by the number of turbines. This approach implicitly assumes either that each murrelet flight through the Project will encounter no more than one turbine, or that encounters with multiple turbines have independent outcomes. The latter alternative is equivalent to the assumption that a murrelet encountering two or more turbines may collide with each of those turbines. Since outcomes are not independent (a murrelet cannot be killed more than once), assuming that fatalities are multiplicative with turbine number likely overestimates the number of fatalities to the extent that murrelets may encounter two or more turbines in the Project. For instance, flights along the ridge would likely encounter more than one turbine; and, thus, collision risk for such flights is over-estimated by the simple multiplication approach.

Taken together, the conservative assumptions for the frontal approach, non-operational turbine blades are not feathered, a uniform flight height distribution, and that fatalities are multiplicative with turbine number used in the model will result in a predicted take level that accounts for uncertainty and is higher than if other assumptions were considered, although there are data that would support less conservative assumptions.

5.1.2.4 Results: Requested Take

Among the multiple scenarios addressed in the modified model, the one considered most likely included operational avoidance probability of 0.90 combined with non-operational avoidance probability of 0.99 (see **Section 5.1.2.2.8**). This scenario yielded predicted annual take of 0.981 murrelets or 30 murrelets for the 30-year permit term (0.981 × 30 = 29.44 murrelets).

However, to account for the uncertainty associated with murrelet flight behavior and collision probability at the Project, the Applicant is seeking authorization for annual take of 2.496 marbled murrelets or 75 murrelets for the 30-year permit term (2.496 murrelets/year × 30 years = 74.89 individuals) based on a more conservative scenario. In this scenario, assumptions included avoidance probabilities of 0.75 for operational turbines and 0.95 for non-operational turbines. That is, the essential difference in the anticipated and requested take levels depended on the assumptions concerning marbled murrelet avoidance probabilities for wind turbines. In both cases, passage rates were assumed to be higher at 10 turbines, with somewhat lower passage rate for the remaining 28 turbines (see **Section 5.1.2.2.9**).

The take estimates above assume no minimization. The proposed minimization strategy, as described in the Project Description, for marbled murrelets consists of curtailment of the 10 turbines with higher passage rate during early morning hours for a 101-day period including the peak breeding season, namely May 1 through August 9 (see **Section 5.1.2.2.10**). With minimization, the model-based estimates of take for the most likely scenario is 0.840 marbled murrelets per year or 26 murrelets for the 30-year permit term (0.840 × 30 = 25.2). For the more conservative scenario, corresponding to assumptions underlying the requested take level, curtailment reduces the annual take to 2.175 murrelets, or 66 murrelets for the permit duration (2.175 × 30 = 65.25). **Table 9** summarizes predicted take under the two scenarios, each with and without minimization; the requested take level without minimization is shown in the first row.

The calculation of cumulative take for both the most likely and the more conservative scenarios (both with and without minimization) assumes constant annual take over the 30-year period. This assumption is itself conservative because the number of fatalities due to collision is directly proportional to passage rate through the Project in both the original and modified collision models. Furthermore, if current population declines continue in the future, then passage rates, and thus fatalities, would likely decline.

Table 9: Predicted Take

Take Scenario	Avoidance Probability		Minimized	Predicted Take	
	Non-Operational	Operational		Annual	30 Years
Requested	0.95	0.75	No	2.4962	75
			Yes	2.1747	65
Most Likely	0.99	0.90	No	0.9814	30
			Yes	0.8395	26

5.1.2.5 Indirect Effects

The take of an adult murrelet due to collision with a wind turbine may lead to the indirect loss of an egg or nestling if that adult is actively breeding because the remaining adult of the pair will not be able to maintain the nest. One approach to estimation of the annual indirect losses depends on the proportion of direct losses that are active breeders. Based on the seasonal adjustments for annual flights (**Table 8**), 78.8 percent of flights occur during the breeding season (April 1 through August 9).[4] By definition, flights occurring outside the breeding season would not be conducted by active breeders. During the breeding season, flights will be conducted by both active breeders and other murrelets (either sexually immature or mature but not breeding). Based on recent literature, the proportion of breeders in the population ranged from 0.11 to 0.79 with an average of 0.541 (Barbaree et al. 2014; Burger 2002; Peery et al. 2006). This average proportion (0.541) was assumed to be directly reflected in the proportion of breeders among all birds making flights in the early morning throughout the breeding season. Furthermore, while most flights occur early in the morning, some flights occur at other times of day during the peak breeding season (July 1 through August 9). Again, based on **Table 8**, 74.1 percent of breeding season flights occur in the morning; correspondingly, 25.9 percent of flights occur later in the day.[5] Consistent with the assumptions

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[4] From Table 8, breeding season cumulative adjustment factors / total cumulative adjustment factors = (91.00 + 85.80) / (7.44 + 91.00 + 85.80 + 11.70 + 3.22 + 25.20) = 0.788.

[5] From Table 8, morning breeding season adjustments / breeding season cumulative adjustment factors = (91 + 40) / (91.00 + 85.80) = 0.741.

described in Sanzenbacher et al. (2015), all of those flights occurring later in the day were assumed to be breeding birds. Putting this information together, the proportion of all *breeding season* flights that are conducted by active breeders is 0.660 = (0.741 × 0.541) + 0.259. Thus, the proportion of all *annual* flights that are conducted by breeders is 0.520 = 0.788 × 0.660. This proportion combined with requested take yields 1.298 = 2.496 × 0.520 active breeders that are taken annually. Finally, not all active breeders successfully fledge their chicks. Based on published values, the least conservative estimate of nest success (among nests that are initiated) is 0.54 (McShane et al. 2004). Combining these last two components yields 0.701 = 1.298 × 0.54 chicks lost annually. That is, the indirect effect of fatalities due to collision is the potential loss of 0.701 chicks that otherwise would fledge each year.

Notably, the reproductive value of a fledgling is lower than that of an adult marbled murrelet. That is, fledglings make a relatively small contribution to future population growth. Consider that, as modeled in the population viability analysis (PVA, **Section 5.1.3**), a fledgling has probability of 0.6125 of surviving to the age of one year and that a one-year-old has probability of 0.777 of surviving to the age of two years, the age at first breeding. Thus, by accounting for survival, the loss of 0.701 fledglings is equivalent to the loss of 0.334 two-year-olds (= 0.701 × 0.6125 × 0.777). A few two-year-olds are sexually mature, but most are not; accounting for survival to full maturity (at age 6 in the PVA) would reduce this number even further. As a consequence of this low reproductive value, the loss of these fledglings is negligible in terms of population dynamics and in terms of the impacts of the take.

5.1.3 Anticipated Impacts of the Taking

The anticipated impact of the taking was modeled using a population viability analysis (PVA). Several murrelet PVAs have been conducted previously. All of these have recognized that murrelet populations are declining but also that some details of murrelet life history are poorly understood (Akçakaya 1997; Caswell 2001; McShane et al. 2004; Peery and Henry 2010).

5.1.3.1 Population Viability Analysis

The range of the ESA listed population has been subdivided into six Conservation Zones; the Washington population is located in Zones 1 and 2 (Raphael et al. 2007). A PVA was conducted for the Washington State murrelet populations in Conservation Zones 1 and 2, as well as the Distinct Population Segment (DPS) as defined in the murrelet listing, i.e., the combined population in California, Oregon, and Washington. The primary purpose of this analysis was to assess the incremental impact of potential incidental take on murrelet population viability, where the potential take is anticipated. Additional details addressing both the methods and results of the PVA modeling are provided in Appendix E.

5.1.3.1.1 Matrix Model

A seven-stage matrix population model was constructed based on previously published murrelet models. The model included two pre-breeding age classes or stages and five breeding stages (four successive age classes and a final stage representing individuals of age five and older). Within the breeding stages, the proportion of sexually mature individuals was low in the youngest stage but increased progressively with age, reaching 1 in the final stage. This seven-stage model represents a compromise between the three- or four-stage models frequently used for modeling murrelets (Beissinger 1995; Akçakaya 1997; Boulanger et al. 1999; Peery et al. 2006; Beissinger and Peery 2007) and the 25-age model of McShane et al. (2004). As is standard for this type of model, only the female half of the population was modeled (Caswell 2001; Morris and Doak 2002). The model assumed exponential growth of the population in common with many preceding murrelet population models (e.g., Beissinger 1995; Boulanger et al. 1999; Boulanger 2000; McShane et al. 2004; Peery et al. 2006; Beissinger and Peery 2007), with no density-dependent feedback on growth rate. That is, mean growth rate was constant over time, although year-to-year growth rate varied randomly. Four separate models were constructed, one for each of the populations in Zones 1 and 2, one for the combined population from both zones (the entire state of Washington), and one for the DPS.

An important feature of the matrix model approach is that it accounts directly for the future reproductive potential of all members of the population. When an individual is removed from the population due to incidental take, as in this PVA, that event has consequences for the future trajectory of the population because the removal of that individual implies the loss of its immediate offspring and the loss of all subsequent generations. By the same token, addition of an individual to the population from an outside source has positive consequences for the population trajectory.

5.1.3.1.2 Parameterization

Initial sizes and mean growth rates for each of the four populations were based on analysis of at-sea survey data (Falxa et al. 2016; Lynch et al. 2016). Within the state of Washington, surveys were conducted each year from 2001 through 2015 inclusive. However, throughout the DPS, complete surveys were conducted only for the period 2001 through 2013. For each population, estimated population sizes from each year of the survey were log-transformed; and a simple linear regression model was fitted to the data, where log-population size was the response and year was the single independent variable (**Figure 12**). The estimated slope was used as the mean growth rate, and the predicted value for the year 2015 was used as the initial population size (**Table 10**). Mean vital rates were based on values used in previous models of murrelet demography, particularly McShane et al. (2004). Furthermore, most vital rates were the same for all four populations, with the following exception — mean fledging success for each population was adjusted so that the stochastic growth rate matched the mean growth rate estimated from the regression model for the at-sea survey data. There is greater uncertainty in murrelet fledging success; and, as for other long-lived species, it is likely to be more labile than other parameters such as adult survival rate (Caswell 2001).

5.1.3.1.3 Demographic Stochasticity

Both demographic and environmental stochasticity were incorporated in the model, consistent with the model developed by Akçakaya (1997). Demographic stochasticity accounts for the fact that — in the real world — birth and death processes necessarily involve integer numbers — e.g., each individual either survives to the next year or not.

However, in a matrix population model without demographic stochasticity, the mechanics of matrix multiplication usually yield non-integer numbers of individuals. In the murrelet model, survival and fecundity were treated as Bernoulli processes (having binary outcomes, either 0 or 1), which, for multiple individuals, yield integer outcomes. Demographic stochasticity also introduces additional variability into population dynamics, though the effects become more prominent with progressively smaller population sizes (Morris and Doak 2002). To simplify implementation, the model assumed that demographic stochasticity was operative at all population sizes.

Table 10: Results from Regression Models Fitted to At-Sea Survey Data

Population	Slope Estimate[1]	Predicted Value for 2015[2]
Zone 1	-0.0545	4,114
Zone 2	-0.0287	1,596
WA	-0.0453	5,949
DPS	-0.0121	17,999

[1] The slope estimate provided the growth rate, and the 2015 predicted value (divided by 2 to yield number of females) provided the initial size for each modeled population

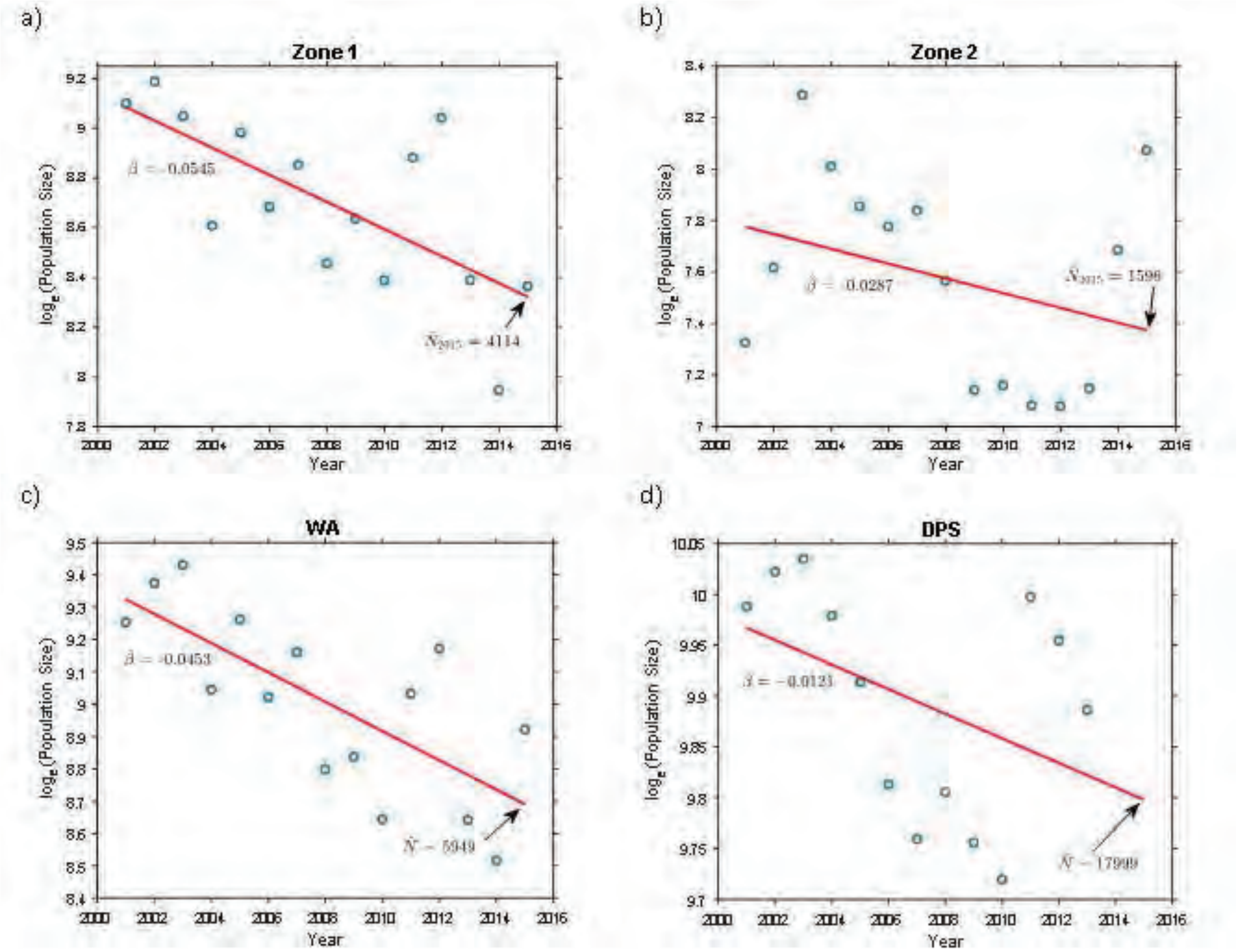

Figure 12: Marbled Murrelet Population Trends

As shown on **Figure 12**, marbled murrelet population estimates (blue circles) are based on at-sea surveys and fitted regressions (red lines) for (a) Zone 1, (b) Zone 2, (c) Washington, (d) the Distinct Population Segment. For each population, the estimated slope $(\hat{\beta})$ and the predicted population size in 2015 $(\hat{N})$ are based on the fitted regression.

5.1.3.1.4 Environmental Stochasticity

Modeled environmental stochasticity is meant to capture the notion that environmental conditions (e.g., weather) vary over time and that these changes will have effects on survival or fecundity or both (Morris and Doak 2002). For the PVA, environmentally driven random variation in vital rates was implemented so that both stage-specific survival probability and fledging success were subject to random variation, and both followed Beta distributions (appropriate when the outcome is restricted to the [0, 1] interval). The coefficients of variation in these vital rates were selected such that annual variation in population sizes was similar to observed variation in population estimates from at-sea surveys. Furthermore, the random variation was designed so that the vital rates were moderately correlated (reasonable if survival rates among different stages, for instance, are subject to the same environmental drivers); correlation was implemented using a procedure recommended by Dias et al. (2008).

5.1.3.1.5 Incidental Take

Two alternative levels of initial mean take were examined, with values based on the predicted numbers of annual fatalities from the modified collision model described in **Section 5.1.2**. In addition to the no-take scenario, simulations were conducted with take corresponding to the scenario considered most likely (0.9704 murrelets per year) and the more conservative scenario (2.4962 murrelets per year) representing the requested take level. Initial mean take values were divided by two since the matrix model represents females only, and half of predicted fatalities would be females, again assuming a 50:50 sex ratio and equal risk for males and females. Thus, the alternative simulated mean take values were 0.4852 females per year and 1.2481 females per year. Mean take was held constant at these values for the 30-year duration of the ITP.

In each year of simulation, the realized take varied randomly according to the Negative Binomial distribution, with mean determined as described above and variance equal to three times the selected mean value. The Negative Binomial distribution was selected because it yields integer take values and it is somewhat more conservative than the alternative Poisson distribution which has equal mean and variance. That is, as determined from preliminary modeling, the greater variation under the Negative Binomial tends to have somewhat greater negative impact on population dynamics.

While the Negative Binomial distribution was used to generate total take in each year, in turn, the Multinomial distribution was used to randomly allocate that total take among the seven stages in direct proportion to the stage-specific abundances. Take was implemented by subtracting individuals from the current stage vector (again, as determined by sampling from the Multinomial distribution) immediately before the annual birth pulse. Finally, all take ceased in year 30 of the simulations, corresponding to the expected term of the ITP.

5.1.3.1.6 Metrics for Assessing Impact of the Take

Several metrics were used to compare populations without take and those with potential incidental take due to the Project. Because projected populations were declining even in the absence of take (**Figure 13**), as consistent with current population trends **(Figure 12**), key metrics were the mean and median times to quasi-extirpation, that is, the average and typical times time to reach a fixed threshold population size. Four alternative quasi-extirpation thresholds were examined: 1/4, 1/8, 1/16, and 1/32 of the initial size of each population. For instance, for an initial population of 1,000, the 1/4 threshold would be 250. Additional metrics were mean and median population sizes at years 30 (the term of the ITP), 50, 75, and

100, and probability of quasi-extirpation (for each threshold size) at years 30 and 75. Probability of quasi-extirpation was calculated as the proportion of simulated population trajectories (out of 100,000) that had fallen below the specified threshold by the specified year.

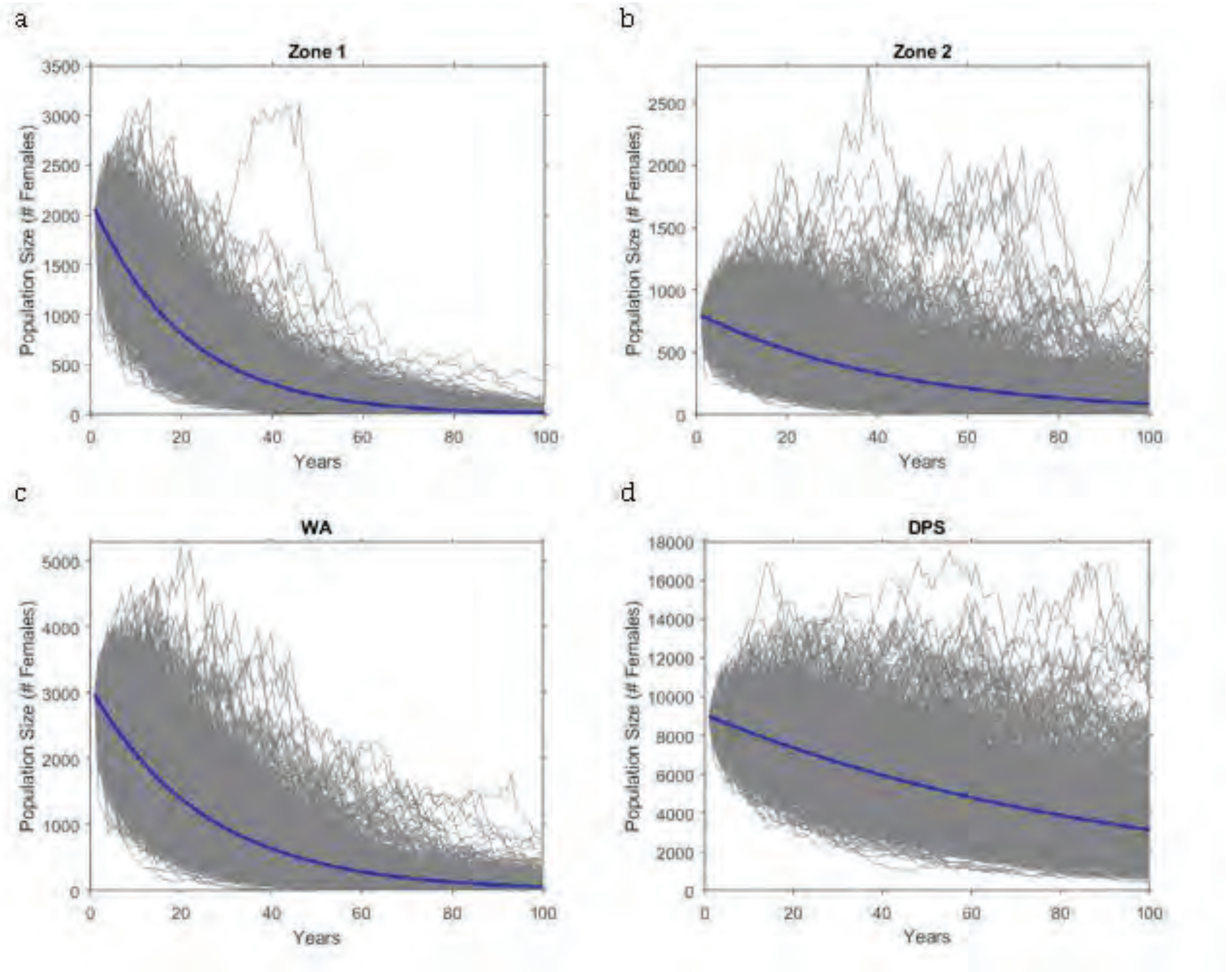

Figure 13: Simulated Population Growth Without Take

1,000 simulated population trajectories (gray lines); mean population (blue line) calculated from 100,000 simulated trajectories for (a) Zone 1, (b) Zone 2, (c) WA, (d) DPS

PVA results: 1,000 simulated population trajectories (gray lines), and mean population (blue line) calculated from 100,000 simulated trajectories for (a) Zone 1, (b) Zone 2, (c) WA, and (d) DPS.

5.1.3.1.7 Results

In general, the effects of take on simulated populations were modest. Mean and median times to quasi-extirpation decreased for populations experiencing take (**Table 11**); that is, populations experiencing take reached the quasi-extirpation threshold more quickly than populations without take. For instance, for the Zone 1 population and a threshold of 1/4 the initial population size, mean time to quasi-extirpation without take was 27.06 years, but with estimated potential take of 0.9704 murrelets/year mean time to quasi-extirpation was 26.91 years, and with the requested take of 2.4962 murrelets/year mean time to quasi-extirpation was 26.61 years. The median time to quasi-extirpation was typically less than the mean, indicating moderately right-skewed distributions (i.e., due to a few iterations in which time to quasi-extirpation was very long). Otherwise, the medians exhibit the same pattern as the means – decreasing time to quasi-extirpation with increasing take. Generally, even in comparing no take to the requested take, the decreases in both mean and median times were a year or less except in Zone 2. In that population, imposing the expected take led to decreased time to extirpation of approximately one or two years, while imposing the requested take led to differences of approximately three or four years compared to no take. The greater effect on the Zone 2 population was likely a consequence of both its smaller initial size and its relatively small growth rate (i.e., small in absolute value); thus, take represented a greater proportion of the population. Because the Zone 2 population did not decrease as rapidly as the Zone 1 or the Washington population (its growth rate was closer to 0), the mean time to quasi-extirpation was greater than for the Zone 1 or Washington populations. Among the four simulated populations, the DPS had the smallest rate of decline (about 1.2 percent annually (**Table 10**) as well as the largest initial size. Mean time to quasi-extirpation was much greater than for the other populations, nearly 117 years at the 1/4 threshold (**Table 11**).

Table 11 shows the mean and median time in years to quasi-extirpation without mitigation, by population, take level, and threshold size for quasi-extirpation; column headed P indicates parameter, either mean ($\bar{x}$) or median (*M*).

Table 11: Mean and Median Time in Years to Quasi-Extirpation

Population	Average Annual Take	P	Threshold Population Size			
			1/4	1/8	1/16	1/32
Zone 1	0	$\bar{x}$	27.06	39.70	52.33	64.68
		M	26	38	51	63
	0.9704	$\bar{x}$	26.91	39.43	52.00	64.32
		M	25	38	50	63
	2.4962	$\bar{x}$	26.61	38.97	51.45	63.76
		M	25	37	50	62
Zone 2	0	$\bar{x}$	51.35	75.27	98.64	121.10
		M	45	69	92	114
	0.9704	$\bar{x}$	50.25	73.98	97.18	119.54
		M	44	68	91	113
	2.4962	$\bar{x}$	48.86	72.17	95.40	117.83
		M	42	66	89	111
WA	0	$\bar{x}$	32.46	47.70	62.88	77.95
		M	30	45	60	75
	0.9704	$\bar{x}$	32.38	47.54	62.67	77.73
		M	30	45	60	75
	2.4962	$\bar{x}$	32.09	47.12	62.22	77.28
		M	30	45	60	75

Population	Average Annual Take	P	Threshold Population Size			
			1/4	1/8	1/16	1/32
DPS	0	$\bar{x}$	116.64	173.50	230.17	285.60
		M	108	164	221	276
	0.9704	$\bar{x}$	116.20	173.05	229.66	285.36
		M	107	164	220	276
	2.4962	$\bar{x}$	116.40	173.45	229.97	285.38
		M	107	164	221	276

The probability of quasi-extirpation increased moderately with take at year 30 (**Table 12**) and at year 75 (**Table 13**). That is, populations experiencing take were more likely to reach the threshold size than were populations without take. For instance, for Zone 1 and the 1/8 threshold, populations without take had a 23.04 percent chance of reaching the threshold by year 30, while populations with the expected take had a 24.17 percent of reaching this threshold within 30 years; and populations with the requested take had a 26.17 percent chance of reaching the threshold. As with time to quasi-extirpation, the effect of take on probability of quasi-extirpation at year 30 was greatest for the Zone 2 population. The DPS had extremely low probabilities of quasi-extirpation at year 30 at all thresholds (**Table 12**). At year 75 the DPS had a 16.01 percent chance of reaching the 1/4 threshold without any take and a 16.26 percent chance of reaching this threshold with the requested take (**Table 13**), still much lower than the other populations.

Mean and median population sizes at years 30, 50, 75, and 100 decreased with take (**Table 14**). Populations experiencing take were smaller than populations without take. Again, the relative differences were greatest for Zone 2, most likely a consequence of its smaller initial size. Notably, for each population, the differences in mean size were greatest in year 30 and progressively smaller in subsequent years. This phenomenon is also illustrated in **Figure 13**, which shows the mean population trajectories without take and with the requested take (the maximum take level evaluated). For the Zone 2 population, the two trajectories show increasing divergence until year 30 when take is terminated; thereafter, the two trajectories begin to converge. These results indicate that the take has a cumulative impact and that once take ceases, impacts gradually diminish even in the absence of other external forces. The pattern is clearest for the Zone 2 population where the divergence is greatest. While the pattern is present in the other populations, the cumulative impact of take is smaller (and less evident in **Figure 13**). Again, even in the absence of take, the trajectory for each of the modeled populations is declining, and the predicted outcome in each case is quasi-extirpation.

Table 12: Probability of Quasi-Extirpation at Year 30
without mitigation, by population, take level, and threshold size for quasi-extirpation

Population	Average Annual Take	Threshold Population Size			
		1/4	1/8	1/16	1/32
Zone 1	0	0.6496	0.2304	0.0403	0.0037
	0.9704	0.6581	0.2417	0.0447	0.0048
	2.4962	0.6702	0.2617	0.0558	0.0080
Zone 2	0	0.1978	0.0339	0.0034	0.0003
	0.9704	0.2166	0.0417	0.0052	0.0005
	2.4962	0.2448	0.0542	0.0083	0.0013
WA	0	0.4696	0.1236	0.0165	0.0013
	0.9704	0.4765	0.1289	0.0175	0.0013
	2.4962	0.4875	0.1386	0.0205	0.0020
DPS	0	0.0007	0.0000	0.0000	0.0000
	0.9704	0.0008	0.0000	0.0000	0.0000
	2.4962	0.0008	0.0000	0.0000	0.0000

Table 13: Probability of Quasi-Extirpation at Year 75
without mitigation, by population, take level, and threshold size for quasi-extirpation

Population	Average Annual Take	Threshold Population Size			
		1/4	1/8	1/16	1/32
Zone 1	0	0.9989	0.9848	0.9174	0.7395
	0.9704	0.9987	0.9855	0.9200	0.7443
	2.4962	0.9988	0.9865	0.9219	0.7510
Zone 2	0	0.7737	0.5157	0.2678	0.1132
	0.9704	0.7853	0.5313	0.2821	0.1197
	2.4962	0.7969	0.5511	0.2992	0.1323
WA	0	0.9860	0.9203	0.7391	0.4686
	0.9704	0.9854	0.9189	0.7412	0.4733
	2.4962	0.9861	0.9218	0.7474	0.4812
DPS	0	0.1601	0.0089	0.0001	0.0000
	0.9704	0.1630	0.0091	0.0001	0.0000
	2.4962	0.1626	0.0089	0.0001	0.0000

Table 14: Mean and Median Population Size by Year, Population, and Take Level

column headed P indicates parameter, either mean ($\bar{x}$) or median (*M*)

Population	Average Annual Take	P	Year			
			30	50	75	100
Zone 1	0	$\bar{x}$	477	180	53	16
		M	410	137	35	9
	0.9704	$\bar{x}$	470	178	53	16
		M	403	136	34	8
	2.4962	$\bar{x}$	460	174	52	15
		M	393	132	34	8
Zone 2	0	$\bar{x}$	408	260	148	85
		M	348	197	97	47
	0.9704	$\bar{x}$	396	253	143	82
		M	337	190	93	45
	2.4962	$\bar{x}$	379	242	138	79
		M	320	180	88	43
WA	0	$\bar{x}$	907	411	153	57
		M	780	316	101	32
	0.9704	$\bar{x}$	900	409	153	57
		M	772	312	100	32
	2.4962	$\bar{x}$	888	404	151	56
		M	759	306	98	31
DPS	0	$\bar{x}$	6,548	5,288	4,049	3,111
		M	6,292	4,939	3,645	2,693
	0.9704	$\bar{x}$	6,526	5,268	4,035	3,094
		M	6,270	4,914	3,635	2,682
	2.4962	$\bar{x}$	6,525	5,273	4,047	3,101
		M	6,282	4,918	3,637	2,686

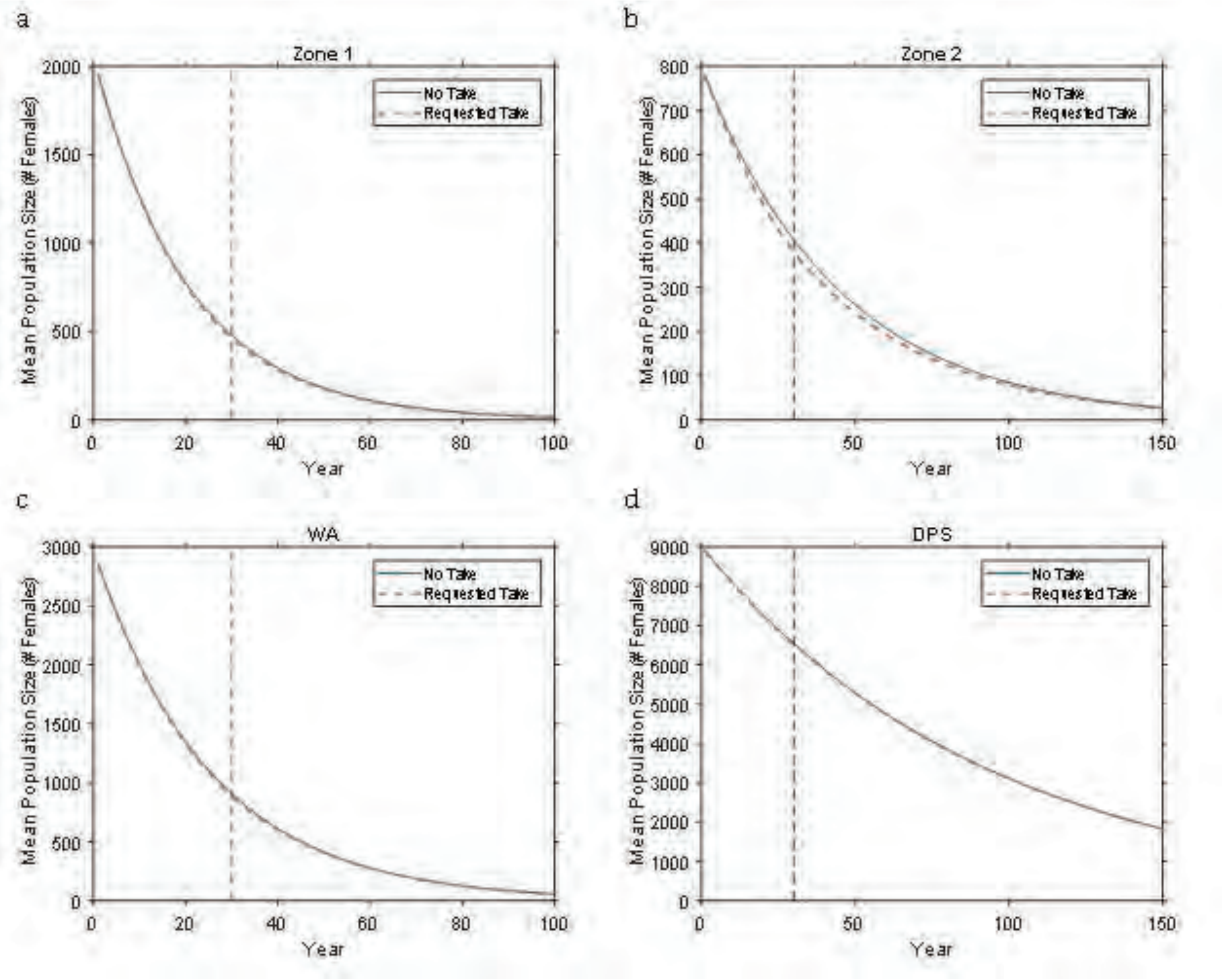

Figure 14: Mean Population Trajectories

Mean population trajectories from the PVA without take (solid blue line) and with requested take (dashed orange line) (initial mean take = 2.4962 murrelets per year = 1.2481 female murrelets per year) for (a) Zone 1, (b) Zone 2, (c) WA, and (d) DPS. The dashed black vertical line indicates year 30, when modeled take ceases.

5.1.3.2 Murrelet Populations

It has been suggested that the Project might have both direct and indirect impacts on a local population. However, such a population has not been defined in terms of geographic extent, current size, trend in size, or vital rates. Given that this local population is lacking in any measurable characteristics, then, based on the best available science, conclusions with respect to impacts on the local population cannot be drawn, and this assessment is not within the scope of this PVA.

5.2 EAGLES

5.2.1 Direct and Indirect Impacts

Wind turbine operation has the potential to directly affect bald eagles and golden eagles in the form of mortality from collision with spinning wind turbines. Bald eagles and golden eagles are both susceptible to wind turbine collisions; however, the number of carcasses found at wind energy projects throughout the United States differs between species. Six bald eagle fatalities were reported from wind projects in the United States from 1997 to June 2012; whereas 79 golden eagle fatalities, excluding the Altamont Pass Wind Resource Area, were reported during the same period by (Pagel et al. 2013).

The ECPG provides a five-stage decision framework for collecting information in increasing detail to evaluate risk and make siting and operational decisions to mitigate risk. If eagle risk is identified at a Project site, developers are strongly encouraged to follow all stages of the ECPG. The ECPG describes specific actions that are recommended to achieve compliance with the regulatory requirements in BGEPA for an ITP, as described in 50 CFR 22.26. The impacts analysis framework in this HCP follows the ECPG and Eagle Rule (50 CFR 22.26) where appropriate. The following sections describe the predicted take of bald eagles and golden eagles that is likely to result from collision with operating wind turbines. It should be noted that other direct impacts such as collisions with transmission lines may also occur at the Project. Also, indirect impacts such as habitat removal may also result in take of bald eagles or golden eagles. However, these are relatively unlikely sources of take, considering aforementioned minimization measures, and are not accounted for in the model.

5.2.2 Anticipated Take of Eagles

5.2.2.1 USFWS Bayesian Collision Risk Model Methodology

The USFWS presented a collision risk model in the Bayesian framework in the ECPG (USFWS 2013). The collision risk model is intended to predict annual fatalities for eagles that would occur during operation based on eagle exposure data collected at the Project. The collision risk model uses statistical models to define the relationship between eagle exposure and collision risk to predict annual eagle take and account for uncertainty. Variables used are presented in **Table 15** and discussed in this section. Details of the model and approach are presented in the ECPG (USFWS 2013). No prior distributions of exposure of collision probability have been developed specifically for bald eagles' use; as such, the USFWS' current recommendation is to use the prior distributions developed for golden eagles to predict bald eagle take (USFWS 2017a).

In addition to the prior distributions provided by the USFWS (2013), a collision rate prior distribution developed by Bay et al. (2016) was used to provide an alternative fatality prediction for bald eagles and golden eagles. Bay et al. (2016) used data collected on golden eagles from wind projects that are more representative of the current technology (e.g., larger turbine rotor radius) than was used by the USFWS (2013). The ECPG (USFWS 2013) states that alternative fatality prediction models should be considered when developing a fatality prediction.

Table 15: Definitions of Variables Used in the USFWS Approach for Predicting Annual Eagle Fatalities from Turbine Collisions at a Wind Facility*

Parameter	Variable Name	Definition
F	Annual Fatalities	Annual eagle fatalities from collision with wind turbines
λ	Exposure Rate	Eagle-minutes flying within the Project footprint (in proximity to turbine hazards) per hour per km^2, or stated another way, the expected number of exposure events (eagle-minutes) per survey hour per km^2
C	Collision Rate	The rate of an eagle colliding with a turbine given exposure
ε	Expansion Factor	Product of operating hours and total hazardous area hour per km^2
κ	Eagle-Minutes	Number of minutes that eagles were observed flying during survey point counts. All eagle minutes were included regardless of the distance from observer or flight height.
δ	Turbine Hazardous Area	Rotor-swept area around a turbine or proposed turbine (km^2)
n	Trials	Number of trials for which eagle-minutes could have been observed (the number of hours per km^2 observed)
τ	Operating Hours	Total hours the facility is predicted to operate each year
n	Number of Turbines	Number of turbines (or proposed turbines) for the Project

* USFWS 2013 Eagle Conservation Plan Guidance [ECPG], App. D. km^2 = square kilometers

5.2.2.1.1 Turbine Specifications

At this stage of development, the turbine model has not been selected for the Project; however, it is expected to be turbine with a rotor radius up to 68 meters, with 38 turbines at the Project. Analysis of these configurations allows conservative approximations for levels of bald and golden eagle take expected for the Project.

5.2.2.1.2 Exposure Rate

Exposure rate (λ) is the expected number of exposure events (eagle-minutes) per survey hour per square kilometer (km^2). The USFWS prior distribution for exposure rate was derived from data from a range of projects under USFWS review and the projects from Whitfield (2009). The prior distribution is intended to model exposure rates for any wind energy facility. The USFWS defines the prior distribution for exposure rate as:

$\text{Prior } \lambda \sim \text{Gamma}(\alpha, \beta)$, with shape and rate parameters $\alpha =$ 0.97 and β = 2.76.

Eagle exposure data collected during pre-construction eagle use surveys are used to update this prior distribution to estimate the parameters for the posterior distribution. By assuming the exposure minutes follow a Poisson distribution with rate parameter λ , the posterior distribution for exposure rate is:

$$\text{Posterior } \lambda \sim \text{Gamma}\left(\alpha + \sum_{i=1}^{n} k_i,\ \beta + n\right)$$

where $\sum k_i$ is the total observed eagle-minutes, *n is* the number of trials, and α and β are from the prior distribution. The number of trials is the number of hours per km^2 that were conducted in the pre-construction survey.

A $Gamma\ (\alpha = 0.97, \beta = 2.76)$ prior distribution with mean (0.35) and standard deviation (0.357) has been recommended by the USFWS for the exposure rate prior distribution. The posterior distribution for exposure rate was estimated as a Gamma distribution with the **α** parameters equal to the sum of the prior **α** and total flight minutes below 200 meters, and the β parameters equal to the sum of the prior β and effort (hours of surveys × km^2 of area surveyed).

Point count survey data were collected at five observation points (points 5, 6, 7, 8, and 9) in 2016 and seven observation points (points 5, 6, 7, 8, 9, 12 and 13) in 2017. Point count survey locations were selected along a ridgeline near proposed turbine locations. Areas along the ridgeline near proposed turbine locations have limited visibility due to topography and vegetation within the Project Area; therefore, survey locations were sited to optimize visibility within 800 meters of the survey location while still providing adequate coverage of the Project Area.

From January 2016 through December 2016, a total of 226 survey hours were conducted at five observation points; these survey hours were used in the analyses of risk, during which time bald eagles were in view for 93 bald eagle minutes, golden eagles were in view for 29 minutes, and unidentified eagles were in view for 7 minutes when the eagle was first observed within 800 meters from the observer when the birds were first observed. Data on eagle-minutes within 800 meters of the observer and flying below 200 meters in flight height were not recorded during the surveys; and, therefore, a conservative assumption was made and the total minutes eagles were in view was used in the analysis. In addition, five bald eagle observations and one unidentified eagle observation were recorded during surveys and were greater than 800 meters from the observer when the birds were first observed. A flight path was not recorded; therefore, it could not be verified if the birds first observed greater than 800 meters from the observer ever flew within 800 meters of the observer. Thus, a conservative assumption was made to include the eagle observations that were first observed greater than 800 meters from the observer. Eagle-minutes were estimated for birds first observed outside of 800 meters from the observer by calculating the number of eagle-minutes per eagle observation using data collected for birds first observed within 800 meters from the observer. An adjustment of 1.9 and 2.1 eagle-minutes per observation was used for bald and unidentified eagles, respectively, for birds first observed at greater than 800 meters from the observer to estimate the total number of eagle-minutes for birds first observed greater than 800 meters from the observer. No golden eagles were first observed at greater than 800 meters from the observer and therefore, no adjustment for eagle-minutes was needed. The adjustment for observations to eagle minutes was calculated using data collected on eagles-minutes within 800 meters of the observer and flying below 200 meters above ground level and the total number of eagle observations during survey. In addition, unidentified eagles were observed during surveys; and the observations could have been bald or golden eagles. The proportion of bald and golden eagle-minutes of the identified eagle species within

800 meters was used to assign the unidentified eagle species to either bald or golden eagle; thus, 72 percent of unidentified eagles were assigned to bald eagles and 28 percent of unidentified eagles were assigned to golden eagles. Based on this data and approach, the collision risk model used 111 bald eagle-minutes and 33 golden eagle-minutes to predict eagle fatalities.

From January 2017 through March 2017, a total of 32 survey hours were conducted at seven observation points; these survey hours were used in the analyses of risk, during which time bald eagles were in view for 24 minutes and golden eagles were in view for 19 minutes. Data on eagle-minutes within 800 meters of the observer and flying below 200 meters in flight height were not recorded during the surveys; and, therefore, a conservative assumption was made and the total minutes eagles were in view was used in the analysis.

Thus, January 2016 – March 2017 data input into the Bayesian collision risk model is conservative in several ways and could over-predict take. First, the treatment of eagles lacking flight paths is conservative in that all possible eagle-minutes are included in the model and it is likely some eagle-minutes would have been excluded had the flight paths been recorded. Second, consistent with the ECPG (USFWS 2013) the upper 80th credible interval is used to predict fatalities and to calculate mitigation for take to account for uncertainty in the modeling process. Although not 100 percent of the 800-meter x 200-meter survey cylinder was visible (63 to 77 percent of the cylinder was visible at each point count location), an adjustment for non-visible area was not included in the model given the two conservative assumptions described and to avoid compounding conservative assumptions.

From April 2017 through November 2017, a total of 63 survey hours were conducted at seven observation points; these survey hours were also used to predict bald and golden eagle fatalities at the Project, during which time 39 bald eagle flight minutes and 6 golden eagle flight minutes were recorded within 800 meters from the observer and below 200 meters in flight height above ground level.

Data collected during the 2016 and 2017 surveys were combined to predict bald and golden eagle take (**Table 16** and **Table 17**). The collision risk model was run for each season separately, and the seasonal prediction distributions were combined to predict annual take at the Project.

Table 16: Estimated Exposure Rate (λ) for Bald Eagles from Eagle Observations Made during Point Count Surveys

Variable	Spring	Summer	Fall	Winter
1) Recorded Flight Minutes below 200 m at points	63	36	25	50
2) Number of Surveys	62	58	58	23
3) Length of Surveys (hours)	1 or 2	1 or 2	1 or 2	1 or 2
4) Survey Hours	92	88	74	67
5) Survey Radius (m)	800	800	800	800
6) Eagle Flight Minutes (alpha: Line 1 + 0.97)	63.97	36.97	25.97	50.97
7) Effort (beta: survey hours x km^2 of area surveyed + 2.76)	187.737	179.694	151.546	137.471
8) Mean Exposure Rate (Line 6 ÷ Line 7)	0.341	0.206	0.171	0.371

Table 17: Estimated Exposure Rate (λ) for Golden Eagles from Eagle Observations Made during Point Count Surveys

Variable	Spring	Summer	Fall	Winter
1) Recorded Flight Minutes Below 200 m at Points	13	2	18	25
2) Number of Surveys	62	58	58	23
3) Length of Surveys (hours)	1 or 2	1 or 2	1 or 2	1 or 2
4) Survey Hours	92	88	74	67
5) Survey Radius (m)	800	800	800	800
6) Eagle Flight Minutes (alpha: Line 1 + 0.97)	13.97	2.97	18.97	25.97
7) Effort (beta: survey hours x km^2 of area surveyed + 2.76)	187.737	179.694	151.546	137.471
8) Mean Exposure Rate (Line 6 ÷ Line 7)	0.074	0.017	0.125	0.189

5.2.2.1.3 Expansion Factor

The expansion factor (ε) is used to scale the per unit fatality rate (fatalities per hour per km^2) to the operational hours (τ) in one year and total hazardous area (km^2) within the Project. The expansion factor is:

$$\varepsilon = \tau \sum_{i=1}^{n} \delta_i ,$$

where *n* is the number of turbines, and δ is the circular area (2-D hazardous area) centered at the base of a turbine having radius equal to the rotor-swept radius of the turbine (or proposed turbine). The expansion factor is dependent on the number of proposed turbines as well as the proposed rotor diameter (**Table 18**).

Daylight hours were estimated to be 4,467 hours per year using sunrise and sunset times at the Project site.

Table 18: Model Parameters and Predicted Eagle Fatalities for Bald and Golden Eagles

Expansion Factor (ε)	Spring	Summer	Fall	Winter
9) Hours per year	1,241	1,394	1,000	832
10) Rotor Radius (meters)	68.0	68.0	68.0	68.0
11) Turbine Hazardous Area (π × radius of turbine in km^2)	0.015	0.015	0.015	0.015
12) Number of Turbines	38	38	38	38
13) Expansion Factor (Line 9 x Line 11 x Line 12)	685	770	552	460

5.2.2.1.4 Collision Rate

The collision rate, *C,* is the rate of an eagle colliding with a turbine per exposure in the hazardous area, where all collisions are considered to be fatal. The prior distribution presented by USFWS was estimated using results taken from the Whitfield (2009) study of avoidance rates, including golden eagle data from four wind facilities: Altamont, Tehachapi, San Gorgonio, and Foote Creek Rim wind resource areas. The *Beta* distribution is intended to model collision rates across all sites considered for prediction of annual eagle fatalities. The USFWS collision rate prior distribution is given as:

$\text{Prior } C \sim \text{Beta}(\nu, \nu')$, with parameters ν=2.31 and ν'=396.69.

The mean collision rate was 0.0058 using the USFWS collision rate prior distribution. Based on the limited understanding of bald eagle and wind facility interaction, it is probable that these present conservative estimates of bald eagle collision rate.

In addition, annual eagle fatality rates at the Project were predicted using the Bayesian collision risk model with an alternative collision rate distribution presented in Bay et al (2016). The mean collision rate was 0.0029, and the collision rate prior distribution is given as:

$\text{Prior } C \sim \text{Beta}(\nu, \nu')$, with parameters ν = 9.28and ν' = 3,224.51.

5.2.2.1.5 Predicted Annual Fatalities

The distribution of predicted annual fatalities can be estimated as the product of the expansion factor, the exposure rate posterior distribution, and the collision rate prior distribution:

$$F = \varepsilon \cdot \text{posterior } \lambda \cdot \text{prior } C.$$

The distribution of estimated annual fatalities is used to obtain statistics such as estimates for the mean, standard deviation, and 80th credible interval of annual fatalities.

5.2.2.2 Risk Modeling Results

Credible intervals (i.e., Bayesian confidence intervals) were calculated using a simulation of 10,000 Monte Carlo draws from the posterior distribution of eagle exposure (λ)and the collision rate distribution (*C*; Manly 1991). The product of each of these draws, with the hazardous area corresponding to turbine type, was used to estimate the distribution of possible fatality rates at the Project. Consistent with the ECPG, the mean and upper 80th credible interval were used to predict annual fatality rates at the Project (USFWS 2016b).

The collision risk model was run for each season separately, and the seasonal prediction distributions were combined to predict annual take at the Project (**Table 19** and **Table 20**). The season with the highest bald eagle fatality rate was spring (1.36 eagles per spring season), and the season with the lowest bald eagle fatality rate was fall (0.54 eagles per fall season). Golden eagle fatalities were predicted to be highest in winter (0.51 eagles per season) and lowest in summer (0.07 eagle fatalities per summer season). Annual predicted fatality rate using operating hours was 4.8 for bald eagles (upper 80th credible interval) and 1.65 for golden eagles (upper 80th credible interval). Based on the 80-percent credible interval predictions for the Project), the Applicant is requesting take authorization for an estimated 146 bald eagles and 50 golden eagles over 30 years. To predict the take over 30 years, the 80th credible interval was multiplied by 30 and rounded to the next whole eagle.

Annual fatalities were also predicted using the collision risk model with an alternative collision rate prior distribution (Bay et al. 2016). The predicted fatality rate was 1.7 for bald eagles per year (upper 80th credible interval) and 0.74 for golden eagles per year (upper 80th credible interval) using the Bay et al. collision rate prior distribution. The take over 30 years is predicted to be 66 bald eagles and 23 golden eagles.

These predictions represent a conservative maximum estimate of take for the Project because they are based on the largest rotor-swept area anticipated to result from turbine models being considered.

Table 19: Seasonal Predicted Eagle Fatalities for Bald and Golden Eagles Using the ECPG Collision Rate Prior Distribution

Species	Prediction (Upper 80th Percentile)			
	Spring	Summer	Fall	Winter
Bald Eagle	1.36 (2.01)	0.91 (1.34)	0.54 (0.80)	0.99 (1.46)
Golden Eagle	0.30 (0.44)	0.07 (0.11)	0.40 (0.59)	0.51 (0.75)

Table 20: Seasonal Predicted Eagle Fatalities for Bald and Golden Eagles Using the Bay et al. (2016) Collision Rate Prior Distribution

Species	Prediction (Upper 80th Percentile)			
	Spring	Summer	Fall	Winter
Bald Eagle	0.67 (0.85)	0.45 (0.58)	0.27 (0.35)	0.49 (0.62)
Golden Eagle	0.15 (0.20)	0.04 (0.05)	0.20 (0.26)	0.25 (0.32)

Table 21: Model Parameters and Predicted Eagle Fatalities for Bald and Golden Eagles

Model Parameters	Bald Eagle		Golden Eagle	
	ECPG	Bay et al.	ECPG	Bay et al.
Predicted annual eagle fatalities	3.81	1.88	1.27	0.63
Upper 80th Percentile	4.86	2.17	1.65	0.74

5.2.3 Anticipated Impacts of the Taking

Determining the significance of potential take on a population requires an understanding of population demographics and, in particular, annual survival or mortality rates. The USFWS estimated bald eagle and golden eagle populations in the United States using a population model in conjunction with estimates of the number of occupied nesting territories in 2009 from a comprehensive aerial survey (USFWS 2016a). The USFWS identified annual take levels of below 5 percent of the local area eagle breeding population as meeting the BGEPA preservation standard of stable or increasing regional breeding populations (USFWS 2016c).

To calculate the local area population (LAP) for analysis, the Project was buffered by 86 miles for bald eagles and 109 miles for golden eagles (USFWS 2016a). The buffers were clipped to exclude the Pacific Ocean, the Puget Sound, and other major bays and inlets along the Washington coast, as eagles do not nest over large expanses of water. Eagle population sizes in 2009 and corresponding densities per management unit were provided by the USFWS (2016c) in the eagle status report and were used to calculate eagle density within the LAP. The USFWS is in the process of conducting a LAP analysis that takes into account authorized and unauthorized eagle take and evaluates how the predicted fatalities from the Project result in an increase of overall take above management objectives.

Bald Eagle: The Project falls within bald eagle management unit Region 1 (Pacific EMU). The local area for bald eagles is 22,981 square miles. The estimated population size for bald eagles in the LAP is 540.09with a 5-percent take benchmark of 27. Thus, absent information on other authorized take, the impacts of the take of 4.86 bald eagles annually does not rise above the 5-percent take benchmark for the LAP addressed in the PEIS (USFWS 2016c).

Golden Eagle: The Project falls within golden eagle management units BCR5 and BCR9 (Northern Pacific Rainforest and Great Basin, respectively). The local area for golden eagles is 33,684 square miles. The estimated population size for golden eagles in the LAP is 246.67 with a 5-percent take benchmark of 12.33. Thus, absent information on other authorized take, the impacts of the take of 1.65 golden eagles annually alone does not rise above the 5-percent take benchmark for the LAP addressed in the PEIS (USFWS 2016c). In addition, the estimated take of golden eagles will be compensated for (through compensatory mitigation) at a 1.2:1 ratio in accordance with regulations and as described in **Section 6.2.3**; however, much or all of that compensatory mitigation may not occur within the LAP.

Table 22: Estimated Bald Eagle Local Area Population (LAP) for the Skookumchuck Wind Project

Bird Conservation Region	Estimated No. of Bald Eagles
Pacific (portion of LAP)	540.09
Total Local Area Population	540.09
1% LAP Benchmark	2.47
5% LAP Benchmark	27.00
10% LAP Benchmark	54.00

Table 23: Estimated Golden Eagle Local Area Population (LAP) for the Skookumchuck Wind Project

Bird Conservation Region	Estimated No. of Golden Eagles
Northern Pacific Rainforest (portion of LAP)	37.76
Great Basin (portion of the LAP)	208.91
Total Local Area Population	246.67
1% LAP Benchmark	2.47
5% LAP Benchmark	12.33
10% LAP Benchmark	24.67

CHAPTER 6.0 – CONSERVATION PROGRAM

6.1 MURRELETS

6.1.1 Biological Goals and Objectives

The biological goals of an HCP are the guiding principles for the proposed conservation program and the rationale for the minimization and mitigation measures. Goals are descriptive, open-ended, and a broad statement of desired future conditions that conveys a purpose (USFWS 2016b). The biological objectives of an HCP are the specific measurable and attainable targets intended to meet or achieve the biological goals. The biological goals and objectives of this HCP were designed to be SMART: specific, measurable, achievable, results-oriented, and time-fixed (USFWS 2016b). While conservation or recovery of a listed species is not required under Section 10 of the ESA, the biological goals and objectives of this HCP are consistent with actions to promote the conservation of murrelets as identified in the Recovery Plan (USFWS 1997).

Goal 1: To minimize Covered Species mortality in the Project Area through curtailment.

Objective 1.1: To implement an operational strategy that will decrease murrelet mortality (through curtailment) by at least one individual every five years from the predicted uncurtailed levels.

Goal 2: To implement conservation projects that increase survival and reproductive capacity of the murrelet in Washington, that, when combined with minimization measures fully mitigates the impacts of the taking anticipated to result from the Covered Activities.

Objective 2.1: To implement conservation projects such as, but not limited to, the protection and restoration of nesting habitat in Washington.

Goal 3: To reduce the threats of climate change to the Covered Species, a noted threat to the Covered Species, concurrently with achieving Goal 1 above.

Objective 3.1: To maximize operational output of the Project, such that the environmental benefits of wind energy are maximized, reducing potential harmful effects of other energy generation technologies (see **Section 6.3** for full discussion).

6.1.2 Measures to Avoid and Minimize Take

Consistent with ESA §10(a)(2)(B), the following sets forth how the Applicant will, to the maximum extent practicable, minimize and mitigate the impacts of the taking for which the Applicant is seeking authorization.

6.1.2.1 Avoidance through Project Design and Planning

While ESA §10(a)(2)(B) does not require the Applicant to avoid impacts as a precondition to obtaining an ITP, the Project has been designed to avoid impacts to murrelets and their nesting habitat to the extent practicable. The Applicant followed a tiered evaluation process similar to the process outlined in the USFWS Land-based WEG (USFWS 2012a) to assess potential impacts of the Project. Per WEG, during Tier 1 and 2 site screening and characterization assessments, the scale of the Project was considerably reduced from 98 turbines to 61 turbines and then again to a 51-turbine layout. The reduction in Project footprint eliminated turbines in areas that contained suitable habitat and concentrated development in areas of active forest management. The Applicant then engaged in detailed discussions regarding the Project with wildlife agencies, community leaders and other stakeholders and in response to their input reduced the Project again to its current 38-turbine layout. Reduction in the number of installed turbines decreases the unminimized take of murrelets that may result from operation of the Project. Details regarding avoidance efforts are provided in **Section 6.5**.

The Applicant is requesting an ITP for the operation and maintenance of the Project. Consequently, construction-related decisions, including turbine siting and configuration, are outside the scope of this HCP; and the Project Applicant is not requesting USFWS approval of those decisions in its Application.

6.1.2.2 Minimization through Project Operations

Modifications to turbine operation and use of best management practices have been shown to minimize the potential impacts from wind energy projects to wildlife (WDFW 2009; USFWS 2012a; Arnett and May 2016). Fatalities of wildlife at other wind facilities have been substantially reduced by modifying the timing of turbine operation (Arnett et al. 2013; Nagy et al. 2013; Sheppard et al. 2014) and marking electrical lines (Jenkins et al. 2010). These minimization measures, among others that will benefit murrelets, will be implemented at the Project and are described below.

- To minimize potential collisions with murrelets during Project operation, seasonal turbine curtailment will be applied to turbines that had the highest murrelet passage rate during pre-construction radar surveys. During the first three years of operation, the maximum curtailment at the facility will include seasonal curtailment from May 1 to August 9 at 10 turbines (T1 through T5 and T34 through T38) located at the eastern and western ends of the Project for a period of three hours each morning (i.e., 1.75 hours before sunrise and 1.25 hours after sunrise). This time period corresponds to the high-use flight period when murrelets travel between their marine foraging habitats and inland nesting habitat (see **Section 5.1.2.2**). Modifications to the curtailment program (e.g., duration and location of turbine curtailment) after the first three years of operations will be based on results collected during post-construction compliance monitoring (see **Section 6.3**) and will be triggered through the Adaptive Management strategy (see **Section 6.4**). Furthermore, reduced seasonal curtailment could occur if alternative take reduction strategies emerge; alternative strategies will be considered if they are demonstrated to be effective (see **Section 7.1.1**). Under the assumptions used to calculate the requested take, the benefit of curtailment is expected to be to minimize (reduce) take by 10 murrelets and indirect effects of take by one adult equivalent[6] murrelet over the 30-year permit term.

- Flight diverters will be installed on all aboveground transmission and distribution lines to minimize collision risk according to Avian Power Line Interaction Committee (APLIC) suggested practices

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[6] An adult equivalent is defined here as a marbled murrelet of age 2 (the age at which breeding first occurs) having accounted for survival from fledgling status. The indirect effects of both take and mitigation strategies, originally quantified in terms of numbers of fledglings, are re-expressed as adult equivalents to account for the fact that fledglings have lower reproductive value than adults (see **Section 5.1.2.5**).

(APLIC 2012). Technological advancements in line-marking systems now include diverters that are visible to birds in low-light conditions.

- To reduce the potential influence of artificial lighting on the murrelet flight behavior, shielding, baffles, or other hardware will be used on buildings or freestanding fixtures to promote down lighting (USFWS 2018). Reduced use of lights will be encouraged and incorporated into the Project design. Per Federal Aviation Administration regulations, blinking red obstruction lighting will be installed on 26 of the 38 (68 percent) of the turbines. A study in Michigan found the use of blinking lights reduced avian fatalities by 50 to 71 percent compared to non-blinking/steady burning lighting (Gehring et al. 2009).

- To minimize potential for vehicle collisions with murrelets during Project operation, vehicle speed limits of 25 miles per hour will be posted and enforced for wind operations staff within the Project.

- To reduce the potential for the artificial increase of potential nest predators in the Project and surrounding landscape, a garbage abatement policy will be in place that prohibits the disposal of garbage in the Project Area.

6.1.3 Measures to Mitigate the Impacts of the Requested Take

The Applicant will fully mitigate the impacts of the taking of murrelets by acquiring conservation lands that promote the preservation and enhancement of suitable nesting habitat for murrelets and by funding the removal of abandoned or derelict fishing nets in the Salish Sea. In coordination with the USFWS and other stakeholders, the Applicant will acquire conservation lands that are strategically located to maximize their biological significance for murrelets. Conservation lands will be selected to maximize habitat connectivity to areas of known murrelet occupancy or nesting and adjacency to other conservation or management lands to create larger blocks of protected space (USFWS 2017a). Removal of abandoned or derelict fishing nets also is an effective measure to reduce incidental mortality of murrelets (USFWS 2017b). Net removal will be accomplished by providing funding to an organization already engaged in this work to implement a net removal program that, in combination with the other elements of the conservation program, will satisfy the biological goals and objectives of this HCP.

The Applicant will convey a conservation easement to a non-profit conservation entity in perpetuity and designate the USFWS as a third-party beneficiary. The conservation easement will be in a form acceptable to the Applicant, easement holder, WDFW, and USFWS. An example of a conservation easement has been provided in Appendix H. A management plan for the conservation land will be developed by the conservation easement holder in a form acceptable to the Applicant, WDFW, and USFWS prior to the commencement of the Covered Activities. The cost of the mitigation project will include funding for the easement-holder to implement the management plan. Acquisition of the conservation easement and development of the management plan will occur prior to commencement of the Covered Activities.

Management actions that may be implemented to promote murrelet habitat are dependent on the landscape and habitat characteristics of the parcel but may include selective thinning to accelerate crown and limb development, 100-meter buffers to protect from windthrow and predator incursions, road decommissioning, tree planting, or brush management. The Applicant selected this approach because it provides a unique opportunity for meaningful conservation measures and because of the proven record of conservation success, organizational integrity, and stewardship goals of nonprofit organizations in the region. Funding a land acquisition program is considered to be the best method of obtaining effective ecological mitigation, and the level of funding would be commensurate with the level of impacts from the Project and habitat characteristics of the conservation land.

6.1.3.1 Regional Assessment of Conservation Priorities

6.1.3.1.1 Methods

To identify potential conservation lands that could be used to mitigate the incidental take of murrelets from Project operation, the Applicant used a tiered approach that (1) started with a board-scale assessment of regional conservation priorities, (2) used the conservation priorities to narrow the geographic area under consideration, and (3) implemented a finer-scale screening process that evaluated potential conservation lands using the following criteria which attempted to maximize the biological contribution to murrelets:

- Parcels were preferably located within approximately 25 miles of marine waters, which is the approximate distance of the Project to the nearest marine waters (e.g., foraging habitat).
- In the case of private lands, parcels that were currently not protected for the conservation or enhancement of murrelet habitat but contained suitable nesting habitat were preferred.
- NGO lands, unencumbered easements, or other trust lands for which the management vision of the parcel is to directly enhance and conserve murrelet nesting habitat were preferred.
- Parcels located adjacent to occupied habitat which created a larger block of contiguous habitat were preferred over isolated, non-contiguous parcels that did not contribute to landscape connectivity of habitat.
- Parcels that contained a range of tree seral stages and species composition that provided a range of habitat conditions including: currently suitable nesting habitat, buffer habitat surrounding nesting habitat, forest which would grow into suitable nesting habitat during the 30-year ITP term were preferred.

Conservation opportunities identified through the regional assessment were shared with biologists from the USFWS and WDFW.

6.1.3.1.2 Results

Based on the results of the regional assessment and outreach with various land-management organizations, the Applicant reviewed 13 parcels that totaled approximately 11,250 acres. Conservation lands were located in three general regions: (1) Cascade Mountain foothills in the vicinity of the Project, (2) western Olympic Peninsula, and (3) southwest Washington.

Initially, conservation opportunities were considered nearest to the Project to help promote habitat for breeding pairs in the general area to mitigate potential take from the Project. Raphael et al. (2008) ranked WDNR's land holding for the overall importance of potential murrelet conservation value. The Skookumchuck Planning Block, located approximately 3 miles northwest from the nearest proposed turbine, was considered the second to last in conservation value for murrelets and was not recommended for conservation emphasis by Raphael et al. (2008; **Figure 15**). Coordination with USFWS and WDFW also did not favor this conservation option. For these reasons, conservation opportunities in the general vicinity of the Project were not pursued.

Several areas that totaled approximately 1,460 acres were considered in the western Olympic Peninsula. Potential conservation areas were located in the low elevation Sitka spruce zone, which was identified as a conservation priority (Raphael et al. 2008). However, the large federal (e.g., USFS, National Park Service), and state-land (WDNR) holdings and their contribution to suitable murrelet habitat decreases the importance of smaller, localized conservation projects that may have a relatively larger benefit elsewhere. For these reasons, conservation opportunities in the western Olympic Peninsula were not pursued.

The southwest Washington region has been identified as a high conservation priority by USFWS for increasing the murrelet population in a conspicuous gap in habitat distribution (Raphael et al. 2008; WDNR 2016; **Figure 15**). Of the approximate 9,500 acres evaluated in the southwest region, two parcels that total approximately 616 acres were identified as potential conservation lands to mitigate take at the Project. The following section provides a more detailed assessment of the potential conservation lands.

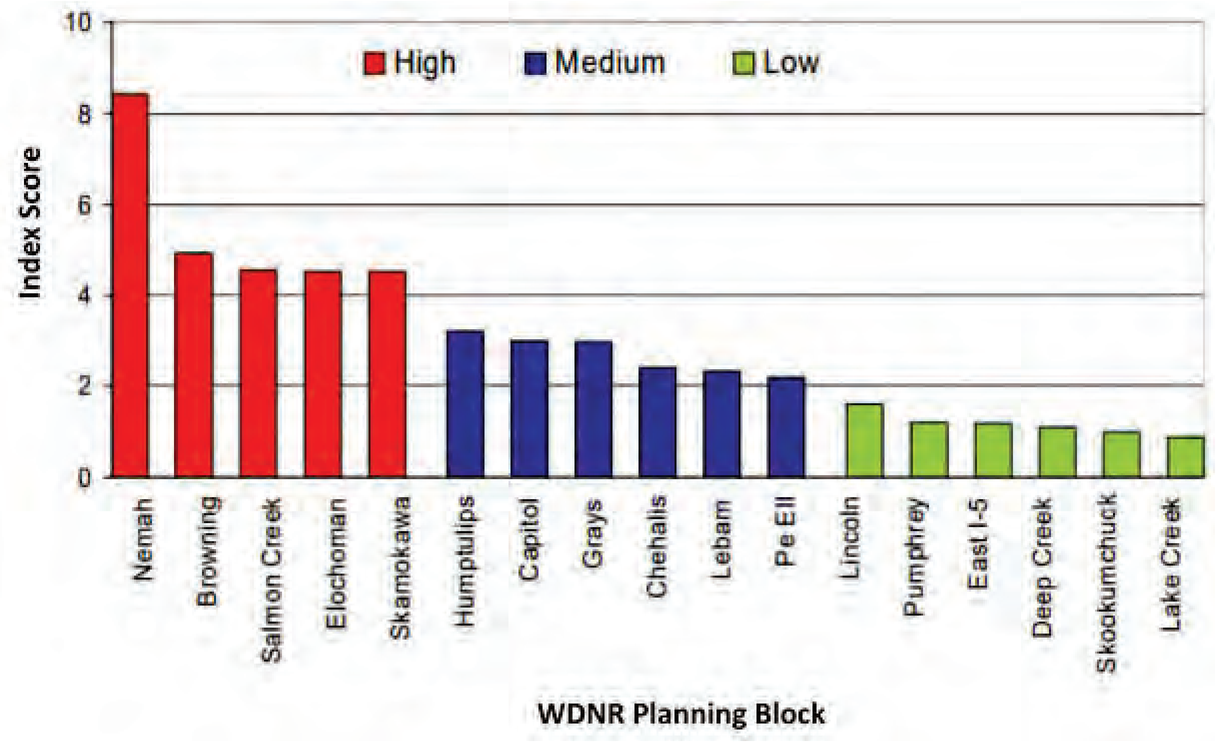

Figure 15: Overall Scorecard Results by Geographic Planning Block for the Southwest Washington Analysis Unit

(Raphael et al. 2008). The higher index score represents a higher relative conservation priority.

6.1.3.2 Assessment of Potential Conservation Lands

Based on results from the regional assessment and input from USFWS and WDFW biologists, two conservation lands were identified to mitigate the potential take of murrelets from the operation of the

Project. Stand characteristics reported for each parcel are derived from stand inventory data (e.g., cruise data) collected by the current landowner, independent market valuation of the parcels, and various site visits in fall 2017 and winter 2018 including one site visit with USFWS biologists on September 6, 2017.

The two conservation lands have several characteristics in common. Located in Pacific County, Washington, both parcels are within 5 miles of Willapa Bay and the USFWS Willapa National Wildlife Complex. Parcels are situated directly adjacent to the Nemah Planning Block, which is managed by WDNR and is designated as occupied murrelet habitat. Additional areas that surround the conservations lands are managed by non-governmental organizations to protect and enhance wildlife and fisheries habitat (**Figure 16**). If acquired by the Applicant, conservation lands would provide biological benefits beyond their borders and contribute to murrelet habitat conservation and connectivity on a larger landscape scale.

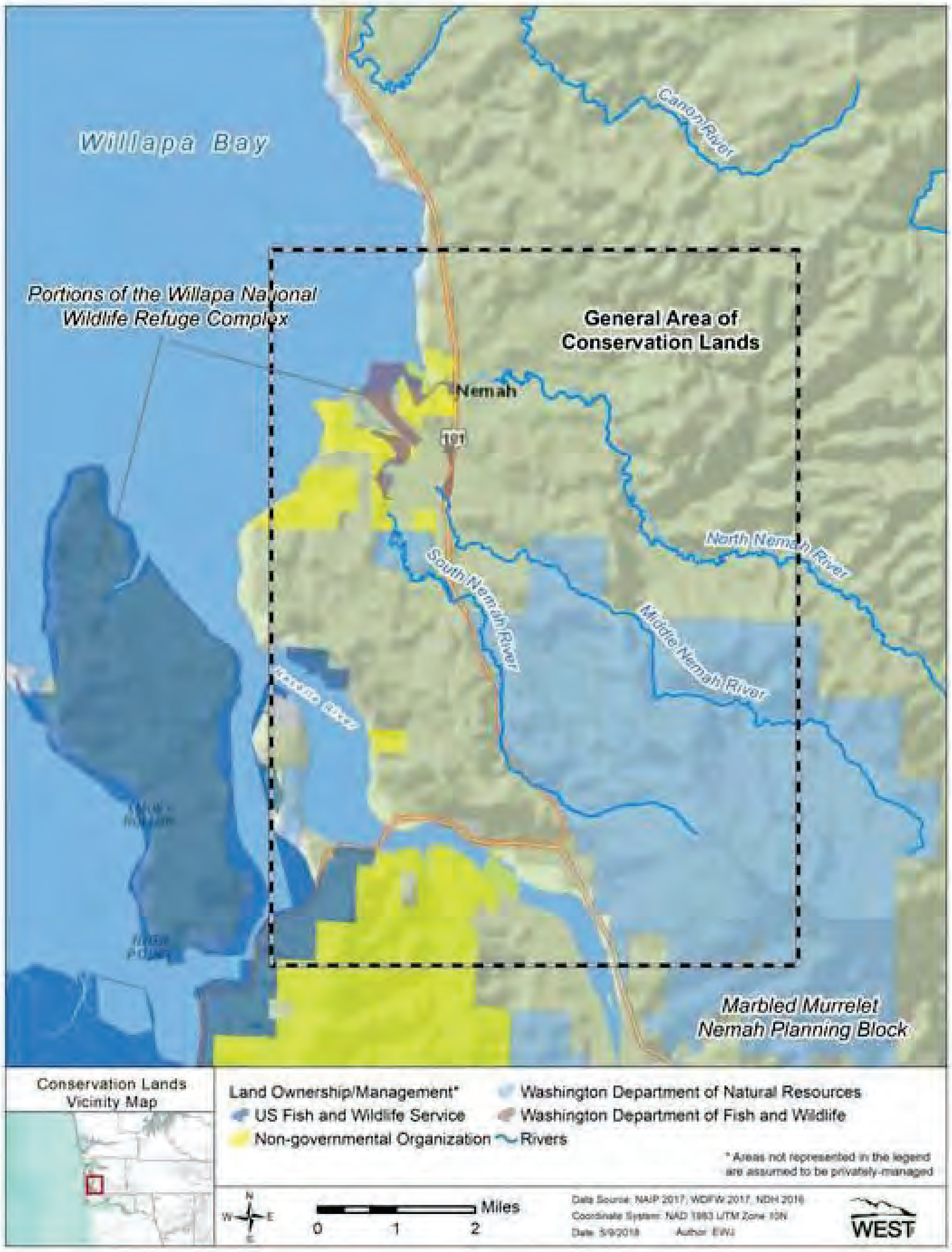

Figure 16: Surrounding Ownership and Landscape in the Vicinity of the Proposed Conservation Lands

Each parcel is approximately 300 acres (620 acres total) and currently managed as private industrial forest land that has a timber harvest rotation of approximately 40 to 45 years. Based on timber cruise data, the most recent timber harvest was over a decade ago in 2003. Portions of each parcel have had detections of subcanopy flight behavior (see discussion below and Appendix C) which has precluded timber harvest in approximately half of the parcels. Each parcel has high growth potential and productivity (Site Index II) based on soil conditions and tree types as determined by the current owner and independent third party. If parcels are not placed in conservation status, areas unencumbered by Forest Practices Application (FPA) restrictions would continue to be harvested, which would continue the deleterious effects of habitat fragmentation in a region of murrelet conservation priority.

The following describes unique characteristics associated with each conservation parcel.

Parcel A

Parcel A is an approximate 320-acre parcel located between the North and South Forks of the Nemah River (**Figure 16**). The parcel contains mixed-conifer stands dominated by western hemlock with a minor component of Douglas-fir and Sitka spruce. The parcel is bisected by Freshwater Creek and various unnamed tributaries that contain flight corridors to suitable nesting habitat found throughout the parcel. Over half of the parcel (174 acres, 55 percent) is composed of stands greater than 60 years old which contain legacy trees that were retained through harvest cycles, high incidence of hemlock dwarf mistletoe (*Arceuthobium tsugense*), and other decadent features (e.g., limb deformities and candelabras), which provide suitable murrelet nesting structure (**Table 24**). An additional 35 acres that have been naturally regenerated are at least 37 years old and expected to grow into suitable habitat over the 30-year permit term. Approximately 109 acres of Douglas-fir have been replanted which would function as buffer habitat unless stand management (e.g., thinning and inter-planting) or natural process (e.g., forest succession or disturbance) occurs that would reduce tree density and promote species diversification (**Figure 17**). Monotypic stands composed solely of Douglas-fir typically lack the tree species composition and growth habits that would naturally develop into suitable nesting habitat.

Table 24: Stand Characteristics of Parcel A

Stand Age*	Year Stand Established	Gross Acres	Stand Type
0	NA	0.85	Unestablished
14	2003	3.32	Plantation
17	2000	15.46	Plantation
18	1999	29.66	Plantation
27	1990	40.10	Plantation
37	1980	30.00	Natural
39	1978	20.10	Plantation
46	1971	4.78	Natural
61	1956	61.06	Natural
63	1954	26.99	Natural
63	1954	10.69	Natural
64	1953	28.23	Natural
64	1953	11.74	Natural
73	1944	1.16	Natural
73	1944	0.37	Natural
73	1944	4.80	Natural
75	1942	31.33	Natural

*Stand age and year of establishment derived from 2017 stand inventory data.

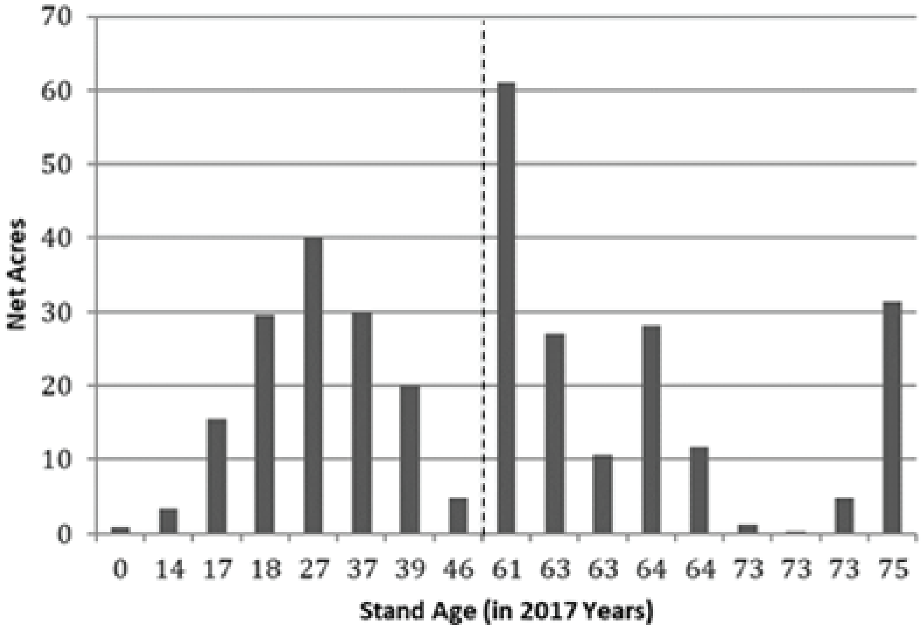

Figure 17: Distribution of Stand Ages within Parcel A

Stands older than 60 years old (threshold identified by black dashed line) contained suitable nesting habitat based on field assessments.

A portion of the stand contains an occupied murrelet site. Audio-visual surveys were conducted at the parcel during the 1999-2000 nesting periods. Of the nine records in the WDFW murrelet database, three detections of two individuals each were observed flying at canopy height (1x), all of which occurred during one morning in early August 2000. Based on stand inventory data, detections were made in stands that were approximately 20 and 45 years old but contained the legacy structures that are still present throughout the stands today. Occupied habitat associated with the subcanopy behaviors was delineated in winter 2018 following FPA guidelines and consists of one site that is approximately 10 acres (**Table 24**).

Areas of moderate to high-quality nesting habitat are found in a 75-year-old stand in the southeastern portion of the parcel, adjacent to 73-year-old riparian areas that bisect the middle of the parcel and pockets of decadent legacy trees that were retained in 61-year-old stands in the north-central portion of the parcel.

Parcel B

Parcel B is an approximate 299-acre parcel located west of the South Fork Nemah River (**Figure 16**). Located adjacent to the WDNR Nemah Block, the Parcel contains many of the same characteristics as Parcel A, including large areas of mistletoe incidence and legacy structure. Over half of the parcel (166 acres, 56 percent) is composed of stands greater than 70 years old. Age distribution of tree stands includes 132 acres of Douglas-fir plantation that would function as a buffer to nesting habitat (**Table 25**). Because of recent timber harvest within the parcel, the distribution of stand ages is currently either later-seral, mature stands, or younger stands less than 26 years old.

Several areas of the stand contain an occupied murrelet site and observations of flight behavior indicative of nesting. Audio-visual surveys were conducted at the parcel during the 1999–2000 and 2004–2006 nesting periods. Of the 38 records in the WDFW murrelet database, 18 (47 percent) were classified as occupied behavior. Of the 18 Status 3 occupied behaviors, the majority (n=13, 72 percent) were observed circling above the canopy (average=1.38x), while five observations (27 percent) were birds circling equal to or below canopy (average=0.94x). The majority (n=16; 89 percent) of occupied behaviors were observed during the 1999–2000 survey season despite only accounting for 50 percent of the total number of surveys conducted at the parcel. Two of the above canopy observations in the south of the parcel were at the edge of a recent clear cut and 53-year-old stand which suggests potential use of young forest. Occupied habitat associated with the subcanopy behaviors was delineated in winter 2018 following FPA guidelines and consisted of one site that was approximately 12 acres (**Table 25**).

Table 25: Stand Characteristics of Parcel B

Stand Age*	Year Stand Established	Gross Acres	Stand Type
0	NA	10.16	Plantation
4	2013	2.12	Plantation
10	2007	20.62	Plantation
15	2002	37.52	Plantation
17	2000	48.14	Plantation
20	1997	13.76	Plantation
22	1995	0.08	Plantation
26	1991	0.08	Natural
26	1991	0.08	Natural
70	1947	41.76	Natural
70	1947	7.14	Natural
70	1947	10.16	Natural
70	1947	79.84	Natural
70	1947	10.44	Natural
71	1946	17.31	Natural

*Stand age and year of establishment derived from 2017 stand inventory data.

Approximately 300 acres of suitable nesting habitat is located outside areas delineated as occupied habitat (**Table 25**). Areas of moderate to high-quality nesting habitat are in the center of the parcel, on an east-facing slope on the east side of the parcel, and in the northwest portion of the parcel. Areas of low-quality nesting habitat that contain residual legacy trees are located within the conservation parcels which currently provide buffer habitat to higher-quality nesting stands and will mature into higher-quality habitat during the ITP term and beyond.

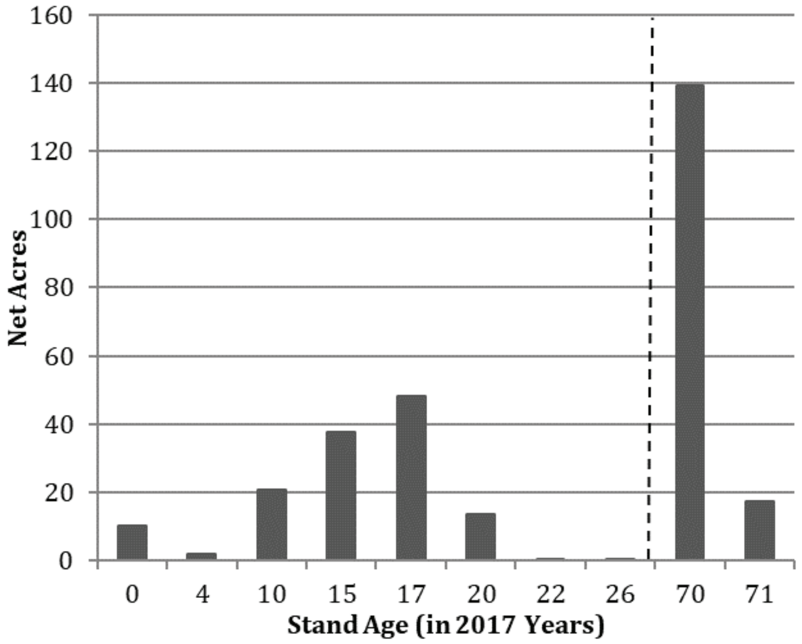

Figure 18: Distribution of Stand Ages within Parcel B

Stands older than 60 years old (threshold identified by black dashed line) contained suitable nesting habitat based on field assessments.

Table 26: Characteristics of Suitable Murrelet Nest Trees within Occupied Nest Habitat at the Conservation Parcels

Tree Species	*n* (% Comp.)	Avg. DBH* (± SD)	Avg. # FPA Platforms/Tree
Western Red Cedar	1 (0.8%)	34.0	2.0
Sitka Spruce	3 (2.5%)	56.3 ± 7.1	4.0 ± 1.9
Western Hemlock	122 (96.7%)	40.8 ± 7.6	3.9 ± 2.3

*DBH = diameter at breast height; FPA = Forest Practices Application

Table 27: Suitable Habitat within the Conservation Parcels

Area	Gross Acreage	Suitable Habitat* (ac)	Murrelet Occupied (ac)	Remaining Suitable (ac)	Remaining % Suitable
Parcel A	320.7	176.4	9.8	166.6	51.9%
Parcel B	299.0	166.7	12.0	154.5	51.7%
Total	619.7	343.1	21.8	311.1	

* considered western hemlock dominant stands > 60 years old

6.1.3.3 Summary of Benefit at the Conservation Parcels

Following consultation with USFWS the Applicant has estimated the potential productivity of the mitigation parcels. Based upon observed habitat conditions at each parcel, the mitigation parcels are reasonably certain to support, collectively, two to four nest sites per year. The average productivity of the nests is expected to be 0.55 fledglings per year. McShane et al. (2004). Consistent with the population viability analysis in section 5.1.3.1, above, each fledgling is assumed to have a probability 0.476 of surviving to age 2 (the age of first breeding). Thus, the conservation parcels can be expected to produce 15 to 30 adult murrelets over the 30-year term of the ITP.

The conservation parcels would be held in perpetuity and maintained as conservation lands long after the expiration of the ITP and decommission of the Project. Therefore, the biological benefits and ecological services of the conservation lands would reach far beyond the time horizon of the ITP term. Not only do the parcels currently provide suitable murrelet nesting habitat, the biological benefits of the conservation parcels would:

- Defer clear-cut timber harvest within the conservation parcels in perpetuity
- Reduce fragmentation at multiple scales including within a stand, parcel, and surrounding landscape
- Reduce the human footprint in parcels, thereby decreasing potential nest predators (e.g., corvid abundance)
- Add nearly a square mile of land adjacent to an existing conservation parcel of high priority (DNR Nemah Block)
- Improve riparian conditions within the stand and downstream by minimizing soil erosion, cooling water temperatures, and improving water quality
- Provide habitat for a number of sensitive wildlife species including pileated woodpecker (*Hylatomus pileatus*), Dunn’s salamander (*Plethodon dunni*), Van Dyke’s salamander (*Plethodon vandykei*) and the fall Chinook salmon (*Oncorhynchus tshawytscha*) run of the Middle Nemah River
- Maintain and increase the benefits of carbon sequestration which would contribute to Biological Objective 3.1.

6.1.3.4 Net Removal for Project Mitigation

The removal of abandoned or derelict fishing nets is an effective measure to reduce incidental mortality of murrelets (USFWS 2017b). Murrelets become entangled in the fishing nets while foraging, which leads to death of the individual and loss of future reproductive productivity (USFWS 2012b). Fishers in Washington waters are legally required to report lost nets, and the agencies that regulate those fisheries are supposed to assure that at least 75 percent of those nets are removed from the water each year (USFWS 2017b). But despite fishers’ reporting obligations, lost nets are routinely discovered by enforcement agencies, the public, and a nonprofit organization that is engaged in tracking and removing lost nets. The Applicant will enhance existing net removal efforts by providing funding to the nonprofit organization currently engaged in this work to identify and remove newly lost nets and net segments.

The first priority for the funds will be to identify and remove lost nets and net segments, where funding for the removal work is not being provided by fishery regulators. Should funding for removal of all discovered nets, in addition to those reported by fishers, be provided by or through fishery regulators, then the Applicant's funds will be used to expand the net removal program through surveys or other efforts to locate unreported lost net segments.

An assessment of derelict fishing gear in the Puget Sound estimated that each net piece remaining in the water entangled 0.00039 marbled murrelets per day for the first three years after becoming lost, and 0.000054 marbled murrelets per day in subsequent years (USFWS 2017b). These baseline murrelet net entanglement rates were based on the estimated Zone 1 murrelet population during 2001–2007, as a proportion of all seabirds in the region.

In evaluating the potential benefits for murrelets that would result from the Applicant's contributions to net removal, the murrelet entanglement rate has been adjusted to account for the continued decline in the murrelet population in Zone 1. The estimated mean population size in Zone 1 in the period 2001–2007 (when entanglement rates were estimated) was 7642, while the current population is represented by the period 2012–2016, with an estimated mean population size of 4,913. Thus, the adjustment factor for density was 0.643, leading to adjusted entanglement rates of 0.000251 murrelets per day for three years and then 0.0000347 murrelets per day in subsequent years.

The Applicant's funding contribution would be made at the beginning of the permit term and so, in estimating the potential benefits of net removal, the program is assumed to start in the first year of the permit. The objective of the program will be to cause the removal of approximately 91 to 96 net segments, sufficient to save at least 53 murrelets, with the objective of fully offsetting the requested take (**Table 30**). This objective is expected to be reached in the first six years of the net removal program by removing a total of 91 nets, or 15.2 nets per year on average. Under these assumptions, the Applicant's contributions to net removal would save 53.2 murrelets over the permit term.

In mathematical terms, let:

n = 15.2 be the average number of nets removed annually
d = 365 be the number of days in a year
y_1 = 3 be the number of years for which the initial higher entanglement/saving rate is applicable
y_2 be the number of years for which the subsequent lower rate is applicable
r_1 = 0.000251 be the daily rate for the first three years
r_2 = 0.0000347 be the daily rate for the remaining years

Then the total number of murrelets saved, MS, is:

$$MS = \sum_{yr=1}^{4} (ndr_1y_1 + ndr_2y_2) = nd \sum_{yr=1}^{4} [r_1y_1 + r_2(30 - yr + 1 - y_1)]$$

The calculated indirect benefit to productivity of the saved birds conservatively assumes that saved murrelets would produce offspring at half the rate as murrelets lost to collision. In that analysis (**Section 5.1.2.5**), the direct loss of 2.496 murrelets annually (the requested take) was estimated to correspond to 0.701 chicks that otherwise would have fledged, which – after accounting for survival – represented 0.334 two-year-olds (considered to be adult equivalents) annually. Over the 30-year permit term, the indirect loss due to collision would be approximately 10 two-year-olds. The rate of indirect gain of two-year-olds associated with removal of derelict nets was assumed to be half the rate of loss because a pair of saved adults would be necessary to produce an offspring, whereas the direct loss of a single adult due to collision would be sufficient cause for the loss of its offspring. Consider that the ratio of direct/indirect loss halved equals the ratio of direct/indirect gain. If x = indirect gain, then $75/(10/2) = 53.2/x$ and $x = 3.55$. Thus, under these assumptions, saving 53 adults by removing derelict nets would lead to the indirect gain of 3 to 4 two-year-olds. This approach is conservative (likely to underestimate the indirect gain) because estimation of indirect losses accounted for the proportion of actively breeding birds among those that collide with turbines, a factor that is not applicable to indirect gain.

Alternative scenarios were conducted to address uncertainty in the assumptions that (1) as many as 15.2 nets could be removed annually, and (2) that all nets removed would be newly lost. **Table 28** shows results for scenarios in which both the number of nets removed annually and the number of years of removal were varied such that the total number of murrelets saved was not less than 53. If fewer nets are removed annually, then the total number of nets needed increases as does the number of years to remove those nets. For instance, removal of 9.5 nets each year for 10 years (95 nets total) would still save 53.2 murrelets.

According to the Northwest Straits Foundation, nearly all nets removed from Puget Sound at this time are newly lost nets. Therefore, the alternative scenarios involved modest adjustment to this assumption such that most nets removed are newly lost while the remainder are one year old. Note that removing an older net would be less beneficial because the higher entanglement rate is applicable only for the first three years after net loss. As shown in **Table 29**, saving at least 53 murrelets requires removal of additional nets as the relative number of older nets increases. For instance, if six nets were one year old at the time of removal, then 96 nets would need to be removed to save 53 murrelets.

Table 28 depicts the number of years and number of nets removed necessary to save at least 53 murrelets. In each case, the prediction assumes that the removal is conducted in year 1 and each year thereafter for the specified number of years.

Table 28: Number of Years and Number of Nets Removed Necessary to Save at Least 53 Murrelets

Years	Total Nets	Nets Per Year	Murrelets Saved
6	91	15.2	53.2
8	93	11.6	53.2
9	94	10.4	53.2
10	95	9.5	53.2

Table 29 depicts the number of nets needed to save at least 53 murrelets when age of nets is varied. In each case, the prediction assumes that at least 15.2 nets per year are removed for six consecutive years and that the removal is first conducted in year 1.

Table 29: Number of Nets Needed to Save at Least 53 Murrelets When Age of Nets is Varied

Number of Nets			Murrelets Saved
New	1 yr old	Total	
15.2	0	91	53.2
12.5	3	93	53.0
10.0	6	96	53.3

6.1.3.5 Implementation

The mitigation project will be implemented prior to or concurrent with commencement of Covered Activities. To implement the conservation parcels portion of the mitigation project, the Applicant will work with a conservation entity (or entities) to implement a specific conservation transaction and coordinate with the USFWS to provide the necessary documentation, real estate assurances, and financial assurances specified in the USFWS Endangered Species Act Compensatory Mitigation Policy (USFWS 2016a) and Interim Guidance on Implementing the Final Endangered Species Act Compensatory Mitigation Policy (USFWS 2017a) that are necessary to secure USFWS approval for the establishment of murrelet conservation lands. The details of the management plan of conservation lands will be refined once more information regarding the acquisition of the specific parcels is known.

The net removal portion of the conservation plan will be implemented by entering into an agreement with a conservation organization to carry out an ongoing net removal program prior to or concurrent with commencement of Covered Activities.

The adaptive management process (**Section 6.4.1**) would be triggered in the event of an unexpectedly high level of mortality rate within a five-year period that would exceed the level of credit in the mitigation program.

6.1.4 Comparison of Requested Take and Benefits of Conservation Program

Collectively, the productivity of the conservation parcels and the reduction in murrelet mortality from the net removal program are projected to fully offset the requested take, after avoidance and minimization measures are taken into account (**Table 30**).

Table 30: Comparison of Requested Take and Benefits of Minimization and Mitigation

Requested Take	Minimization and Mitigation
Requested Take – 75 Adults over 30 years	Minimization avoids take of 10 adults and indirect effect of 1 adult equivalent over 30 years
Resulting Indirect effect of the Take – 10 adult equivalents	Net removal – Avoids direct loss of 53 adults and indirect loss of 3 adult equivalents over 30 years
Total - 85 adults and adult equivalents over 30 years	Mitigation Lands – Will produce 15-30 adult equivalents over 30 years
	Collective Mitigation Measures – 71 to 86 adults and adult equivalents from mitigation and net removal
	Minimization and mitigation – 82 to 97 adults and adult equivalents over 30 years

As discussed in **Section 5.1.3.1.7**, the impacts of the requested take on the affected murrelet population, without taking into account minimization and mitigation measures, would be modest. The combination of minimization and the conservation program's mitigation measures will fully offset the impacts of the requested take, fully replacing the biological value that would otherwise be lost as a result of the Covered Activities.

6.2 EAGLES

6.2.1 Biological Goals and Objectives

The biological goals of an HCP are the guiding principles for the proposed conservation program and the rationale for the minimization and mitigation measures. The biological objectives of an HCP are the specific measurable and attainable targets intended to meet or achieve the biological goals. As described in the five-point policy in the USFWS Handbook, "Biological goals and objectives are inherent to the HCP process and as such explicit goals and objectives clarify the purpose and direction of the HCP's operating conservation program. They create parameters and benchmarks for developing conservation measures, provide the rationale behind the HCP's terms and conditions, promote an effective monitoring program, and, where appropriate, help determine the focus of an adaptive management strategy." The biological goals and objectives of this HCP were designed to be SMART: specific, measurable, achievable, realistic, and timely. While conservation or recovery of a listed species is not required under Section 10 of the ESA, the biological goals and objectives of this HCP are consistent with actions to promote the preservation of eagles as set forth in the Final Eagle Rule (USFWS 2017a).

Goal 1: Reduce the potential of incidental take of bald eagles and golden eagles caused by the operation of the Project.

Objective 1.1: Minimize potential incidental take by implementing collision avoidance strategies demonstrated to be effective in reducing the take of eagle species.

Objective 1.2: To implement an operational strategy that will result in an estimate of no more than four bald eagle mortalities on average per year over the 30- year permit term.

Objective 1.3: To implement an operational strategy that will result in an estimate of no more than two golden eagle mortalities on average per year over the 30- year permit term.

Goal 2: Promote a healthy bald eagle and golden eagle population in the LAP and meet the USFWS' preservation standards.

Objective 2.1: Provide compensatory mitigation at a ratio of 1.2:1 for the taking of golden eagles, which will benefit bald eagles by completing power pole retrofits of high risk poles within the LAP or potentially the Eagle Management Unit.

Goal 3: The Applicant will promote a sense of stewardship of the land and awareness of the sensitive biological resources present in the Plan Area among employees at the Skookumchuck Project.

Objective 3.1: Develop an environmental awareness and educational program at the Project that describes covered species in the Plan Area and the importance of minimization measures that will reduce risk to the species. Operations and Management (O&M) staff will be trained to be aware of and recognize bird carcasses. Educational material may include brochures, poster, or other permanent interpretive display in the O&M building describing the covered species occurring in the Plan Area.

6.2.2 Measures to Avoid and Minimize Take

Consistent with the issuance criteria as set forth in the Final Eagle Rule 22.26(f)((4)), the text below describes how the Applicant has applied all appropriate and practicable avoidance and minimization measures to reduce impacts to eagles. As described in **Section 2.2**, the Applicant has pro-actively taken measures to avoid and minimize potential impacts to eagles during the design phase; measures include:

- In 2017 the Applicant reduced the Project to 38 turbines, further minimizing Project impacts to wildlife, including the murrelet, golden eagle, and bald eagle (**Section 2.2.2**).

- In response to the Tier 3 surveys, the Applicant removed the two turbine locations nearest to Skookumchuck Reservoir in the northwest portion of the Plan Area. The eagle use surveys indicated higher eagle use in the vicinity of these two turbines in comparison to the rest of the Project. Throughout this time, the Applicant continued to coordinate with the USFWS and WDFW with respect to potential impacts to murrelets and bald and golden eagles in efforts to develop this HCP. Maximizing use of previously disturbed areas (i.e., agricultural lands, timberland) and avoiding native habitats for facility locations as practicable (**Section 2.2.3**).

- Utilizing existing roads, where feasible.

- Minimizing length and number of road and collection lines as practicable.

- Using underground low-voltage collector lines to the extent possible to reduce eagle collision and electrocution risk associated with aboveground lines.

- Following the APLIC (2006) guidance on power line design to minimize risk of electrocution.

Avoidance and minimization measures that will be implemented during operations include:

- Implementing a mammal carrion reporting program in which carrion detected incidentally during operations or maintenance activities on site near wind turbines is reported for removal

- Instructing operating staff to recognize and report eagles, if present on site
- Establishing a 25-mile-per-hour speed limit for wind operations staff on Project roads to minimize the risk of eagle collisions
- Avoiding storage of materials and equipment near turbines that could provide cover for rabbits or other potential eagle prey (e.g., rock piles, pipes, etc.)

The Applicant will minimize potential impacts of take of eagles from operation of the Project by implementing a machine vision technology called IdentiFlight® to curtail turbines when eagles are at risk. The IdentiFlight® technology will undergo up to two years of testing at the facility. Each IdentiFlight® tower consists of a ring of eight fixed, wide field of view (WFOV) cameras and one set of two movable high resolution stereo cameras (HRSC) mounted on a tower. The WFOV cameras and lenses are designed to register an eagle-sized object up to 1,000 meters away. IdentiFlight's® technology determines motion that is of interest by comparing subsequent frames and ignoring objects not of interest, such as turbine rotors and clouds. Once an object is detected, IdentiFlight® directs the HRSC to point at the object to determine distance to the object and gather data to determine if the object is an eagle or not an eagle. Each IdentiFlight® tower produces a large amount of data (1 gigabyte of data per second, with frame rates from 200 to 300 milliseconds per frame) that provides an opportunity for data analysis and interpretation.

A recent study has shown that IdentiFlight® is capable of detecting birds out to 1 km and had a false negative rate (identified an eagle as another bird species) of 6 percent (9/149; McClure et al. 2018). Two IdentiFlight® units will be deployed along the turbine array to detect eagles within 1 km of 9 turbines (approximately 24 percent). IdentiFlight® technology is a new technology that has not been tested at an operational wind facility in Washington; therefore, two IdentiFlight® units will be installed at the Project with the intent to collect data from the Project which will be analyzed to understand the curtailment parameters and the potential reduction of collision risk to eagles. If the IdentiFlight® technology is determined to be effective prior to the end of two years, then the IdentiFlight® technology will be utilized for year-round curtailment provided that the total curtailment does not exceed 100 hours per year or if a more effective collision avoidance strategy has not been demonstrated at other wind power projects. However, if during the first two years of the IdentiFlight® technology being tested, and prior to the curtailment parameters being determined, the eagle take is on trajectory to exceed the permit threshold, then IdentiFlight® will be utilized provided the total curtailment does not exceed 200 hours annually. However, if a more effective collision avoidance strategy is demonstrated during this time period, then the Applicant could utilize a different collision avoidance strategy that has been proven at other wind power projects.

6.2.3 Measures to Mitigate the Unavoidable Take

Power poles are known to electrocute eagles, and the USFWS has developed a resource equivalency analysis (REA) to estimate the number of power pole retrofits necessary to offset the take of golden and bald eagles from energy development (REA Models; USFWS 2013). The output of the REA is an impact calculation (debit), expressed in bird-years and the number of power pole retrofits (credit) necessary to offset the impact. Details regarding the REA are provided in Appendix G of the ECPG. Mitigation from the wind project will be over and above any retrofitting currently agreed to under an existing Avian Protection Plan.

Bald Eagles: While take of individual bald eagles will occur, the overall population of bald eagles is increasing, both nationally, within the eagle management unit, and the LAP in which the Project is located. The predicted take is lower than the 5-percent LAP take benchmark when considered with all other authorized take in the LAP. The USFWS has analyzed the impacts of bald eagle take and concluded that take of less than 5 percent of the LAP will have impacts that will not threaten the persistence of the LAP and is compatible with the preservation of bald eagles (USFWS 2016a). Therefore, the impacts of the take requested for bald eagles will have a minimal effect on the sustainability of the LAP or range-wide population.

The use of IdentiFlight® will minimize the Project's impacts to bald eagles. Additionally, the mitigation provided for murrelets (Section 6.1.3) will be directly beneficial through its protection of riparian corridors and habitat conservation. Currently, there are 21 previously-documented bald eagle nests within 10-miles of the conservation parcels (WDFW 2018). Of the 21 nests, three nests within the Lynn Point territory are located between 1-1.7 miles west of the conservation parcels. Bald eagle nests are located along the South Fork of the Nemah River and were surveyed in 2018 but no status was provided (WDFW 2018). Freshwater Creek and unnamed tributaries to the South Fork Nemah River bisect the conservation parcels and contain four salmonid species that are common bald eagle prey (Buehler 2000). Winter steelhead (*Oncorhynchus mykiss*), Coho (*O. kisutch*), and the fall run of Chum (*O. keta*) occur within Freshwater Creek that bisects the northern parcel and coastal cutthroat (*O. clarki*) is located in the unnamed tributaries to the South Fork Nemah River, which bisect the southern conservation parcel. In addition to food resources, the conservation parcels contain suitable perch and roosting structure in large, emergent western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*) trees. The conservation parcels' forest structure is suitable for nesting; and habitat suitability should increase as forests age and structure matures.

Further, electrocution and collision on electric transmission and distribution lines are a known cause of bald eagle mortalities in Washington; therefore, the power pole retrofits provided for golden eagles (Section 6.2.3, below) will provide immediate and direct benefits to bald eagles. These murrelet and golden eagle mitigation measures, along with the minimization measures provided for bald eagles, will fully offset the impacts of the requested bald eagle take.

Golden Eagles: A requirement for permit issuance is that all golden eagle take must be offset at a ratio of 1.2:1, and mitigation will be provided in five-year increments. An accepted mitigation method to offset golden eagle take is power pole retrofits. The USFWS REA provided in ECPG Appendix G was used to determine the number of power pole retrofits that needed to be completed to offset the predicted golden eagle take of 1.65 individuals per year for the first five years. Consistent with the REA, a 30-year life of retrofit was assumed, and a 1.2:1 mitigation ratio was used (USFWS 2016a). Considering this, the REA calculates that 117 power pole retrofits of high-risk poles (to golden eagles) are needed over the first five years of operation. The Applicant will provide the funding for the power pole retrofits prior to the commencement of Covered Activities and provide confirmation to the USFWS that payment has been made. It is the Applicant's intent that the power pole retrofits are implemented as soon as possible after funding. If the estimated take at the five-year review is less than initially predicted, mitigation in excess of estimated take will be credited to the next five-year review period 50 CFR §22.26(c)(7)(iv)(c). Throughout the ITP term, the Applicant will fund power pole retrofits at the end of each five-year review period, less any mitigation credits left over from the preceding five-year period, such that mitigation will remain ahead of any eagle take.

An integral component of the ECPG and compensatory mitigation program to offset eagle take is identifying applicable actions to retrofit, reframe, or rebuild power poles (i.e., power pole modifications) to "avian-friendly" designs, reducing the potential short- and long-term electrocution risk to eagles. This program encompasses initiating communications with an electric utility and the APLIC to identify and implement practical considerations when developing a pole modification program to offset eagle take at a wind facility. The following process summarizes the recommended phases and steps to facilitate this process and associated communications.

The Applicant has partnered with Puget Sound Energy (PSE) to identify high-risk poles and implement power pole retrofits. The Applicant and PSE will conduct the risk assessment for at-risk poles within the PSE's service territory for future pole modifications. The risk assessment will examine the overlay of eagle use areas, applicable habitats, and power lines to identify applicable mitigation areas, starting with a desktop analysis and verification in the field. The USFWS is in the process of developing localized risk assessments based on eagle use and habitat data and existing power lines. The risk assessment will include available USFWS data available and focus on poles beyond those included as a part of the utility's own retrofit program. These results, in conjunction with PSE engineering and management input, would determine the best geographic locations for the pole modifications and whether existing poles would be retrofitted, reframed, or rebuilt and how best the mitigation dollars would be applied. Data recorded during the field risk assessment would include:

- Pole identification number
- Global Positioning System (GPS) waypoint and photo numbers
- Pole configuration
- Existing equipment and number of exposed jumper wires
- Grounding practices on each structure
- Suggested retrofits, if applicable
- Any existing bird fatalities or signs of bird use
- Common habitats and human-use influences
- Overall habitat value for eagles
- Topography of pole
- Priority ranking

If PSE does not have a sufficient number of high-risk poles available for the Applicant's mitigation, the Applicant will partner with another electric utility to complete its mitigation obligation.

6.3 MONITORING

A monitoring program will be implemented as part of this HCP to verify ITP compliance through evaluation of the level of take of the covered species, to provide progress reports on the fulfillment of mitigation requirements, and to enable evaluation of the effectiveness of the minimization and mitigation actions in meeting the biological goals and objectives. The monitoring program consists of mitigation effectiveness monitoring to ensure that the mitigation projects are implemented and functioning as planned and that compliance monitoring to evaluate the level of take of the covered species at the Project is conducted. Monitoring will provide a feedback loop into the decision-making process that will help inform adaptive management decisions. Monitoring results will be reported annually to the USFWS.

6.3.1 Compliance Monitoring

The compliance monitoring program that will be implemented as part of this HCP will provide the information necessary to assess ITP compliance and Project impacts and verify progress toward meeting the biological goals and objectives identified in Chapter 5. Based on information derived from monitoring, adaptive management will be used to make modifications to the proposed minimization and mitigation measures, if the existing measures have been ineffective at meeting the authorized annual take levels as well as biological goals and objectives of the HCP (see **Section 6.1.1** and **6.2.1**).

Take compliance monitoring for the HCP will be conducted in three phases: Evaluation Phase, Implementation Phase, and Re-evaluation Phase. In all phases, fatality monitoring will be conducted to determine the number of carcasses detected. As part of the fatality monitoring, the area available to be searched will be mapped, and searcher efficiency and carcass persistence will be measured with field trials. At the end of each year of fatality monitoring, a report will be developed that presents the estimated number of fatalities. Specific details of the fatality monitoring plan are discussed further below.

Evaluation Phase – The Evaluation Phase is the most intensive phase of monitoring. Because the quantification of the risk to the covered species and the effectiveness of minimization measures have some degree of uncertainty, monitoring will be most during years 1, 2, and 3 of Project operation. A key aspect of Evaluation Phase monitoring is that 100 percent of turbines will be searched each year.

Implementation Phase – After completion of three years of Evaluation Phase mortality monitoring, provided adaptive management measures are not implemented, the Applicant will implement Implementation Phase monitoring using the Evaluation Phase monitoring plan during years 7, 14, 22, and 30 of Project operations. However, if it is determined the Applicant is in compliance with the ITP during the Implementation Phase monitoring a stepped-down approach to monitoring may be adopted and will depend on the estimated take and attributes of the monitoring program. The Implementation Phase will remain as outlined above for the remainder of the operational life of the Project unless a short-term or long-term adaptive management trigger is reached during the operational life of the Project.

Re-Evaluation Phase – If a short-term or long-term adaptive management trigger is met, operational changes will be considered as needed in accordance with the adaptive management framework described in **Section 6.4**; and one year of Re-evaluation Phase monitoring will be conducted following the operational change to confirm the altered operational adjustment protocol’s effectiveness at reducing eagle or murrelet mortality to a level sufficient to maintain annual take of the covered species below the estimated level. The level of effort in monitoring would be the same intensity as the Evaluation Phase. After a year of Re-evaluation Phase monitoring, the Applicant will return to conducting the Implementation Phase monitoring.

Fatality monitoring methods and analysis are described in detail in the post-construction monitoring plan (Appendix G).

Table 31: Generalized Compliance Monitoring Schedule for the Skookumchuck HCP

Year of ITP	Type of Monitoring	Purpose of Monitoring
1 - 3	Evaluation phase	Establish baseline take estimates under ITP, inform adaptive management decisions to optimize efficiency of HCP minimization and monitoring programs
4 - 30	Implementation phase	Monitor take estimates over ITP term, detect and respond to changes in take requiring adaptive management
1 - 30	Incidental reporting	Document and report Covered Species carcasses found incidentally
Any year following an adjustment to the HCP minimization program in response to adaptive management	Re-evaluation phase	Establish take estimates under the adjusted HCP minimization program, evaluate efficacy of adaptive management action(s) in reducing take estimates for compliance with ITP

6.3.2 Monitoring Methods Considered But Not Implemented for Fatality Monitoring

Systematic sampling is important to calculate adjusted fatality estimates because of the underlying assumptions of the statistical models. Thus, the introduction of other methods of detection, such as those described below, introduce unmeasured bias that might not be readily accounted for in a fatality estimate model. Further, although advances in technology can appear promising, the technologies described below have not been developed in a fatality monitoring context or are undergoing further verification testing. Further, reactive fatality monitoring – searching a turbine with previous knowledge that a fatality could have occurred – could result in incidental detections, which would be excluded from the fatality estimate. Thus, to reduce uncertainty in fatality modeling associated with non-systematic methods, the following methods were considered, but not implemented for fatality monitoring at this time. Should technology emerge that is commercially feasible and can be incorporated into the systematic fatality monitoring without introducing additional bias, it will be considered by the Applicant.

Blade strike detection – A system of detecting bird collision with wind turbine blades through the use of sensors in the blades was tested by a graduate student at Oregon State University (Flowers 2015). The suite of sensors (vibration, accelerometer, acoustic) detected 57 percent of the experimental blade strikes. Blade strike detection is undergoing further testing to determine if increased strike detection can be achieved. In addition to the technology being in development, uncertainties regarding how the sensors are installed in the turbine blades make this technology not viable at this time.

Machine vision technology – IdentiFlight® has been developed in an informed curtailment context for eagles and not for fatality monitoring. Algorithms to identify other species such as murrelet have not been developed. Real-time monitoring of IdentiFlight® will not occur; and, as one image is recorded every second, thousands of images could be recorded every day; detailed review of image data will not be conducted as it is currently unknown if a turbine strike can be determined from the images. If, in the event that IdentiFlight® data indicates a fatality could have occurred, the turbine will be noted and searched according to the systematic sampling protocol so that if a fatality is detected it could be included in the fatality estimate.

Drones – Unmanned aerial vehicles (UAV or drone) are emerging technologies for wildlife surveys, and have benefits and limitations. A primary benefit is that UAVs are able to survey areas that might be hazardous for humans to access such as steep terrain (Lichant et al. 2015; Jones et al. 2006). Although some portions of the terrain at the Project might limit survey access for carcasses, making UAVs an option, the ground conditions could result in a low probability of detection of murrelet carcasses. Eagle carcasses could have a higher probability of detection than murrelets, but other factors such as limited ability to view the terrain in real-time on a screen will likely limit the benefits of using UAVs for murrelet surveys. If advances in UAV technology make this option viable and cost-effective, it will be considered as part of the monitoring program.

Nets – As murrelets are small and cryptic, a carcass has the potential to go undetected during fatality monitoring. Nets attached to the turbine tower have been suggested as a potential tool to catch and collect turbine-related fatalities. However, potential vegetation regrowth in the Pacific Northwest may be vigorous and could interfere with the net, such that vegetation control measures would need to be implemented. Further, any carcasses (murrelets or other birds) could attract scavengers, which could become entangled in the net.

Dogs – Currently, there is no plan to use dogs, though that approach may potentially be considered under Adaptive Management in the future. Dogs have been utilized at some other projects and improved detection. However, logistical and safety issues are associated with the use of dogs as well.

6.3.3 Effectiveness Monitoring

Unavoidable incidental take of murrelets at the Project will be mitigated by the purchase and maintenance of conservation lands that provide suitable nesting habitat. Effectiveness monitoring at mitigation lands will include an annual assessment that verifies the parcel is intact and available to murrelets for nesting. The specific effectiveness monitoring program will be developed by the conservation entity in cooperation with state and federal partners and included in the management plan.

Post-retrofit monitoring for target pole modifications completed as part of the compensatory eagle mitigation program achieves three objectives: (1) a check on device and material installation (i.e., was it done correctly or are there signs of operational issues), (2) device and material longevity (i.e., exposure to environmental conditions), and (3) efficacy of the installation (i.e., are there signs of subsequent bird mortality). Permanent modifications (e.g., pole reframing or replacement to achieve 60 inches of horizontal and 40 inches of vertical clearances between phase-to-phase and phase-to-ground contacts) may require only one post-construction monitoring check, since these modifications would apply to the life of the pole (~50 years). For retrofits to existing structures (e.g., applying cover-up), one complete examination of the retrofits would be warranted post-retrofitting. Additional monitoring during the life of the permit would depend on geographic location (e.g., coastal vs. inland), habitats, types of retrofits completed, and pole configurations (e.g., complicated equipment poles vs. simple tangent poles). The entity responsible for this monitoring will have expertise in the electrical infrastructure and approaches to minimize electrocution risk. The monitoring regime elements (e.g., frequency, roles and responsibilities, reporting) should be negotiated among the Applicant, PSE, and USFWS.

6.3.4 Changed Circumstance

The Applicant expects that the proposed monitoring program will provide a sufficient probability of detection of murrelets to inform adaptive management decisions and enable evaluation of compliance with the ITP. The monitoring program was designed using data on carcass distribution, searcher efficiency, and carcass persistence for medium-sized birds collected at other wind-energy facilities and will be adjusted as necessary to improve detection probability as data for these parameters are collected on-site. However, because this will be the first mortality monitoring focused on estimation of murrelet take at a wind energy facility, the need for alternative monitoring strategies to detect murrelets at the Project, although unlikely, is within the realm of reasonably foreseeable possibilities. The Applicant has included a changed circumstance to address this potential situation (**Section 7.1**).

6.4 ADAPTIVE MANAGEMENT STRATEGY

The adaptive management framework described below aims to provide a similar approach for two species that differ in their management and biology so that the level of response is generally similar within a tier. Following the framework of the Eagle Rule (USFWS 2016a), eagle take will be evaluated during a five-year review period. Although murrelets are not managed on five-year review periods, the adaptive management approach is aligned with eagles to provide consistent timing for evaluations of the recognized take against the permitted limit. The estimated number of fatalities, which accounts for imperfect detection, will be used to evaluate the annual take estimate against the take limit. To be responsive to the detection of a carcass incidental to the standardized fatality monitoring, all carcasses discovered will be used when evaluating the need for adaptive management. For example, the two eagle carcasses found incidentally by operations staff outside a search plot will not be included in the fatality estimate but will be used to determine if an adaptive management response is warranted.

Incidental finds are accounted for in the difference between the estimate and the number of carcasses found during protocol searches, and a problem arises only when the total number of carcasses observed (during searches plus incidentals) becomes larger than the estimate.

6.4.1 <u>Murrelet Adaptive Management</u>

An adaptive management strategy was developed to ensure that murrelet mortality remains within the authorized take limits of the murrelet ITP received by the Applicant for the Project. The strategy incorporates a feedback loop where the effectiveness of avoidance and minimization techniques are reevaluated when a fatality occurs that meets a particular threshold relative to the ITP limit. Thresholds are presented as a tiered progression of potential levels of take that may lead to an exceedance of the permitted take for the Project. Each progressive level warrants an assessment of conditions and potential implementation of additional minimization measures if take is on a trajectory to exceed the level permitted for the 30-year term (**Table 32**).

A conservative estimate of 2.496 murrelet fatalities is predicted to occur per year. Adaptive management begins with the detection of one murrelet carcass so that information on the fatality and potential correlates of risk can be examined. As variability in the number of fatalities that occur per year is likely, and that the take permit review period will coincide with the five-year eagle review period, further adaptive management Tiers will be based on short-term (Tiers 1-3) and long-term (Tier 4) review periods. Thresholds are designed to trigger adaptive management measures in time to respond to annual increases in fatalities and provide corrective actions to prevent a sustained high rate of take at the Project. Tiers are structured to respond to single fatalities (e.g., found on search plot or incidentally), rare events (e.g., three or more incidental fatalities), or increased fatality rates at different time scales: annually or sustained over a number of years. Each tier includes a progressively more detailed assessment of the fatality event or pattern and corresponding corrective action designed to ensure compliance with the ITP limit and associated compensatory mitigation.

As stated above, the Applicant will implement adaptive management when the first fatality is discovered within a monitoring year and build upon the body of information already collected to help inform patterns and appropriate minimization measures (**Table 32**). Rare events such as incidental discoveries that exceed the permitted take are also recognized by implementing standard carcass searches (if not already being conducted in accordance with **Section 6.3.1**), reviewing and revising the curtailment program if needed, and evaluating the efficacy of the sample design (Tier 2). Similarly, if a take estimate is higher than the conservative annual estimate of 2.496 murrelets within a monitoring year, radar or other available technology will be deployed to monitor and evaluate MAMU passage at the Project, and enhanced avoidance measures will be applied to high-risk areas or periods (Tier 3). To account for annual variation in fatality estimates among monitoring years, a rolling average will be calculated to ensure the rate is not on a trajectory to exceed the ITP limit. If the level of take reaches or exceeds the permitted take, additional avoidance, minimization, and/or curtailment actions need to be initiated as necessary to avoid any unauthorized take.

Consistent with the reporting requirement discussed in **Section 6.5**, if a threshold is reached, the Applicant will schedule a conference call with USFWS to occur within two weeks of the discovery to discuss appropriate responses consistent with **Table 32**.

Table 32: Summary of Stepwise Adaptive Management Process for Murrelet Take at the Skookumchuck Wind Power Project
Based on a permitted take rate of 2.496 murrelets per year and totaling 75 murrelets (rounded up) over a 30-year permit period

Tier	Threshold	Threshold Relative to ITP Limit	Avoidance and Minimization Measures[1]
1	During any monitoring year, one murrelet carcass detected at any time.	Take is not on trajectory to exceed permit limit is permitted and fully mitigated.	• Assess murrelet fatality to determine if cause or risk factor can be determined (e.g., location, season, weather, estimated time of death, or other event) and whether management response is warranted.
2	Based on results of fatality monitoring during any monitoring year, the estimated fatality rate is on a trajectory that may exceed permitted take (e.g., annual take estimate of ≥ 3 individuals) or if three fatalities are found incidentally in any 12-month period outside of standardized carcass monitoring.	Take potentially on trajectory to exceed 30-year permit limit but is currently permitted	• Review and modify monitoring design to improve probability of detection as discussed in the Post-Construction Monitoring Plan (Appendix G). • • During intensive monitoring, if the site-wide probability a carcass is available to be found and detected by searches (g) is less than 0.31, the Applicant will modify the monitoring program to achieve a g value that is 0.31 or greater. • Revise the turbine curtailment program if the pattern of fatalities at the Project indicates that adjustment to the selection or timing of turbines being curtailed may reduce fatalities (e.g., changing which turbines are curtailed and/or time of day or duration of curtailment). No change in maximum hours of curtailment. • To address this rare event, initiate Evaluation Phase monitoring (**Section 6.3.1**).
3	At the conclusion of any five-year monitoring period, the estimated average fatality rate is on a trajectory to exceed the level of permitted take (e.g., ≥13 murrelet fatalities estimated for Years 1-5, >25 murrelets for Years 1-10, etc.).	Take potentially on trajectory to exceed 30-year permit threshold but is currently permitted	• Consider alternative minimization options that may include the deployment of marine radar monitoring to evaluate passage rates at the Project to optimize effectiveness of curtailment strategy or other proven risk minimization technologies. Enhanced avoidance and minimization measures will be applied to high-risk areas or periods (e.g., nesting season), which may include revising the turbine curtailment program (e.g., changing which turbines are curtailed and/or time of day or duration of curtailment) if the pattern of fatalities at the Project indicates that adjustment to the selection or timing of the 10 turbines being curtailed may reduce fatalities. Additional curtailment not-to-exceed 900 turbine hours above the baseline (baseline = May 1-Aug. 9 at 10 turbines for 3 hours per day = 101 days x 10 turbines x 3 hours = 3,030 hours). Consider the need for a permit amendment.

Tier	Threshold	Threshold Relative to ITP Limit	Avoidance and Minimization Measures[1]
4	At any point during Project operation the level of take, estimated and incidental, exceeds 75 murrelets.	Depending on when this occurs in the permit term, take is likely to be on a trajectory to exceed the 30-year permit threshold	• Consult with USFWS regarding actions necessary to avoid unauthorized take until authorization of additional take has been achieved.

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[1] Each Tier incorporates the preceding avoidance and minimization measures. Example: Tier 3 includes the reevaluation of the curtailment program, an additional year of Evaluation Phase monitoring, in addition to avoidance and minimization measures discussed in Tiers 1 and 2.

6.4.2 Eagle Adaptive Management

Based on the conservative nature of the eagle species fatality predictions, it is likely that the estimated number of fatalities from the Project will be lower than what was predicted. However, if the results of ongoing fatality monitoring indicates that the eagle mortality rate may be higher than predicted, adaptive management measures will be implemented.

A total of 4.86 bald eagle and 1.65 golden eagle fatalities (upper 80-percent credible interval) are predicted to occur per year (**Table 21**). Assuming an overall detection probability of approximately 0.5 for eagles, one carcass detected would represent two fatalities estimated. Thus, the triggers presented in **Table 33** are for eagle carcasses and not estimated fatalities. As few golden eagle fatalities are predicted to occur, the implementation of adaptive management will occur after fewer detections of a carcass than for bald eagles. Adaptive management begins with the detection of one golden eagle carcass or two bald eagle carcasses so that information on the fatality and potential correlates of risk can be examined. As variability in the number of fatalities that occur per year is likely, and the eagle take permit review period is five years, further adaptive management steps will be based on the average eagle fatalities after two years of monitoring. The adaptive management strategy in **Table 33** was developed to ensure that eagle mortality remains within the authorized take limits by increasing the management actions that are undertaken if actual take approaches the allotted take. Thresholds are presented as a tiered progression of potential levels of take that, if no adaptive management were implemented, may exceed the level of take to be permitted at the Project. Each progressive level warrants increased concern and potential adaptive management if the rate of take approaches the level permitted for the five-year term.

Interaction between the Applicant and the USFWS will occur as regularly as necessary to detect and respond accordingly to adaptive management triggers.

Table 33: Summary of Stepwise Adaptive Management Process for Golden Eagle and Bald Eagle Take

Tier	Threshold	Threshold Relative to ITP	Adaptive Management Measure
1a	During any monitoring year, one golden eagle carcass or two bald eagle carcasses detected at any time.	Take is not on trajectory to exceed permit limit and is permitted and mitigated.	Assess eagle fatality to determine if cause or risk factor can be determined (e.g., location, season, weather, estimated time of death, or other event) and whether management response is warranted.
1b	Four bald eagle carcasses or two golden eagle carcasses found in any 12-month period.	Take is not on trajectory to exceed permit limit and is permitted and fully mitigated.	To address this rare event, initiate Evaluation Phase monitoring and apply measures described in Tier 2.
2	Average of three bald eagle carcasses discovered per year over a two-year period.	Take is on trajectory to potentially exceed permitted limit but within limit. Take is permitted and fully mitigated.	Assess eagle fatalities to determine if cause or risk factor can be determined (e.g., season, time of day, weather, presence of prey/carrion, fire, or other event) to inform potential risk reduction measures. Determine if IdentiFlight® can be optimized[1] to reduce collision risk and implement optimization measures if feasible. Optimization will at no point exceed 200 hours of curtailment.
3	Average of three bald eagle carcasses discovered per year or two golden eagle carcasses discovered per year over a three-year period.	Take is on trajectory to potentially exceed permitted limit but within threshold. Take is permitted and fully mitigated.	Evaluate optimized IdentiFlight® units to determine if additional IdentiFlight® unit is needed to reduce collision risk. Deploy additional IdentiFlight® unit if areas of risk not covered by IdentiFlight® are identified. Deployment of additional IdentiFlight® unit will not exceed 300 hours of curtailment.
4	Average of three bald eagle carcasses discovered per year or two golden eagle carcasses discovered over a four-year period.	Take is on trajectory to exceed permitted limit but within permitted limit	If the Applicant determines that IdentiFlight® units cannot be optimized to reduce collision risk, implement detection or deterrence technology as appropriate based on risk factor assessment and latest information available. In order for technology to be considered and implemented, it must be logically feasible and economically comparable to IdentiFlight® units. Consider need for permit amendment.
5	At any point during Project operation the level of take, estimated and incidental, equals the level of permitted take.	Take equals the 30-year permit threshold	In consultation with the USFWS, increase minimization actions so as to avoid unauthorized take until authorization of additional take has been achieved.

[1] Optimization can include updates to software, hardware, or curtailment rules.

6.5 REPORTING

The table below (**Table 34**) includes the timing and reporting metric of each monitoring, minimization, and mitigation measure.

Table 34: Timing and Reporting Metric of Each Monitoring, Minimization, and Mitigation Measure

Topic	Timing	Reporting Metric
Mitigation Lands	Bi-annually	Management activities implemented (e.g., road closures, stand management). Any change in murrelet nesting habitat area (acres) resulting from natural or anthropogenic disturbances (e.g., windthrow, wildfire, timber theft).
Fatality Monitoring	Annual	Date and location (UTM or Lat./Long.) of all carcasses found for both covered spp., and noncovered spp.
Fatality Monitoring	Annual	Methods and data used to calculate searcher efficiency, carcass persistence, and proportion of carcass distribution searched, with resulting g values. Include maps of searchable and unsearchable areas.
Fatality Monitoring	Annual	Take estimates calculated by EoA at the 80% and 50% confidence levels (or other estimate agreed upon between the Applicant and USFWS).
Fatality Monitoring	Annual	Indirect take estimates calculated based on observed take and on unobserved portion of take estimate, using same methods used to calculate in HCP (or as agreed to with *US*FWS).
Fatality Monitoring	Annual	Report of carcasses removed from project area to reduce attractiveness to scavengers.
Radar Results	First year and annually, whenever implemented	Passage rate of MAMU at each station, location of stations, timing, height of murrelet passes.
Net Removal	Annual, whenever implemented	Location and date of surveys, number, location, date, and if possible age of nets removed.
Identiflight®	Annual	Percent of time working, detection and avoidance of eagles, eagle observations, and curtailment

6.5.1 Project Status and Impacts (e.g., completed stages)

The Applicant will send a notification to the USFWS Region 1 Migratory Bird Permit Office and the USFWS Lacey Washington Ecological Services Office within two weeks of operational commencement to inform USFWS that the facility has commenced operations.

6.5.2 Take Tracking

In the event a fatality is discovered, the Applicant will notify the USFWS Region 1 Migratory Bird Permit Office and USFWS Lacey Field Office within 24 hours or, if discovered on the weekend, the Applicant will notify USFWS of the take on the next business day.

U.S. Fish and Wildlife Service
Migratory Bird Permit Office
911 N.E. 11th Avenue
Portland, OR 97232-4181
Tel. (503) 872-2715
Fax (503) 231-2019

U.S. Fish and Wildlife Service
Lacey Field Office
510 Desmond Drive SE
Lacey, WA 98503
Tel. (360) 753-9440

In the event an injured bird is discovered, the Applicant will notify the USFWS Permit Office within one hour of discovery and the Applicant will ensure the bird is transported to an appropriate rehabilitation facility that possesses valid federal and state handling permits.

In addition to the permit office, an eagle fatality will be reported to the appropriate representative at the U.S. Fish and Wildlife Service Migratory Birds Program, Office of Law Enforcement, and Washington Fish and Wildlife Office.

6.5.3 Avoidance, Minimization, and Monitoring

At the end of each monitoring year, an assessment of the fatality rate will be calculated to determine if the level of take is consistent with the level of permitted take and to reevaluate whether additional minimization measures are needed at the Project. The fatality monitoring report will include an annual summary of fatalities found at the Project, including the specific steps that were taken to avoid and minimize potential impacts to murrelet. The annual report will be submitted to USFWS within 90 days of the end of the monitoring year.

6.5.4 Mitigation

6.5.4.1 Murrelets

A description of stand characteristics and biological potential of the potential conservation lands is found in Appendix F and will serve to establish baseline conditions of the mitigation lands. Effectiveness reporting will occur once every five years of the permit term and will compare the stand conditions against the baseline and document any management activities that have occurred on the land or are planned during the next five-year period.

6.5.4.2 Golden Eagles

A report that describes how power pole retrofits were identified and prioritized will be developed prior to construction. The report will describe and show the location, type of retrofit (e.g., insulation or redirection or separation), funding effort and effectiveness monitoring the various stakeholders intend to initiate over the life of the ITP term.

6.5.4.3 Bald Eagles

The status of bald eagle mitigation will be included in the reporting prepared for 6.5.4.1 and 6.5.4.2.

6.5.5 Funding

The Applicant will be responsible for the full cost of obtaining an ITP under Section 10(a)(1)(B) of the ESA and adhering to all conditions imposed by the USFWS to do so. Funding and disbursements reports will be made available at the end of each fiscal year.