Revised Draft Environmental Impact Statement

September 2018

Long-term Conservation Strategy *for the* Marbled Murrelet

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Estimated total costs associated with developing and producing this document:
USFWS (co-lead): $684,000; DNR (applicant, co-lead): $9,763,000

Marbled murrelet photos courtesy www.HammerEnvironmental.com (upper left) and National Park Service (lower right)

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September 2018

Dear Interested Party,

The Washington State Department of Natural Resources (DNR) is developing a long-term conservation strategy for the marbled murrelet. DNR intends to amend the 1997 *State Trust Lands Habitat Conservation Plan* (HCP) and apply for an amendment to DNR's incidental take permit for the marbled murrelet under the Endangered Species Act. Once approved by U.S. Fish and Wildlife Service and the Board of Natural Resources, the long-term conservation strategy will replace the current, interim strategy for the marbled murrelet, and will be implemented in concert with the other conservation strategies under the HCP.

The marbled murrelet is listed as a threatened species under the federal Endangered Species Act. These small, fast-flying seabirds have an intriguing life history, spending most of their lives in the marine environment while nesting inland on large tree limbs in older forest in western Washington. Marbled murrelet population decline in Washington has been linked to the loss of inland nesting habitat, as well as threats in the marine environment. Uncertainty about DNR's strategy for habitat conservation of the marbled murrelet on state trust lands has created challenges and uncertainties as we conduct forest management activities and implement the HCP. A long-term conservation strategy will better identify strategically important murrelet nesting habitat on DNR-managed lands and therefore contribute to long-term conservation of the species, while providing long-term certainty for timber harvest and other management activities on forested state trust lands.

This revised draft environmental impact statement (RDEIS), which replaces the 2016 draft EIS, evaluates seven alternative long-term conservation strategies and a no action alternative (the current, interim strategy). Each action alternative provides a unique approach to murrelet habitat conservation, designating varying amounts of habitat for conservation and applying conservation measures to ensure long-term protection of forestlands important to the marbled murrelet.

Produced collaboratively with the U.S. Fish and Wildlife Service, this document is intended to satisfy the environmental review requirements of both the State Environmental Policy Act and National Environmental Policy Act for adopting a long-term conservations strategy and amending the HCP and incidental take permit for the marbled murrelet. We invite you to provide comment on this RDEIS. Further information is posted at https://www.dnr.wa.gov/long-term-conservation-strategy-marbled-murrelet.

Thank you for sharing my interest in habitat conservation for the marbled murrelet and the sustainable management of state trust lands. I encourage your engagement in this very important process.

Hilary Franz
Commissioner of Public Lands

DEPARTMENT OF
NATURAL RESOURCES

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REVISED DRAFT

Environmental Impact Statement

for a

Long-Term Conservation Strategy for the Marbled Murrelet

Lead Agencies:

Washington State Department of Natural Resources (DNR)
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Olympia, WA 98504

U.S. Fish and Wildlife Service
Pacific Region
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Cover Sheet/Fact Sheet

Title: Revised Draft Environmental Impact Statement (RDEIS) for a Long-term Conservation Strategy for the Marbled Murrelet

Description of Proposal: This document is a joint RDEIS between U.S. Fish and Wildlife Service (USFWS) and Washington State Department of Natural Resources (DNR) to satisfy both the National Environmental Policy Act and the State Environmental Policy Act. This proposal involves amending the DNR *State Trust Lands Habitat Conservation Plan* with a long-term conservation strategy for the marbled murrelet. Eight alternatives, including a no action alternative and DNR's preferred alternative, are analyzed.

Proponent: DNR

Legal Mandate: Endangered Species Act of 1973; National Environmental Policy Act; State Environmental Policy Act

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Date of Issue of RDEIS: September 7, 2018

Comment Period:

The comment period for this RDEIS is September 7, 2018 through November 6, 2018. Comments are due to the SEPA center no later than 5:00 pm on November 6, 2018.

Public Meetings:

October 9, 2018 (6-8 pm)
Rainforest Arts Center
35 North Forks Avenue
Forks, WA 98331

October 11, 2018 (6-8 pm)
River Street Meeting Room
25 River Street
Cathlamet, WA 98612

October 15, 2018 (5-7 pm)
Ballard Library Meeting Room
5614 22nd Avenue NW
Seattle, WA 98107

October 17, 2018 (6:30-8:30 pm)
Burlington Public Library Rotary Community Meeting Room
820 East Washington Avenue
Burlington, WA 98233

Anticipated Issuance of Final EIS: Spring 2019

Notice of Availability:

This RDEIS is posted online at:
https://www.dnr.wa.gov/long-term-conservation-strategy-marbled-murrelet

Copies will be sent to the Board of Natural Resources, affected local government planning departments (city and county), affected tribes, all state and federal agencies with jurisdiction, academia, Washington newspapers, libraries, and other interested parties.

A limited number of print copies and computer print CDs will be available at no charge upon request. After these are distributed, copies will be available for the cost of printing or CD production. Requests can be sent to the DNR contact address.

Location of Supporting Documents:

Supporting documents for this RDEIS including the 1997 *State Trust Lands Habitat Conservation Plan* can be found online at www.dnr.wa.gov, and are available for review at the DNR SEPA Center at 1111 Washington Street SE in Olympia, Washington.

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List of Acronyms

CFR	Code of Federal Regulations
CEQ	Council on Environmental Quality
DAHP	Department of Archaeology and Historic Preservation
DEIS	Draft environmental impact statement
DNR	Washington State Department of Natural Resources
EIS	Environmental impact statement
FEIS	Final environmental impact statement
FEMAT	Forest Ecosystem Management Assessment Team
GIS	Geographic Information System
1997 HCP	State Trust Lands Habitat Conservation Plan
IPCC	Intergovernmental Panel on Climate Change
LiDAR	Light Detection and Ranging
MMMA	Marbled Murrelet Management Area
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
OESF	Olympic Experimental State Forest
RCP	Representative concentration pathway
RCW	Revised Code of Washington
RDEIS	Revised Draft Environmental Impact Statement
RFRS	Riparian Forest Restoration Strategy
SEPA	Washington State Environmental Policy Act
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife

Other Terms

Board	Board of Natural Resources
Federal Services	USFWS and National Marine Fisheries Services
Legislature	Washington State Legislature

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SUMMARY

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Summary

This revised draft environmental impact statement (RDEIS) is a joint document produced by the Washington Department of Natural Resources (DNR) and U.S. Fish and Wildlife Service (USFWS) (referred to as the "Joint Agencies"). This document is intended to satisfy the requirements of the National Environmental Policy Act (NEPA) and the Washington State Environmental Policy Act (SEPA) for environmental review. The proposed action under review is an amendment to DNR's *State Trust Lands Habitat Conservation Plan* (1997 HCP). The amendment will replace the interim conservation strategy for the marbled murrelet (*Brachyramphus marmoratus*) with a long-term conservation strategy. The amendment is limited to this subject and does not change other conservation strategies of the 1997 HCP.

1. Proposed Action: Need, Purpose, and Objectives

■ Need

DNR

DNR needs to obtain long-term certainty for timber harvest and other management activities on forested state trust lands, consistent with commitments in the 1997 HCP and DNR's fiduciary responsibility to the trust beneficiaries as defined by law.

USFWS

USFWS' need is to fulfill its legal obligations under Section 10(a)(1)(B) of the Endangered Species Act in response to DNR's request to amend its incidental take permit for the marbled murrelet long-term conservation strategy.

■ Purpose and Objectives

DNR

The purpose of the proposed action is to develop a long-term conservation strategy for marbled murrelets on forested state trust lands in DNR's six west-side HCP planning units, subject to DNR's fiduciary responsibility to the trust beneficiaries as defined by law, which achieves all of the following objectives:

- **Objective 1, Trust Mandate**: Generate revenue and other benefits for each trust by meeting DNR's trust management responsibilities. Those responsibilities include making state trust lands productive, preserving the corpus of the trust, exercising reasonable care and skill in managing the trust, acting prudently with respect to trust assets, acting with undivided loyalty to trust beneficiaries, and acting impartially with respect to current and future trust beneficiaries.
- **Objective 2, Marbled Murrelet Habitat**: Provide forest conditions in strategic locations on forested state trust lands that minimize and mitigate incidental take of marbled murrelets resulting from DNR's forest management activities. In accomplishing this objective, DNR expects to make a significant contribution to maintaining and protecting marbled murrelet populations.
- **Objective 3, Active Management**: Promote active, innovative, and sustainable management on state trust lands.
- **Objective 4, Operational Flexibility**: Provide operational flexibility to respond to new information and site-specific conditions.
- **Objective 5, Implementation Certainty**: Adopt feasible, practical, and cost-effective actions that are likely to be successful and can be sustained throughout the life of the 1997 HCP.

USFWS

USFWS' purposes are to ensure that Endangered Species Act permit issuance criteria are met; the amendment complies with all other applicable Federal laws and regulations; and, consistent with USFWS' legal authorities, the incidental take permit and implementation of the 1997 HCP amendment achieve long-term species and ecosystem conservation objectives at ecologically appropriate scales.

2. Changes Between the 2016 DEIS and RDEIS

The Joint Agencies added two new alternatives to the RDEIS, in addition to Alternatives A through F originally analyzed in the 2016 DEIS.

- **Alternative G**, which is primarily responsive to comments received on the 2016 DEIS from the U.S. Environmental Protection Agency (USEPA) and Washington Department of Fish and Wildlife (WDFW).
- **DNR's preferred alternative (Alternative H)**, which DNR developed with direction from the Board of Natural Resources (board) and which is responsive to comments received on the 2016 DEIS. DNR intends to submit Alternative H to USFWS in the form of an HCP amendment in support of an amendment to DNR's incidental take permit.

USFWS will specify their preferred alternative in the FEIS.

In addition to the two new alternatives, the RDEIS includes both new analysis and updated analysis of Alternatives A through F using updated data. The analyses contained in the 2016 DEIS were based on data generated in 2015. DNR has updated its data, primarily due to an updated forest inventory and updates to its large data overlay, current as of January 2018 (the large data overlay is a complex GIS model). Using the updated data, DNR produced new acreages for timber harvest and conservation. Tables and Figures in the RDEIS have been updated to reflect these new calculations. Refer to Appendix O for a description of data updates.

In Chapter 2, the descriptions of the alternatives were altered to include information on marbled murrelet habitat growth over time.

Revisions also were made to some of the conservation measures in the RDEIS, with some measures being specific to Alternative H and others applying to all action alternatives.

Changes made based on comments received on the 2016 DEIS include the following:

- Two special habitat areas were added near the Strait of Juan de Fuca in Clallam County under Alternative H.
- Special habitat areas in Wahkiakum and Pacific counties were made smaller to reduce adverse socioeconomic impacts under Alternative H.
- A section called “Alternatives Considered but not Analyzed in Detail” was added to Chapter 2. This section addresses the alternatives submitted by commenters.
- A jobs analysis was added to the socioeconomic section of Chapter 4.

Also, the marbled murrelet sections of Chapters 3 and 4 have been updated to reflect strategic locations, which will be described in the following section of this summary.

Finally, a change was made to the population viability analysis in Chapter 4. In this RDEIS, just as it was in the 2016 DEIS, a P-stage value of 1 indicates an occupied site. This value was assigned in the P-stage model to all acres within an occupied site, regardless of the forest condition of those acres. For example, some occupied sites may include areas of non-habitat. For the population viability analysis in this RDEIS, Dr. Zach Peery and Gavin Jones modeled the actual P-stage value of all acres within occupied sites, instead of simply assigning the entire occupied site a value of 1. They also modeled the growth of forests in occupied sites over the analysis period. The Joint Agencies believe these methods result in a more accurate representation of marbled murrelet habitat and more accurately reflect an increase in nesting carrying capacity over the analysis period.

3. The Alternatives

For the 2016 DEIS, the Joint Agencies worked together to develop six alternatives to analyze, including the no action alternative. The Joint Agencies carried these alternatives forward into this RDEIS and also added two new alternatives (G and H).

These alternatives represent a range of approaches to long-term marbled murrelet habitat conservation. The alternatives differ in the amount and location of DNR-managed forestland designated for long-term conservation and also include a combination of conservation measures proposed to protect marbled murrelet habitat.

These forestlands all occur within 55 miles of marine waters. This 55-mile line is the same as was used in the *Northwest Forest Plan* and is used by USFWS as an estimate of the inland range of the marbled murrelet in Washington. The total acreage of DNR-managed lands within this analysis area is approximately 1.38 million acres.

Acres proposed for continued conservation include lands already protected as long-term forest cover by DNR, such as old-growth forests, high-quality owl habitat, riparian areas, natural areas, and other conservation commitments of the 1997 HCP and *Policy for Sustainable Forests*. These areas provide conservation benefits to the marbled murrelet either by supplying current and/or future nesting habitat or by providing security to that habitat from predation, disturbance, and other threats. The alternatives also delineate additional forestlands with specific importance for marbled murrelet conservation. The range of acres proposed for conservation under the alternatives is summarized in Table S.3.1.

Table S.3.1. Summary of Conservation Acres Proposed Under Each Alternative (Alt.)

	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt G	Alt H
Acres of existing conservation under the 1997 HCP, *Policy for Sustainable Forests*, and Washington State Law	567,000	567,000	567,000	567,000	567,000	567,000	567,000	567,000
Acres of additional, marbled murrelet-specific conservation[1]	33,000	9,000	50,000	51,000	55,000	176,000	76,000	43,000
Total approximate acres	600,000	576,000	617,000	618,000	622,000	743,000	643,000	610,000

All of the alternatives release certain amounts of marbled murrelet habitat for timber harvest. These acres are not part of the conservation acres shown in Table S.3.1 and will continue to be managed under the 1997 HCP and *Policy for Sustainable Forests*. The total acres released is shown in Table S.3.2.

[1] Acres reported here are those which do not overlap other existing conservation lands.

Table S.3.2. Estimated Acres of Marbled Murrelet Habitat Released for Harvest, by Alternative

	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt . G	Alt. H
Estimated marbled murrelet habitat released	37,000	47,000	34,000	40,000	33,000	24,000	25,000	38,000

Marbled Murrelet Conservation Areas

Marbled murrelet conservation areas include all of the occupied sites currently protected under the interim strategy, additional occupied site acreage based on recommendations from the 2008 *Recommendations and Supporting Analysis of Conservation Opportunities for the Marbled Murrelet Long-Term Conservation Strategy* (Science Team Report) (Alternatives B through H), and a variety of areas proposed specifically for strategic marbled murrelet conservation under different alternatives. These proposed marbled murrelet conservation areas are summarized in Table S.3.3 and mapped in Appendix F.

Table S.3.3. Summary of Marbled Murrelet-Specific Conservation Areas Proposed Under Each Alternative

Alternative	Conservation areas
Alt. A (no action)	• Existing occupied sites (not including those recommended for addition by the Science Team Report) • Occupied site buffers (328 feet [100 meters]) • Habitat identified under the interim strategy
Alt. B	• Occupied sites (including those delineated in the Science Team Report)
Alt. C	• Occupied sites (including those delineated in the Science Team Report) • Occupied site buffers (328 feet [100 meters], except in the Olympic Experimental State Forest (OESF) HCP Planning Unit, where sites 200 acres or larger have 164-foot [50-meter] buffers) • Special habitat areas: Discrete areas of marbled murrelet habitat and adjacent security forest within which active management and other land uses are restricted • Emphasis areas: Enhanced (0.5-mile) buffers on occupied sites within the emphasis area, current and future marbled murrelet habitat, and areas of active management • Isolated stands of high-quality marbled murrelet habitat
Alt. D	• Occupied sites (including those delineated in the Science Team Report) • Occupied site buffers (328 feet [100 meters], except in OESF, where sites 200 acres or larger have 164-foot [50-meter] buffers) • Special habitat areas: Discrete areas of marbled murrelet habitat and adjacent security forest within which active management and other land uses are restricted

Alternative	Conservation areas
Alt. E	• Occupied sites (including those delineated in the Science Team Report) • Occupied site buffers (328 feet [100 meters], except in OESF, where sites 200 acres or larger have 164-foot [50-meter] buffers) • Emphasis areas (as described under Alternative C), in which both habitat protection and active management area are allowed • Special habitat areas in which active management and other land uses are restricted; there are fewer acres of special habitat areas proposed under Alternative E than under Alternative D • Isolated stands of high-quality marbled murrelet habitat
Alt. F	• Occupied sites (including those delineated in the Science Team Report) • Occupied site buffers (328 feet [100 meters]) • Marbled Murrelet Management Areas (MMMAs) as delineated in the Science Team Report and additional MMMAs in the North Puget planning unit; these areas allow some management activities consistent with habitat development and protection
Alt. G	• Occupied sites (including those delineated in the Science Team Report) • Occupied site buffers (328 feet [100 meters]) • All habitat with a P-stage value of 0.47 or higher throughout the analysis area • In the OESF HCP Planning Unit, all current habitat (P-stage greater than zero in decade zero) • Emphasis areas as designated under Alt. C • Special habitat areas as designated under Alt. D • Habitat identified by Washington Department of Fish and Wildlife during the 2016 DEIS comment period • Four MMMAs in the North Puget Planning Unit (Spada Lake/Morningstar, Whatcom, Middle Fork Hazel/Wheeler Ridge, Marmot Ridge) and the MMMA in the Elochoman block, as drawn for Alternative F, managed as an emphasis area
Alt. H	• Occupied sites (including those delineated in the Science Team Report) • Occupied site buffers (328 feet [100 meters]) • Special habitat areas in which active management and other land uses are restricted

For alternatives C through H, DNR-managed lands were segregated into two types of landscapes: high value landscapes and marginal landscapes. The high value landscapes were further separated into strategic locations and other high value landscapes.

Strategic locations are geographic areas within Washington that the Joint Agencies view as having a disproportionately high importance for murrelet conservation. These areas are important for one or more of the following reasons:

- Proximity to marine waters (within 40 miles), including proximity to marine “hotspots” (Raphael et al. 2015), which are areas with higher-than-average murrelet density
- Proximity to known occupied sites
- Abundance of habitat
- Abundance and distribution of occupied sites
- Capacity for developing future habitat based on forest types
- Protection from disturbance
- Proximity to federal lands

The strategic locations are as follows:

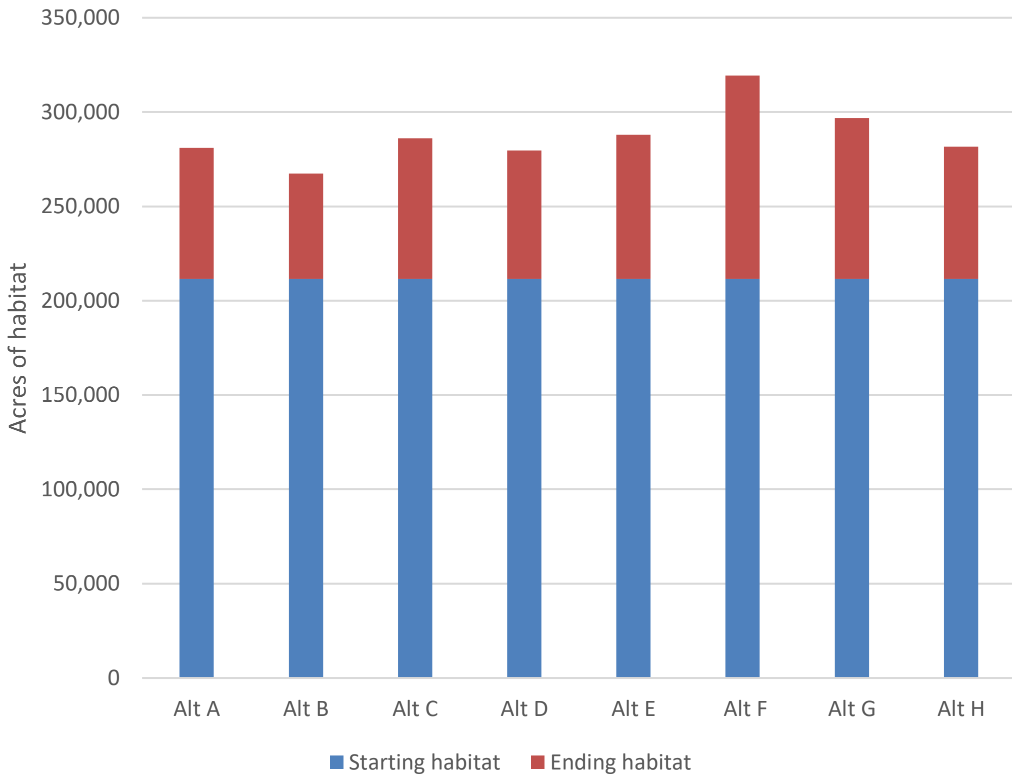
- Southwest Washington
- OESF and Straights (west of the Elwha River)
- North Puget

Strategic locations were identified based on the specific characteristics of each geographic location:

- The Southwest Washington strategic location captures areas that are in close proximity to marine waters, but where federal ownership is lacking.
- The OESF and Straits west of the Elwha River strategic location contains an abundance of high quality habitat, is in close proximity to marine waters, and also is close to areas identified by Raphael and others (2015) as “marine hot spots.”
- The North Puget strategic locations provides forested landscapes within commuting distance to nest sites from marine foraging areas around the San Juan Islands, which were identified by Raphael and others (2015) as “hot spots” due to heavy murrelet use and prey availability.

Under all alternatives, marbled murrelet habitat within these proposed conservation areas and throughout long-term forest cover is expected to increase over the life of the long-term conservation strategy (through 2067), as illustrated in Figure S.3.1.

Figure S.3.1. Growth of Habitat Through Time, by Alternative (Acres Not Adjusted for Habitat Quality)



4. Conservation Measures

The action alternatives establish conservation measures that would be added to the 1997 HCP to minimize impacts from new or expanded forest management and land use activities within marbled murrelet habitat. These measures are based on current understanding about activities that could disturb nesting murrelets and/or result in habitat loss. The measures limit harvest within long-term forest cover, limit thinning activities within and near habitat, prohibit or limit road construction in marbled murrelet conservation areas, apply daily timing restrictions to potentially disturbing management activities such as road construction or aerial operations during nesting season, limit development of new or expanded recreational facilities in marbled murrelet conservation areas, and minimize the impacts of other non-timber harvest activities.

5. How the Proposed Long-Term Strategy Relates to Other DNR Conservation Commitments

Many of the existing 1997 HCP conservation strategies, such as the riparian and northern spotted owl conservation strategies, provide conservation benefits to the marbled murrelet. In addition, the *Policy for Sustainable Forests* provides for protection of old-growth forests and conservation of forestland for wildlife diversity, genetic resources, uncommon habitats, and other specific conservation objectives. The action alternatives are intended to work in concert with these strategies and policies. Where proposed conservation areas overlap areas conserved for other reasons (for example, an occupied site within a riparian management zone), the most protective management policy or measure would apply.

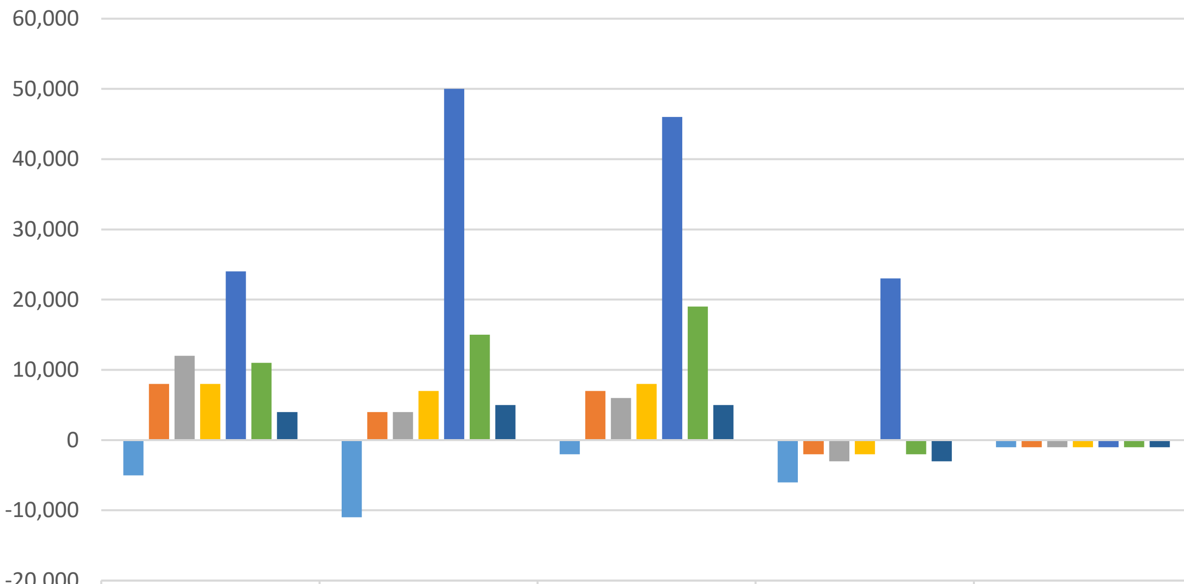
6. Summary of Potential Impacts to Elements of the Environment

Impacts evaluated in this RDEIS relate primarily to the acres of long-term forest cover provided by each action alternative and the proposed conservation measures (for example, measures proposed for thinning, recreation, and road construction).

Compared to the no action alternative, Alternative B would decrease the area of long-term forest cover by 24,000 acres (approximately 2 percent of DNR-managed forestland in the analysis area). Alternatives C through E would increase long-term forest cover by 17,000 to 22,000 acres, Alternative F would increase this area by 142,000 acres, Alternative G would increase long-term forest cover by 43,000 acres and Alternative H would increase it by 10,000 acres.

Figure S.6.1 provides a summary of how these acres change from Alternative A (no action), reported by alternative and landscape.

Figure S.6.1. Estimated Change in Long-term Forest Cover Acres From Alternative A (No Action), by Alternative and Landscape



	Southwest Washington	OESF and Straits west of the Elwah River	North Puget	Other high value landscape	Marginal landscape
Alt B	-5,000	-11,000	-2,000	-6,000	-1,000
Alt C	8,000	4,000	7,000	-2,000	-1,000
Alt D	12,000	4,000	6,000	-3,000	-1,000
Alt E	8,000	7,000	8,000	-2,000	-1,000
Alt F	24,000	50,000	46,000	23,000	-1,000
Alt G	11,000	15,000	19,000	-2,000	-1,000
Alt H	4,000	5,000	5,000	-3,000	-1,000

Alt B   Alt C   Alt D   Alt E   Alt F   Alt G   Alt H

■ Natural Environment: Earth, Climate, Aquatic Resources, Vegetation, Wildlife, and Marbled Murrelets

Forests within long-term forest cover are expected to become more structurally complex through time and experience less active management. Elements of the natural environment are not expected to be adversely impacted by these changes. Soil resources and areas subject to landslide hazards would continue to be protected by existing DNR policies and procedures. The alternatives are not expected to exacerbate climate change impacts on any element of the environment, and carbon sequestration is expected to be greater than emissions under all alternatives.

Existing riparian protection strategies remain in place under all the alternatives, and aquatic functions are expected to be maintained or enhanced under all alternatives. Minor, localized impacts to microclimate are possible under Alternative B.

Some limitations on thinning (Alternatives C, D, and E) could delay some riparian or natural areas from meeting their restoration objectives within a shorter time frame. However, overall management objectives of the 1997 HCP, *OESF HCP Planning Unit Forest Land Plan*, and natural areas management plans are not impacted.

Many wildlife and plant species would benefit from an increase in structurally complex forest that will occur in long-term forest cover over the planning period. Wildlife diversity is likely to increase over time with all alternatives. Some local changes in habitat conditions may temporarily affect some species, but overall abundance and distribution of species, including listed and sensitive species (not including the marbled murrelet), would remain stable or increase on DNR-managed lands.

In areas where land would be "released" from its current conservation status, the existing framework of regulations, policies, and procedures designed to minimize the environmental impacts from active management would remain in place.

■ Impacts to Marbled Murrelet Habitat and Populations

Between 2001 and 2016, the marbled murrelet population declined at an average annual rate of 3.9 percent in Washington.[2] While the direct causes for ongoing marbled murrelet population declines are not completely known, the USFWS Recovery Implementation Team identified the most likely primary factors as the loss of inland habitat, including additive and time-lag[3] effects of inland habitat losses over the past 20 years; changes in the marine environment, reducing the availability and quality of prey; and increased densities of nest predators (USFWS 2012, Falxa and others 2016). Recent analysis indicates that the amount and distribution of higher suitability habitat are the primary factors influencing the abundance and trends of murrelet populations. Habitat loss has occurred throughout the listed range of the murrelet, with the greatest losses documented in Washington, where the steepest declines of murrelet populations occurred (Raphael and others 2016).

The final HCP amendment must meet the Section 10 issuance criteria for issuing an incidental take permit. Part of the analysis undertaken by USFWS when issuing an incidental take permit is to consider whether an alternative jeopardizes the continued existence of a species. "Jeopardize the continued existence" is defined in 50 CFR §402.02 as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." This

[2] Due to reduced sampling efforts starting in 2014, statewide trend estimates for Washington are only available up to the year 2016 (Pearson and others 2018). This population trend is different than that used in the population viability analysis (a decline of 4.4 percent). The population viability analysis is described in this chapter and Appendix C.

[3] Time lag means a population response that occurs many years after the loss of inland habitat.

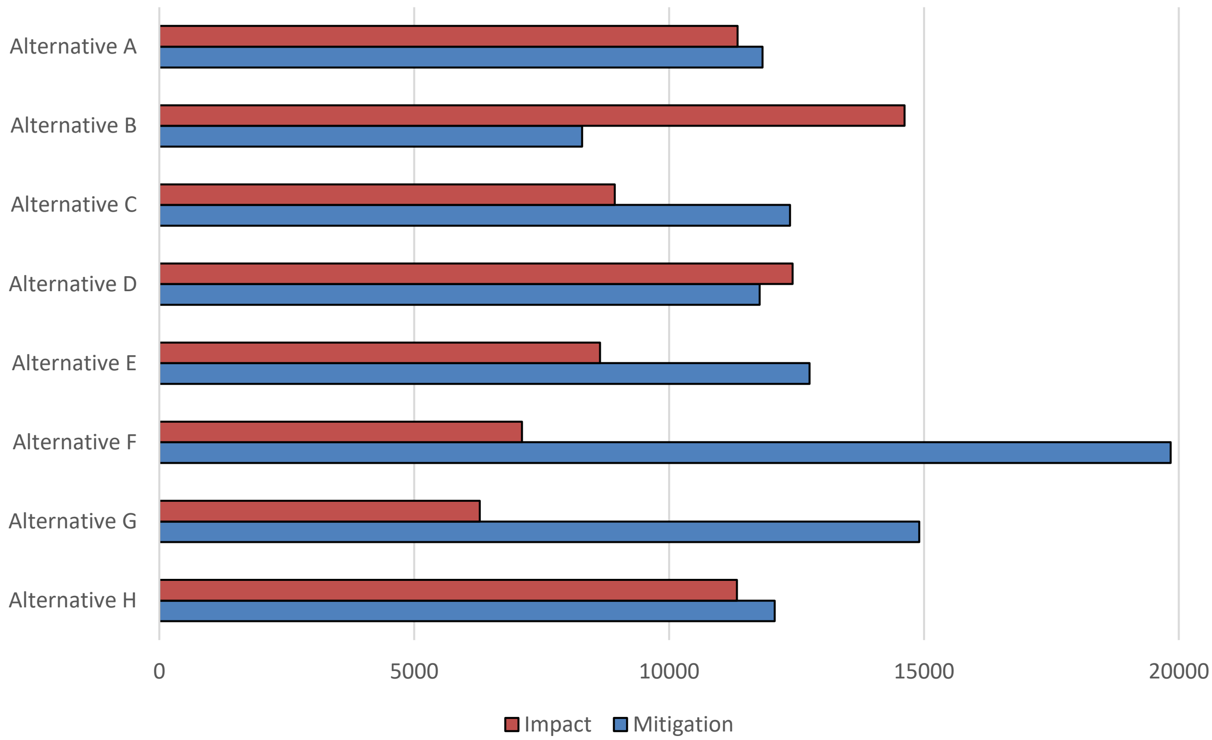
determination is made when USFWS completes a biological opinion on the issuance of the take permit for the HCP amendment.

The Joint Agencies recognize the importance of protecting existing occupied marbled murrelet habitat and recruiting additional habitat in specific areas. The alternatives vary by providing differing levels of habitat protection and recruitment, coupled with some short-term habitat loss. The intent is to improve current population trends through conservation and recruitment of additional nesting habitat on DNR-managed lands.

Two analytical approaches were used to evaluate the effects of the proposed alternatives on marbled murrelet habitat and populations. The acreage, quality (as influenced by stand condition and edge effects), and timing of habitat harvested and developed under each alternative provide a relatively direct measure of impacts. Potential consequences of each alternative relative to one other on the Washington murrelet population were evaluated with a population viability analysis model. This model explores two scenarios, both based on the assumption that habitat is the main influence on current population declines: 1) other factors compound the negative effects of insufficient habitat, making it difficult for murrelet populations to respond to increases in habitat availability (risk scenario), and 2) murrelet survival and reproduction are sufficient to allow for population growth as habitat increases (enhancement scenario).

For alternatives A through E, habitat loss in the short term (the first decade of the planning period, due to harvest of habitat outside of long-term forest cover) is expected to be mitigated over time by the recruitment of more and higher-quality habitat and an increase in interior habitat in strategic locations within long-term forest cover. However, impacts are not fully mitigated in all alternatives. When the acres of this habitat are adjusted for quality and timing, the cumulative adverse impacts expected to marbled murrelet habitat are exceeded by the mitigation expected under every proposed alternative except Alternatives B and D (Figure S.6.2). Alternatives F through H are designed to have no net loss of habitat capacity.

Figure S.6.2. Acres of Habitat Loss (Impact) and Gain (Mitigation) by the End of the Planning Period, by Alternative and Adjusted for Quality



The following section summarizes data for the alternatives on population size, reproduction, and distribution of marbled murrelet. This section does not replace analysis in the biological opinion produced by USFWS as part of issuing an incidental take permit.

Population Size

The population viability analysis shows that alternatives C, E, F, G and H could result in a larger murrelet population than under Alternative A. These differences were distinguishable at the scale of DNR-managed land. The population viability analysis showed little distinction between alternatives at the statewide scale, in term of population size or quasi-extinction probability.

In summary, the population viability analyses suggest that relative to the other alternatives, Alternative B results in the highest risk of local declines and the smallest projected local population sizes during the modeled planning period. Alternatives F and G are projected to result in the lowest risk of local declines, and Alternative F has the largest projected local population sizes, with intermediate results projected under Alternative A and Alternatives C through E, G and H.

Reproduction

Successful reproduction is required to maintain marbled murrelet populations. In addition to the quality and quality of habitat available in the forest environment, reproduction also is impacted by predation and disturbance. The alternatives support marbled murrelet reproduction by reducing disturbance. Alternatives F, G, and H provide 328-foot (100-meter) buffers around all occupied sites to reduce the risk of predation and natural disturbance. Alternative A also has 328-foot (100-meter) buffers, but around smaller occupied sites. Alternatives, C, D, and E have 328-foot (100-meter) buffers around most occupied site, but applies 164-foot (50-meter) buffers on occupied sites over 200 acres in the OESF HCP Planning Unit. Alternative B does not include buffers, which could result increased predation and disturbance of occupied sites. Conservation measures described in Chapter 2 reduce disturbance from management activities and recreation.

In addition to occupied site buffers, special habitat areas, emphasis areas, and marbled murrelet management areas all are intended to provide security forest surrounding murrelet habitat. Each type of conservation area takes a slightly different approach to supporting murrelet reproduction by reducing the likelihood of predation and natural disturbances. In alternatives C, D, E, and G, special habitat areas are also intended to reduce anthropogenic disturbances. Alternatives A and B do not include any of these strategies. Alternative F includes marbled murrelet management areas; alternatives D and H include special habitat areas; alternatives C and E include special habitat areas and emphasis areas, and Alternative G includes all three strategies.

Distribution

Under all alternatives except Alternative B, there are more acres of raw habitat, adjusted habitat, and interior forest habitat in Decade 5 than current conditions in all landscapes. Additional analysis at the watershed scale shows that in Decade 5, adjusted habitat acres will increase in most watersheds in the analysis area under alternatives C, D, E, F, G and H. However, all alternatives include net declines in habitat in some watersheds. In Alternative F, these declines affect only a few isolated watersheds, whereas in Alternative B, large clusters of watersheds are projected to experience habitat declines in all three of the strategic locations.

However, impacts exceeds mitigation in some strategic locations under some alternatives. Notably, impacts exceed mitigation in the North Puget strategic location under alternatives A, C, E, and H (even though mitigation exceeds impacts in these alternatives at the analysis area scale).[4] The reason is the time it takes for habitat to develop as mitigation in this strategic location. Therefore, there will be a period of time, up to several decades, when there will be less habitat available in North Puget than there is now. Only Alternatives B and D result in greater impacts than mitigation in OESF and the Straits west of the Elwha, and only Alternative B shows greater impacts than mitigation in Southwest Washington.

[4] Impacts exceeds mitigation in both the North Puget strategic location and the analysis area as a whole under alternatives B and D.

At a smaller scale, alternatives vary in their conservation of specific areas such as the Clallam area in OESF and the Straits, the Elochoman area in Southwest Washington, and areas to the west of federal lands in North Puget. Alternatives A and B include no conservation areas (emphasis areas, MMMAs, or special habitat areas) in these areas. Alternatives C, E, G, and H provide conservation areas for the Clallam area. Alternatives F, G, and H provide conservation areas for the Elochoman area. West of federal lands in North Puget, only Alternatives C thought H include conservation areas. In order from least to most acreage in conservation areas in North Puget, the alternatives are C, H, D, E, G, and F.

■ Human Environment: Recreation, Forest Roads, Public Services and Utilities, Environmental Justice, Cultural Resources, and Socioeconomics

Some localized impacts to these elements of the human environment are expected as a result of increasing the acres of marbled murrelet conservation and implementing proposed conservation measures. Cumulatively, these impacts are expected to be minor for all elements of the human environment except socioeconomics (refer to the following section), considering the scale of the analysis area and the availability of other DNR-managed lands for these land uses. Impacts are similar across all action alternatives.

Compared with the no action alternative, adding acres of marbled murrelet conservation would result in local reductions in the land available for new or expanded recreation facilities or non-timber leases/ or easements, shifting demand to lands elsewhere within the analysis area. Existing facilities, easements, leases, and land uses would largely remain unaffected, although the timing of some maintenance activities could be impacted.

Where conservation measures limit road development, compensatory increases in road miles may occur nearby, but overall road density in the analysis area is unlikely to increase as a result of the alternatives. Increased road abandonment in conservation areas likely would occur, which in turn could affect recreational use and access within these areas. Continued access to and use of cultural resources is unlikely to be significantly affected, however, and existing DNR policies and procedures for tribal consultation and cultural resource protection will remain in place.

No environmental justice impacts under any alternative are anticipated from this conservation strategy, although local economic impacts in two counties could be adverse (as discussed in the next section).

Socioeconomic Impacts

NEPA requires an examination of socioeconomic impacts of the proposed action. Socioeconomic impacts in this analysis concern the relationship of DNR-managed land to local economies, including county revenues, state trust revenues, employment, and local tax generation. These impacts were measured both qualitatively, by considering how activities on DNR-managed land contribute broadly to the local economy, and quantitatively, by attributing assumed values to the acres that would be available for harvest under each alternative.

The change in the value of operable acres was found to be relatively small at the scale of the entire analysis area. The overall change in operable acres ranges from a 3 percent increase under Alternative B to a decrease of between 1 and 5 percent for Alternatives C through H.

Federally granted trusts (trusts supported by State Lands) would experience gains in operable acres under Alternative B (increases between 1 and 7 percent) and reductions under alternatives C though H. Reductions vary by alternative and trust but are under 10 percent with two exceptions. First, operable acres are reduced on the University Trust by more than 10 percent under alternatives C through H, with a maximum reduction of 20 percent under Alternative D. Second, operable acres are reduced on the Scientific School Trust by 16 percent under Alternative F.

On State Forest Transfer and State Forest Purchase lands, which benefit counties, operable acres remain stable or increase under Alternative B. Under the other alternatives, operable acres remain stable, increase or decrease depending on the county. The largest changes in operable acres are on the State Forest Purchase Trust in Pacific County, with declines of 23 to 42 percent under alternatives C through H. The largest changes in operable acres are on State Forest Transfer Lands in Wahkiakum County, where operable acres decrease 10 to 27 percent under alternative C through G. Under Alternative H, operable acres on State Forest Transfer Lands in Wahkiakum County increase 7 percent. State Forest Transfer Lands in Pacific County decline by 2 to 17 percent under the action alternatives. Under Alternative F, operable acre declines of greater than 10 percent are expected on State Forest Transfer Land in Pierce and Whatcom counties.

Alternative B, by increasing the number of operable acres available for harvest as compared with Alternative A, is expected to result in stable or increased harvests levels on all trusts and in all counties in the analysis area, stable or increased revenue for all trust beneficiaries with lands within the analysis area, and stable or increased tax revenue and employment in counties within the analysis area.

Alternatives C through H, by decreasing the number of operable acres available for harvest, are expected to result in stable or decreased harvest levels on most trusts and in all counties in the analysis area, stable or decreased revenue for most trust beneficiaries with lands within the analysis area, and stable or decreased tax revenue and employment in counties within the analysis area.

Pacific County is most likely to be adversely impacted by Alternatives C through H. Wahkiakum County is most likely to be adversely impacted by alternatives C through G. These counties are more heavily dependent on timber harvest for local government revenue and have below average economic diversity, compared with other counties in the analysis area. The economies of Pacific and Wahkiakum counties are therefore less able to tolerate the reduction in harvest volume anticipated under Alternatives C through G, and Alternative H for Pacific County only, because of their low socioeconomic resiliency.

Some of the adverse economic effects due to reduced timber supply in the near term could be offset over time by the cumulative benefits of improved efficiencies and effectiveness in forest management, additional opportunities for thinning (which is more labor intensive), more regulatory certainty under the

Endangered Species Act, and potential use of the State Forest Trust Land Replacement Program in Pacific and Wahkiakum counties.

Impacts on DNR Operations

The establishment of discrete marbled murrelet conservation areas under the action alternatives will improve operational certainty (for example, in 1997 HCP implementation, harvest planning, road construction, leasing, and recreation planning) as compared with the no action alternative, which includes operational uncertainty about the exact location and extent of protected habitat. The conservation measures largely acknowledge the need for most DNR routine operations to continue to occur within long-term forest cover and limit restrictions or prohibitions to within specific marbled murrelet habitat areas. Thus active management of forest resources can largely continue, following clear parameters for seasonal timing restrictions and disturbance buffers. For four types of operations within long-term forest cover (thinning, roads, blasting, and recreation), the conservation measures differ among alternatives, with some limiting DNR management activities more than others. Site-specific consultation with USFWS is expected under the proposed conservation measures for some forest management activities.

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Chapter 1

INTRODUCTION

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Chapter 1

Introduction

This chapter describes the proposed action and states the need, purpose, and objectives of this proposal. This chapter also outlines the regulatory and policy framework for the marbled murrelet long-term conservation strategy, describes the analysis area, highlights the environmental impact statement and approval process, and describes what has changed from the 2016 Draft Environmental Impact Statement.

1.1 Proposed Action: Need, Purpose, and Objectives

The action proposed by Washington Department of Natural Resources (DNR) and U.S. Fish and Wildlife Service (USFWS) is to amend DNR's 1997 *State Trust Lands Habitat Conservation Plan* (1997 HCP) by replacing the marbled murrelet (*Brachyramphus marmoratus*) interim conservation strategy described in the 1997 HCP with a long-term conservation strategy. An amendment to the 1997 HCP and associated incidental take permit involves both state and federal action subject to the Washington State Environmental Policy Act (SEPA) and the National Environmental Policy Act (NEPA), respectively. This proposed action is considered a non-project action under SEPA. A SEPA/NEPA environmental impact statement was prepared for this amendment due to the potential for probable significant adverse impacts on the environment.

■ Need for the Proposed Action

DNR

DNR needs to obtain long-term certainty for timber harvest and other management activities on forested state trust lands, consistent with commitments in the 1997 HCP and DNR's fiduciary responsibility to the trust beneficiaries as defined by law.

USFWS

USFWS' need is to fulfill its legal obligations under Section 10(a)(1)(B) of the Endangered Species Act in response to DNR's request to amend its incidental take permit for the marbled murrelet long-term conservation strategy.

■ Purpose of the Proposed Action

DNR

The purpose of the proposed action is to develop a long-term conservation strategy for marbled murrelets on forested state trust lands in DNR's six westside HCP planning units, subject to DNR's fiduciary responsibility to the trust beneficiaries as defined by law, which achieves all of the following objectives:

- **Objective 1, Trust Mandate**: Generate revenue and other benefits for each trust by meeting DNR's trust management responsibilities. Those responsibilities include making state trust lands productive, preserving the corpus of the trust, exercising reasonable care and skill in managing the trust, acting prudently with respect to trust assets, acting with undivided loyalty to trust beneficiaries, and acting impartially with respect to current and future trust beneficiaries.
- **Objective 2, Marbled Murrelet Habitat**: Provide forest conditions in strategic locations on forested state trust lands that minimize and mitigate incidental take of marbled murrelets resulting from DNR's forest management activities. In accomplishing this objective, DNR expects to make a significant contribution to maintaining and protecting marbled murrelet populations.
- **Objective 3, Active Management**: Promote active, innovative, and sustainable management on state trust lands.
- **Objective 4, Operational Flexibility**: Provide operational flexibility to respond to new information and site-specific conditions.
- **Objective 5, Implementation Certainty**: Adopt feasible, practical, and cost-effective actions that are likely to be successful and can be sustained throughout the life of the 1997 HCP.

USFWS

USFWS' purposes are to ensure that Endangered Species Act permit issuance criteria are met; the amendment complies with all other applicable Federal laws and regulations; and, consistent with USFWS' legal authorities, the incidental take permit and implementation of the 1997 HCP amendment achieve long-term species and ecosystem conservation objectives at ecologically appropriate scales.

1.2 Regulatory and Policy Framework

DNR-managed lands within the analysis area are subject to a variety of federal and state laws, as well as policies adopted by the Board of Natural Resources (board). The long-term conservation strategy for the marbled murrelet must comply with these regulations and policies.

Federal Endangered Species Act

The purposes of the Endangered Species Act include protecting the ecosystems on which threatened and endangered species depend and providing a program that conserves populations of threatened and endangered species and includes appropriate steps to achieve these purposes. The long-term conservation strategy must meet multiple criteria under the Endangered Species Act, including the following Section 10 issuance criteria:

- The take will be incidental (refer to Text Box 1.2.1).
- The applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such take.
- The applicant will ensure that adequate funding for the plan will be provided.
- The take will not appreciably reduce the likelihood of survival and recovery of the species in the wild.
- Other measures (if any) that the Secretary of the Interior may require as being necessary or appropriate for the purposes of the plan are implemented.

Text Box 1.2.1. What Is "Take"?

"Take" is defined in the Endangered Species Act as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species. Harm may include significant habitat modification when such modification actually kills or injures a listed species through impairment of essential behavior (for example, nesting or reproduction).

Incidental take means harm or harassment to individuals of a listed species when such take is incidental to, and not the purpose of, carrying out otherwise lawful activities such as timber harvests (DNR 1997).

1997 HCP

The proposed action is an amendment to the 1997 HCP and associated incidental take permit. The 1997 HCP is a long-term land management plan that is authorized under Section 10 of the Endangered Species Act and prepared in partnership with USFWS and National Marine Fisheries Service (the Federal Services). The 1997 HCP describes how DNR meets the Endangered Species Act Section 10 issuance criteria with a suite of habitat conservation strategies focused on the northern spotted owl, marbled murrelet, salmon species, and riparian obligate species, as well as other unlisted species (associated with uncommon habitats). These strategies range from passive (for example, protect unique habitats such as cliffs) to active (for example, thin forests to speed development of habitat). Through these HCP conservation strategies, DNR offsets the potential harm of forest management activities on individual members of a species by providing for conservation of the species as a whole.

A long-term conservation strategy for the marbled murrelet would work in concert with other existing HCP conservation strategies (refer to Text Box 1.2.2). The objectives and approaches described in the riparian conservation strategy, northern spotted owl conservation strategy, and the protection of uncommon habitats would not change through this SEPA/NEPA planning process. Under some of the alternatives analyzed in this revised draft environmental impact statement (RDEIS), some existing, permitted activities may be modified at the local scale to enhance their conservation benefit for marbled murrelets. The effect of the long-term conservation strategy alternatives on existing conservation strategies will be discussed in more detail in the following chapters.

Text Box 1.2.2. Will the Long-Term Conservation Strategy Amend the Existing HCP Conservation Strategies?

The long-term strategy focuses on marbled murrelet conservation and is intended to work with the existing conservation strategies of the 1997 HCP. Under some alternatives proposed in this RDEIS, some existing, permitted activities may be modified at the local scale to enhance their conservation benefit for marbled murrelets.

An HCP is a required component of an application for an incidental take permit, which is required when activities occurring on non-federal lands, such as timber harvests, have the potential to result in incidental take of a threatened or endangered species. The contents of an HCP are defined in Section 10 of the Endangered Species Act and its implementing regulations. Content includes the following:

- An assessment of the impacts likely to result from the proposed taking of one or more federally listed species.
- Measures the permit applicant will undertake to minimize, mitigate, and monitor for such impacts; the funding that will be made available to implement such measures; and the procedures to deal with unforeseen or extraordinary circumstances.
- Alternative actions to the take that the applicant analyzed and the reasons why the applicant did not adopt such alternatives.
- Additional measures that USFWS may require as necessary or appropriate.

■ State Trust Lands

By meeting the terms of the 1997 HCP and incidental take permits, DNR fulfills its obligations under the Endangered Species Act. The 1997 HCP and incidental take permits provide DNR the stability, certainty, and flexibility it needs to meet its responsibility as a trust lands manager, which is to provide a perpetual source of revenue to its trust beneficiaries while simultaneously developing a complex, healthy, resilient forest ecosystem capable of supporting native species.

As a trust lands manager, DNR must follow the common law duties of a trustee. Two of these duties were addressed in the 1984 landmark decision *County of Skamania v. State of Washington*: 1) a trustee must act with undivided loyalty to the trust beneficiaries to the exclusion of all other interests, and 2) a trustee has a duty to manage trust assets prudently (DNR 2006, p. 15). Refer to the *Policy for Sustainable Forests* for a more detailed discussion of DNR's trust management duties (DNR 2006, p. 9–16).

For a more detailed explanation of the Endangered Species Act's Section 10 process as it applies to this conservation strategy, refer to Section 1.4.

This RDEIS refers to "state trust lands" or "trust lands" to describe the following trusts defined under state law and managed by DNR to provide revenue to specific trust beneficiaries. Chapter 3 provides information on the acres of each trust within the analysis area. The term "state trust lands" used in this RDEIS refers to:

- **State Lands** (RCW 79.02.010(14)): Shortly before Washington became a state in 1889, Congress passed the Omnibus Enabling Act of 1889 (Volume 25, U.S. Statutes at Large, Chapter 180, p. 676) to grant the territory more than 3 million acres of land as a source of financial support for named beneficiaries, primarily for public schools and colleges. Unlike states that sold many of their federally granted lands early in the 1900s, Washington retained ownership of most of these lands and continues to manage them to provide revenue and other benefits to the people of Washington (DNR 2006). These lands are called State Lands.

- **State Forest Lands** (RCW 79.02.010(13)): DNR manages two categories of State Forest Lands. *State Forest Transfer Lands* were acquired by 21 counties in the 1920s and 1930s through tax foreclosures. Unable to manage these mostly harvested and abandoned lands, counties deeded them to the state to manage as state trust lands. In exchange for the deed transfer, the county and taxing districts in which the land is located are given most of the revenue from timber sales and other revenue-producing activities. *State Forest Purchase Lands* were either purchased by the state or acquired as a gift. State forestlands are to be used primarily for forestry, forever reserved from sale, and managed similar to federally granted trust lands.

Two other trusts are located within the analysis area, covering significantly fewer acres:

- **Community and Technical College Forest Reserve (RCW 79.02.420):** In addition to the State Lands and State Forest Lands, DNR also manages more than 3,500 acres of forestlands for community and technical colleges. The Community and Technical College Forest Reserve was established by the Washington State Legislature (legislature) in 1996. Funds for DNR to purchase the properties were first appropriated that year.

  These lands, located near urban areas, form a buffer between other working forests and suburban uses. The properties are managed for sustained timber production, but special consideration is given to aesthetics, watershed protection, and wildlife habitat. Revenues go to a special fund for building and capital improvements on community college campuses.

- **King County Water Pollution Control Division State Trust Lands**: DNR manages more than 4,300 acres of state trust lands for the benefit of King County and its Wastewater Treatment Division. These lands were transferred to DNR for management through an agreement with the county in June 1995 and are managed for long-term forestry, the same as other state trust lands. Some of King County’s biosolids will be applied to these lands where soils and locations are appropriate.

■ *Policy for Sustainable Forests*

The *Policy for Sustainable Forests* (DNR 2006) is DNR’s guiding set of policies for the management and stewardship of forested state trust lands. The *Policy for Sustainable Forests* describes DNR’s obligations for managing forestlands on behalf of the trusts (refer to “State Trust Lands” in this chapter), and establishes specific policies for economic performance, forest ecosystem health and productivity, and social and cultural benefits. The policies in this document work to support implementation of the 1997

HCP. Therefore, this RDEIS uses the *Policy for Sustainable Forests* to establish criteria for the analysis of potential environmental consequences of the alternatives (Chapter 4). The multiple benefits of state trust land management are discussed in the *Policy for Sustainable Forests*; policies are grouped into major categories that address key aspects of sustainable forest management including economic performance, forest ecosystem health and productivity, social and cultural benefits, and implementation (DNR 2006, p. 25–50).

Sustainable Harvest Calculation

The sustainable harvest calculation is approved by the board and establishes a sustainable harvest level of timber to be scheduled for sale from state trust lands during a planning decade. The marbled murrelet long-term conservation strategy will have implications for the sustainable harvest calculation. An update to the calculation, which is currently underway, will incorporate a range of conservation lands proposed under the marbled murrelet long-term conservation strategy alternatives in order to properly analyze potential harvest levels. Once the long-term strategy has been adopted, DNR will adjust the sustainable harvest level as necessary to meet the strategy's requirements (DNR 2006).

Old-growth Forests in Western Washington

The *Policy for Sustainable Forests* includes a policy to identify and protect old-growth forests. These forests are defined as stands of pre-European settlement origin (prior to 1850) that have not been actively managed. These forests have a high level of structural complexity and provide conditions for marbled murrelet nesting. DNR maintains an inventory of old-growth forests of at least five acres in size. Protection of old-growth forests complements the 1997 HCP, as such protection provide conservation benefits to northern spotted owl, riparian, and marbled murrelet habitat. In the Olympic Experimental State Forest (OESF) HCP Planning Unit, some management of old-growth forests is allowed, consistent with the 1997 HCP and the research objectives of the OESF.

■ State Forest Practices Act

In 1974, the legislature passed the Forest Practices Act, which regulates activities such as growing and harvesting timber on all non-federal forestlands in the state, including forested state trust lands. The Forest Practices Board adopts forest practices rules that implement the Forest Practices Act.

In 1999, the legislature directed the Forest Practices Board to amend the rules to be consistent with the April 1999 Forests and Fish Report. The objectives of that report are to protect public resources, focusing on water quality, salmon habitat, federally-listed species, and other aquatic and riparian resources. The legislature also directed the Governor to seek assurances from federal agencies so that compliance with the forest practices rules would satisfy federal requirements under the Endangered Species Act. In 2001, the Forest Practices Board amended the rules and in 2006, the Federal Services approved the programmatic Forest Practices Habitat Conservation Plan (Forest Practices HCP) and associated incidental take permits to conserve fish and seven amphibian species. The Forest Practices HCP provides Endangered Species Act coverage for forest landowners through the state's Forest Practices program.

Field staff in DNR's six regions administer and enforce the forest practice rules (and thus the Forest Practices HCP). DNR's Forest Practices division provides staff support to the Forest Practices Board and programmatic oversight for the regions and is entirely independent of DNR's divisions that manage forested state trust lands.

Specific forest practice rules apply to forest practices covered by the 1997 HCP. Forest practices activities on DNR-managed lands not covered by the 1997 HCP (some limited acreage in western Washington but mostly eastern Washington) obtain Endangered Species Act coverage through the Forest Practices HCP.

■ NEPA

The purpose of NEPA is to promote analysis and disclosure of the environmental issues surrounding a proposed federal action. The scope of NEPA goes beyond that of the Endangered Species Act by considering the impacts of a federal action not only on fish and wildlife resources, but also on other aspects of the environment such as water quality, cultural resources, recreation, and other pertinent areas, depending on the scope of the action. The NEPA process is intended to help public officials make decisions that are based on understanding of environmental consequences and take actions that protect, restore, and enhance the environment.

■ SEPA

Enacted by the Washington Legislature in 1971, SEPA is intended to ensure that environmental values are considered during decision-making by state and local agencies. SEPA directs state and local agencies to identify and evaluate probable impacts, alternatives and mitigation measures, emphasizing important environmental impacts and alternatives, and to encourage public involvement in decisions.

■ Other Related Laws and Policies

DNR complies with all other applicable state and federal laws. Some examples include the state Shoreline Management Act, which is intended to protect valuable shoreline resources; and the state and federal Clean Water Act, which establish the basic structure for regulating discharges of pollutants into the waters of the United States. The state and federal Clean Air Acts and certain local laws also affect the management of state trust lands. Chapter 3, "Affected Environment," summarizes the applicable laws and policies for each element of the environment evaluated for impacts.

Natural Areas

DNR manages a statewide system of conservation lands called natural areas that contribute to biodiversity conservation in Washington. These lands also are included in the 1997 HCP as "permit lands." **Natural area preserves** protect rare or vanishing flora, fauna, and geological, natural historical, or similar features of scientific or educational value. **Natural resources conservation areas** include areas with a high priority for conservation, natural systems, wildlife, significant geologic features, archaeological resources, or scenic attributes, and often provide public access. DNR actively manages natural areas to ensure control of invasive species and to restore native species. Natural area preserves and natural resource conservation areas are included in the marbled murrelet long-term conservation strategy when they provide habitat and security to marbled murrelet habitat.

1.3 Analysis Area

The analysis area for this RDEIS is all 1997 HCP-covered DNR-managed lands (approximately 1.38 million acres) within 55 miles of all marine waters in western Washington (refer to Figure 1.3.1). This 55-mile line is the same as was used in the *Northwest Forest Plan* (U.S. Department of Agriculture and U.S. Department of the Interior 1994) and is used by USFWS as an estimate of the inland range of the marbled murrelet in Washington.

Figure 1.3.1. Analysis Area for the RDEIS

The land within the 55-mile range totals over 16 million acres. DNR manages approximately 9 percent of this land. DNR organizes its habitat conservation by ecological units called "HCP planning units," which include the OESF, Straits, South Coast, Columbia, North Puget, and South Puget. State trust lands managed under the 1997 HCP within these planning units are the areas where the marbled murrelet long-term conservation strategy will be implemented.

Other lands within the inland nesting range of the marbled murrelet are owned and managed by private industries, municipalities, organizations, and individuals, as well as federal agencies. Table 1.3.1 includes a breakdown of ownership.

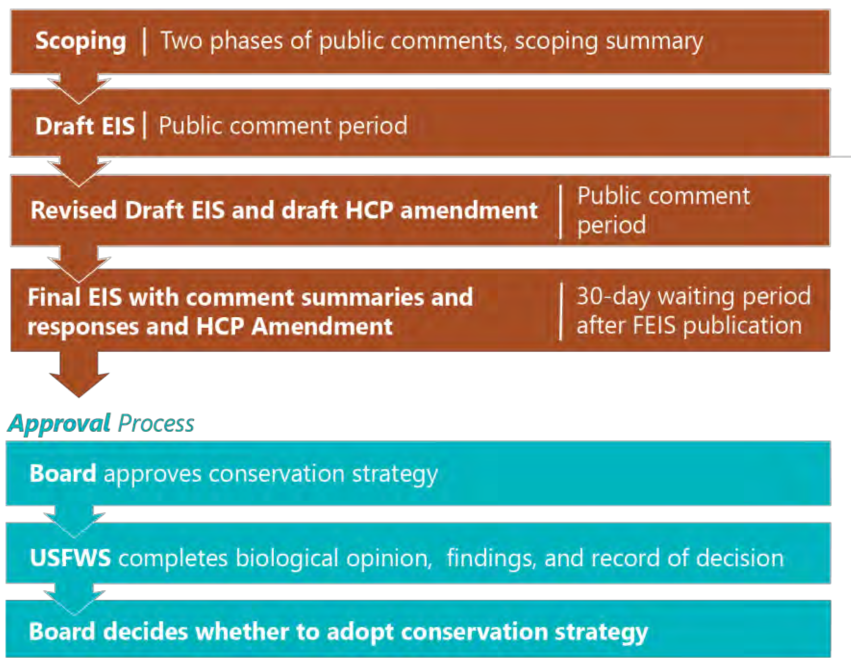
Table 1.3.1. Land Ownership Within the Washington Inland Range of the Marbled Murrelet

Land within 55 miles of saltwater	Acres	
Total land regardless of ownership	16,060,000	
	Acres	Percent
US Forest Service, USFWS, and National Park Service land	4,170,000	26%
DNR-managed land	1,380,000	9%
Private and other	10,510,000	65%

1.4 EIS and Approval Process

Figure 1.4.1 shows the steps of this project from scoping through final approval. Each of these steps is described in the following section.

Figure 1.4.1. EIS and Approval Process



Scoping

Scoping involves defining the range of the issues to be addressed in an environmental impact statement (EIS). Scoping helps the lead agency recognize areas of concern and eliminate less significant impacts from detailed study, which helps focus the EIS. Comments from concerned citizens and organizations help agencies identify reasonable alternatives to be analyzed in an EIS, and the opportunity to comment during the scoping process also helps promote agency and public communication.

2006 Determination of Significance and Public Scoping Notice

On September 15, 2006, DNR issued a Determination of Significance and Public Scoping Notice for the marbled murrelet long-term conservation strategy, indicating that an EIS would be prepared. On that same date, USFWS, as a joint agency, issued a federal Notice of Intent to conduct public scoping and prepare a joint EIS (71 Federal Register 54515). The proposal's geographic area at that time included OESF, Straits, South Coast, and Columbia HCP planning units only.

After the public scoping notices were issued, DNR and USFWS (the Joint Agencies) held four public meetings at the following dates and locations in western Washington:

- **September 25, 2006:** Olympic Natural Resources Center, Forks
- **September 28, 2006:** Natural Resources Building, Olympia
- **October 4, 2006:** Willapa Harbor Community Center, South Bend
- **October 5, 2006:** Lacey Community Center, Lacey

Ten scoping comments were received during the scoping comment period (September 15 through October 30, 2006). DNR decided not to proceed immediately with development of the EIS for the long-term conservation strategy because of the economic downturn and resulting budget cuts.

2012 Project Resumption

In January 2012, the Joint Agencies resumed development of the EIS for the long-term conservation strategy pursuant to their respective authorities under NEPA and SEPA and reinitiated and expanded public scoping due to the passage of time since the original scoping notice was issued. Subsequently, the Joint Agencies prepared a statement of need, purpose, and objectives consistent with their respective authorities in order to facilitate the identification of a reasonable range of alternatives.

2012 and 2013 Scoping

Scoping was done in two 30-day phases for the preparation of the 2016 draft EIS (DEIS). Phase 1 was initiated on April 20, 2012, when DNR issued a Public Scoping Notice and USFWS issued a federal Notice of Intent to conduct scoping (77 Federal Register 232743). In Phase 1, the Joint Agencies requested public comment related to the following: a proposed statement of need, purpose, and objectives, range of alternatives, impacts that should be considered, and environmental information relevant for the analysis for the long-term marbled murrelet conservation strategy. (These comments would be in addition to those received during the 2006 scoping process, which were retained by both agencies.) In addition, the Joint Agencies geographically expanded the proposal to include the North and South Puget HCP planning units. Meetings were held in western Washington on these dates:

- **April 30, 2012:** Natural Resources Building, Olympia
- **May 3, 2012**: Northwest Region Office, Sedro Woolley
- **May 8, 2012:** Pacific Cascade Region, Cathlamet County courthouse
- **May 9, 2012:** Olympic Region Office, Forks

In all, about 2,040 individual comments were received during the Phase 1 scoping period (April 20 through May 21, 2012). Comments were summarized by subject.

At the August 2012 Board meeting, the Board approved the need, purpose, and objectives statement for inclusion in the 2016 DEIS.

Subsequently, the Joint Agencies decided to hold a second phase of scoping. On May 13, 2013, DNR issued a "Notice of Public Meetings and Request for Comments on the Scope of an Environmental Impact Statement," initiating Phase 2 of scoping. Though not required under SEPA or NEPA, Phase 2 scoping increased the opportunities for the public to learn about and provide input into the conservation strategy process. In this second phase of scoping, the Joint Agencies sought public comment on a set of conceptual alternatives for the conservation strategy. Public meetings were held on these dates in western Washington:

- **June 5, 2013**: Natural Resources Building, Olympia
- **June 10, 2013**: Northwest Region Office, Sedro Woolley
- **June 12, 2013**: Olympic Region Office, Forks
- **June 19, 2013**: Pacific County Courthouse Annex, South Bend

During the Phase 2 scoping period (May 13 through July 1, 2013), 1,976 individual comments were received regarding the Joint Agencies' conceptual alternatives. These comments were summarized by subject in July and August 2013. By reviewing all of the comments from the 2006 scoping and both phases of the 2012 through 2013 scoping, the Joint Agencies narrowed the scope of issues for consideration in the 2016 DEIS. Refer to Appendix A for the scoping summary report provided to the board.

2015 Public Comment

In addition to the formal scoping process, DNR presented draft alternatives to the board on October 15 and December 3, 2015. Public comment received during those meetings was also considered and is summarized in the Scoping Report in Appendix A.

■ Development of the 2016 DEIS

Following scoping, the Joint Agencies developed a set of management alternatives through a collaborative working process. The alternatives represent different management options to the Joint Agencies' respective decision makers and reflect the ideas and concerns raised by the public and stakeholders during the entire scoping process.

The Joint Agencies then prepared the 2016 DEIS. The 2016 DEIS analyzed a reasonable range of alternatives to identify potential environmental impacts and mitigation measures under both NEPA and SEPA.

On December 9, 2016, a Federal Register notice of availability for the 2016 DEIS initiated a 90-day public comment period (81 FR 89135) in compliance with NEPA. Notice of availability under SEPA was issued on November 18, 2016. The 2016 DEIS analyzed six alternatives for a long-term conservation strategy for the marbled murrelet on DNR-managed lands. The 2016 DEIS did not specify a preferred alternative for the long-term conservation strategy.

The Joint Agencies received over 5,000 individual comments during this comment period. Comments came in the form of individual letters, form letters, postcards, and emails. Some commenters supported one of the alternatives analyzed, some suggested new alternatives, and others suggested changes to what was analyzed in the 2016 DEIS and what should be included in subsequent analysis. In the final EIS (FEIS), the Joint Agencies will respond to comments received on the 2016 DEIS and additional comments received on the RDEIS.

■ Development of the RDEIS and FEIS

A considerable portion of the text from the 2016 DEIS is used directly in this document. However, there are key changes in this RDEIS. For example, the Purpose and Need statements in this chapter were separated by agency. Two new alternatives were added, and the document also includes both new and updated analysis. Other changes were made as well. For a description of changes made between the DEIS and RDEIS, refer to "Changes between the DEIS and RDEIS" at the end of this chapter.

The comment period for the RDEIS begins when the RDEIS is formally issued. The comment period gives the public a chance to comment on the RDEIS and the draft 1997 HCP amendment. After the comment period, the Joint Agencies will review and consider all comments received and prepare an FEIS.

Who Is the DNR Decision Maker?

DNR's decision maker for this action is the board (refer to Text Box 1.4.1). Board approval is required for this project because the proposal will amend an existing board-approved policy, the 1997 HCP. As the decision maker, the board will be responsible for selecting a final alternative plus any proposed mitigation. The board may adopt an alternative in its entirety or it may combine elements of different alternatives. Although the final selected alternative may not be identical to any one particular alternative in this RDEIS, it will be within the range of alternatives analyzed.

Text Box 1.4.1. What Is the Board of Natural Resources?

The Board of Natural Resources (board) was established when DNR was created in 1957. The board sets policies ensuring that the acquisition, management, and disposition of the lands and resources in DNR's care are based on sound principles and consistent with applicable laws. The board approves timber sales and the sale, exchange, or purchase of state trust lands and also establishes the sustainable harvest level for forested state trust lands. Any change to DNR policies requires board approval.

Membership in the board is set by state statute and includes the Commissioner of Public Lands, the Governor of Washington or designee, the Washington Superintendent of Public Instruction, a county commissioner from a county with state trust lands, the Director of the School of Environmental and Forest Sciences at the University of Washington, and the Dean of the College of Agriculture, Human, and Natural Resource Sciences at Washington State University.

■ USFWS Approval Process

Following the 60-day public comment period on the RDEIS and draft amendment (set by DNR), the Joint Agencies will review the comments received and prepare a final EIS (FEIS) and a proposed final amendment.

In order for USFWS to process and evaluate an application for a permit amendment under Section 10 (a)(2)(A) of the Endangered Species Act, DNR must specify the following:

- The impact that likely will result from the take.
- What steps DNR will implement to minimize and mitigate such impacts, and the funding that will be available to implement such steps.
- What alternative actions to such take DNR considered and the reasons why such alternatives are not being utilized.
- Other measures USFWS may require as being necessary or appropriate for purposes of the plan (amendment in this case).

If USFWS finds, after opportunity for public comment with respect to the permit amendment, that the following issuance criteria are met, an amendment will be approved.

- The take will be incidental.
- DNR will, to the maximum extent practicable, minimize and mitigate the impacts of such take.

- DNR will ensure that adequate funding for the amendment and procedures to deal with unforeseen circumstances will be provided.
- The take will not appreciably reduce the likelihood of the survival and recovery of the species in the wild.
- Any measures required by USFWS will be implemented.

To conclusively determine that the permit amendment issuance criteria have been met, USFWS will need to make an independent Endangered Species Act Section 10 "findings" determination relative to the issuance criteria, and additionally, conduct an intra-USFWS consultation under Section 7(a)(2) of the Endangered Species Act. The Section 10 findings will be documented in a memorandum, and the Section 7 consultation will result in a biological opinion on the effects of issuing the permit amendment on the marbled murrelet and any other listed species and critical habitat that may be affected.

Along with the Section 10 findings and biological opinion, USFWS must complete the NEPA process by preparing a NEPA record of decision. The record of decision must include what the decision was, alternatives considered and the environmentally preferred alternative(s), a statement of whether all practicable means to avoid or minimize environmental harm from the alternative selected have been adopted, and a monitoring and enforcement program for adopted mitigation measures (40 CFR 1505.2).

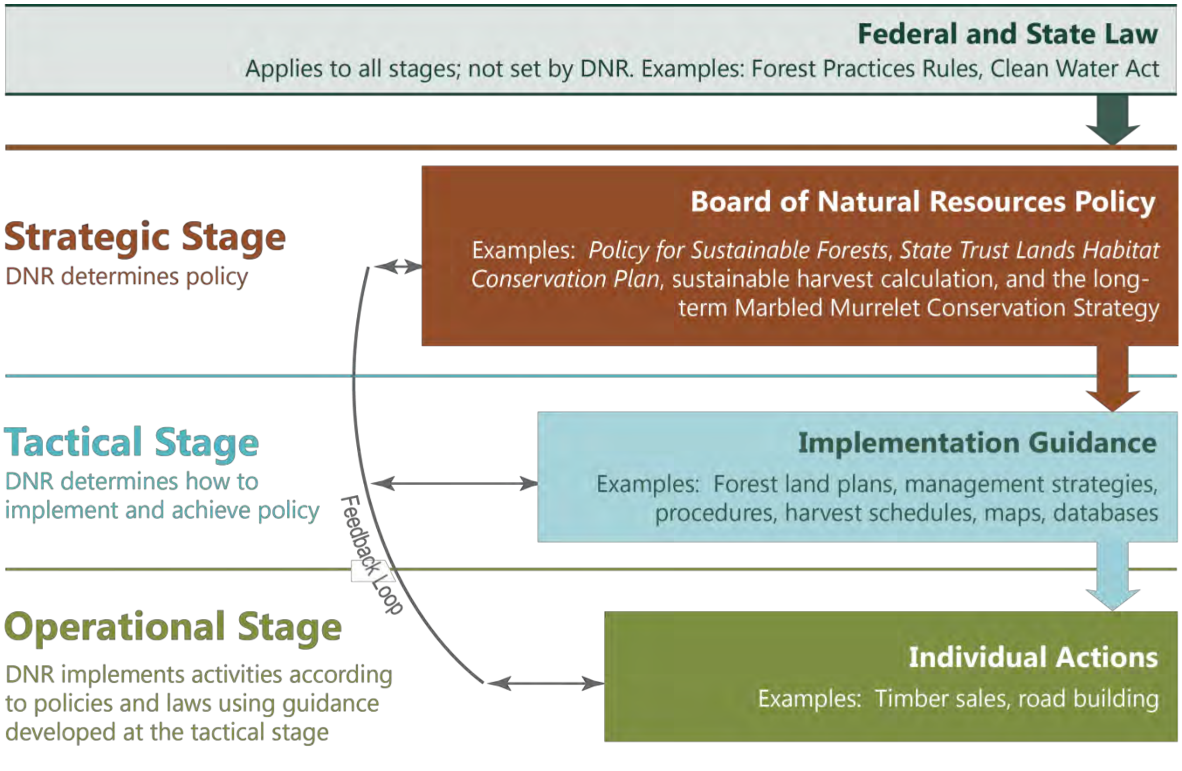
What Happens if USFWS approves DNR's application*?*

If USFWS makes a final determination to approve DNR's application, the board will decide whether DNR will adopt the conservation strategy and accept the permit terms and conditions.

Will the Long-Term Conservation Strategy Affect Other DNR Planning Processes?

Yes. To understand why and how, it is important to understand DNR's planning process. This process has three stages: strategic, tactical, and operational (refer to Figure 1.4.2).

Figure 1.4.2. DNR's Planning Process



The first planning phase is called **strategic** because it involves developing policies that define DNR's basic operating philosophy, establish standards, and provide direction upon which subsequent decisions can be based, including tactical and operational decisions. Examples of policies include the 1997 HCP and the *Policy for Sustainable Forests*. Amendment of the 1997 HCP and incidental take permits for the long-term marbled murrelet conservation strategy both fall within the strategic level of planning. All of these policies require approval from the board.

Another example of a strategic level of planning is the sustainable harvest calculation. The sustainable harvest calculation establishes the volume of timber to be scheduled for sale from state trust lands during a planning decade. The sustainable harvest calculation policy has some flexibility designed to optimize the economic value of forest stands and timber production over time. Within the planning decade, the harvest level in any given year can vary up to 25 percent (plus or minus) from the sustainable harvest level, but the decadal mean must be sustained over the decade. This requirement ensures that timber harvesting continues into the future in a way that is fair to all generations of trust beneficiaries. The sustainable harvest level is recalculated each decade. However, DNR may recalculate the level more often to accommodate new legal, economic, and environmental considerations.

The second stage in DNR's planning process is called tactical because it involves determining how to implement and achieve DNR policies. At this stage, DNR may develop specific management strategies, maps, databases, models, or other items designed to achieve specific policy objectives. DNR also may develop comprehensive documents called forest land plans, through which DNR determines the best way to implement the full suite of DNR policies in a given HCP planning unit (DNR 1997). To date, DNR has completed forest land plans for the South Puget and OESF HCP planning units.

Because they are based on DNR policies, forest land plans and other items developed at the tactical stage must be amended if those policies change. The long-term marbled murrelet conservation strategy may affect procedures, management strategies, and other key elements of DNR's forest land plans. Such elements will be adjusted to the new long-term strategy as appropriate.

Site-specific activities such as individual timber sales are designed at the operational stage of planning using the guidance developed at the tactical stage. Management activities must comply with all applicable local, state, and federal laws as well as policies developed at the strategic stage (refer to Text Box 1.4.2).

Review under SEPA occurs at each stage of planning. Policies are evaluated at the strategic phase, forest land plans are reviewed at the tactical stage, and most site-specific projects or actions, such as individual timber sales, are evaluated at the operational stage as they are proposed.

Text Box 1.4.2. After a Long-Term Conservation Strategy Is Adopted, Will Individual Projects in the Analysis Area Still be Reviewed Under SEPA, NEPA, and Other Laws?

Yes, unless the project is exempt under state or federal law. As a non-project action under SEPA, the long-term conservation strategy is not site-specific. Supplemental review of site-specific projects such as timber sales, recreation site development, major leases, and easements will occur under SEPA (and if a federal project, under NEPA) and any other applicable local, state, or federal law.

What Is the Time Frame for the Long-term Conservation Strategy?

The long-term conservation strategy follows the timeline of the 1997 HCP, which runs to the year 2067. All analysis conducted in this RDEIS considers January 2018 as the starting point and 2067 as the ending point. Data often is presented in terms of the decade of the strategy (decade 0) [current conditions] through final decade) for comparison purposes.

■ Changes Between the DEIS and RDEIS

The Joint Agencies added two new alternatives to the RDEIS, in addition to Alternatives A through F originally analyzed in the 2016 DEIS.

- **Alternative G**, which is primarily responsive to comments received on the 2016 DEIS from the U.S. Environmental Protection Agency and Washington Department of Fish and Wildlife.
- **DNR's preferred alternative (Alternative H)**, which DNR developed with direction from the board and which is responsive to comments received on the DEIS. Under this alternative, thinning is allowed in areas that are currently non-habitat and do not become habitat by the end of

Decade 5. DNR intends to submit Alternative H to USFWS in the form of an HCP amendment in support of an amendment to DNR's incidental take permit.

USFWS will specify its preferred alternative in the FEIS. Alternatives G and H are described in detail in Chapter 2 of the RDEIS.

In addition to the two new alternatives, the RDEIS includes both new analysis and updated analysis of Alternatives A through F using updated data. The analyses contained in the 2016 DEIS were based on data generated in 2015. DNR has updated its data, primarily due to an updated forest inventory and updates to its large data overlay, current as of January 2018 (the large data overlay is a complex GIS model; refer to Chapter 7 for more information). Using the updated data, DNR produced new acreages for timber harvest and conservation. DNR also used more recent vegetation height data to more accurately measure current vegetation height, which improves estimates of current edge condition and type for the marbled murrelet analysis in Chapter 4. Tables and Figures in the RDEIS have been updated to reflect these new calculations. Refer to Appendix O for a description of changes made to the data.

In Chapter 2, the descriptions of the alternatives were altered to include information on marbled murrelet habitat growth over time.

Revisions also were made to some of the conservation measures in the RDEIS, with some measures being specific to Alternative H and others applying to all action alternatives. (Conservation measures are described in Chapter 2.)

Changes made based on comments received on the 2016 DEIS include the following:

- Two special habitat areas were added near the Strait of Juan de Fuca in Clallam County under Alternative H.
- Special habitat areas in Wahkiakum and Pacific counties were made smaller to reduce adverse socioeconomic impacts under DNR's preferred alternative.
- A section called "Alternatives Considered but not Analyzed in Detail" was added to Chapter 2. This section addresses the alternatives submitted by commenters.
- A jobs analysis was added to the socioeconomic section of Chapter 4.

Also, the marbled murrelet sections of Chapters 3 and 4 have been updated to reflect strategic locations. Strategic locations are areas that the Joint Agencies view as more valuable for long-term murrelet conservation due to an abundance of habitat, close proximity to known occupied sites, and higher capability for developing future habitat based on forest types. The RDEIS also identifies other high-value landscapes and a marginal landscape. Landscapes and strategic locations are described in greater detail in Chapter 2.

Finally, a change was made to the population viability analysis in Chapter 4. In this RDEIS, just as it was in the 2016 DEIS, a P-stage value of 1 indicates an occupied site. This value was assigned in the P-stage model to all acres within an occupied site, regardless of the forest condition of those acres. For example, some occupied sites may include areas of non-habitat.

For this RDEIS, Dr. Peery and Gavin Jones modeled the actual P-stage value of all acres within occupied sites, instead of simply assigning the entire occupied site a value of 1. They also modeled the growth of forests in occupied sites over the analysis period. The Joint Agencies believe these methods result in a more accurate representation of marbled murrelet habitat and more accurately reflect an increase in nesting carrying capacity over the analysis period.

■ What Is in the Other Chapters of This RDEIS?

The other chapters of this RDEIS include the following information:

- **Chapter 2**, "The Alternatives," describes the alternatives in detail, with information about how the alternatives were developed, what conservation lands are being proposed under each alternative, conservation measures that apply to different forest management activities and land uses in the conservation areas, and data comparing the alternatives with each other.
- **Chapter 3**, "Affected Environment," describes elements of the natural and built environment likely to be affected by the alternatives and provides current conditions against which the RDEIS will evaluate potential impacts from the alternatives.
- **Chapter 4**, "Environmental Consequences," analyzes the potential impacts from the different alternatives on the elements of the environment described in Chapter 3.
- **Chapter 5**, "Cumulative Effects," provides a synthesis of the potential cumulative effects of the alternatives and other activities, actions, and trends taking place within the analysis area.
- **Chapter 6**, "Literature Cited," identifies the materials and sources referred to throughout this RDEIS.
- **Chapter 7**, "Key Definitions," defines terms used in this RDEIS.

Chapter 2

THE ALTERNATIVES

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Chapter 2

The Alternatives

In this chapter, the Washington State Department of Natural Resources (DNR) and U.S. Fish and Wildlife Service (USFWS), also referred to as the Joint Agencies, describe eight alternatives being considered for the long-term strategy, including a no action alternative. These alternatives represent a range of conservation strategies for the marbled murrelet on DNR-managed lands. Conservation measures common to all the alternatives are described. Components unique to an alternative or alternatives are compared to one another and to the no action alternative.

2.1 Developing and Screening the Alternatives

For the 2016 draft environmental impact statement (2016 DEIS), the Joint Agencies worked together to develop six alternatives to analyze, including the no action alternative. The Joint Agencies carried these alternatives forward into this revised draft EIS (RDEIS) and also added two new alternatives.

The two new alternatives in the RDEIS are Alternatives G and H. Alternative G is predominately responsive to comments received from Washington Department of Fish and Wildlife (WDFW) and the U.S. Environmental Protection Agency (USEPA). Alternative H, DNR's preferred alternative, also was developed in response to comments received on the 2016 DEIS and direction from the Board of Natural Resources (board).

Text Box 2.1.1. What Are the Main Differences Among the Alternatives?

The alternatives differ in the amount of forestland designated for marbled murrelet conservation, where conservation is located, and how conservation areas will be managed.

The alternatives cover a range of acres and configurations of forestland that DNR manages for marbled murrelet conservation. The alternatives differ in the amount of land that is designated for marbled murrelet conservation, where conservation is located, how conservation areas will be managed (refer to Section 2.3 for a descriptions of conservation areas associated with each alternative), and the amount of marbled murrelet habitat that will be removed. Development of these alternatives was informed by the scoping process described in Chapter 1and by comments received on the 2016 DEIS. Appendix A provides a summary of the scoping process and the scoping comments received.

Comments on the 2016 DEIS were used to inform the RDEIS and will be provided in the final EIS (FEIS) along with the Joint Agencies' responses. Comments and comment responses on the RDEIS also will be included in the FEIS. Chapter 1 describes the changes made to the 2016 DEIS for the RDEIS.

The alternatives were screened by the Joint Agencies for their potential ability to meet the adopted need, purpose, and objectives (refer to Chapter 1) and basic criteria under the Endangered Species Act. A discussion of how each alternative addresses the need, purpose, and objectives is included at the end of this chapter.

■ How Were the Alternatives Developed?

The Joint Agencies used an analytical framework to guide the process of developing and screening alternatives (refer to Appendix B, "Analytical Framework Focus Paper"). The framework used scientific methods to identify habitat, analyze habitat quality, calculate impacts and mitigation, and estimate marbled murrelet population impacts over the planning period. This work was used to design and compare the action alternatives.

Conservation Approaches That Were Not Developed Into Alternatives

Potential conservation approaches that did not meet the need, purpose, and objectives were not considered feasible and were not developed into alternatives. Following is a description of these approaches.

REMOVING HCP COVERAGE

One approach that did not meet the need, purpose, and objectives was removing HCP coverage for the marbled murrelet and managing instead under the forest practices rules (WAC 222) and existing DNR policies. This approach was rejected for several reasons:

- Removing HCP coverage would not provide DNR with certainty that it could meet its trust obligations through continued, sustainable timber management.
- Managing under only the forest practices rules would mean potential costly delays to the timber sale process due to required surveys of each stand for marbled murrelet occupancy (a one- to two-year process with up to 18 site visits [Evans Mack and others 2003]) and consultation[1] with USFWS each time potential impacts to habitat are identified.
- Performing the sustainable harvest calculation that DNR relies on to plan its harvest schedules would be very difficult with this level of uncertainty.
- Removing HCP coverage also would be unlikely to contribute to conservation efforts for the marbled murrelet, as DNR would not be setting aside lands to protect and grow murrelet habitat over the long term, but would instead be managing habitat on a piecemeal basis. Managing this way could foreclose future options for habitat development in areas strategically important to the bird's population.

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[1] "Consultation" refers to a joint agency agreement process, and not consultation under Section 7 of the Endangered Species Act.

CEASING TIMBER HARVEST ACTIVITIES

Ceasing timber harvest activities on state trust lands was not considered feasible as doing so would violate DNR's trust obligations set forth in state law and the need, purpose, and objectives (Objective #1; refer to Chapter 1 for a description of state trust lands).

Supplementary Analyses

Although these approaches were not considered feasible and therefore not included as action alternatives, the Joint Agencies did conduct some additional analyses on the following scenarios. These scenarios included the following:

- **No harvest of state trust lands land through the planning period or immediate removal of all DNR-managed habitat:** The board requested analysis of these scenarios to understand how these extremes would affect the marbled murrelet population (refer to Appendix C, "Population Viability Analyses").
- **Including "stringer" habitat**: This scenario involved including stringer habitat in long-term forest cover order to understand the effect this habitat might have on the population. ("Long-term forest cover" is land that provides marbled murrelet conservation through existing DNR policies, plus marbled murrelet-specific conservation areas. "Stringer" habitat is long, relatively narrow (less than 656 feet [200 meters] wide) corridors of long-term forest cover, primarily associated with riparian areas. Refer to sections 2.2 and 2.4, respectively, for more information).
- **Metering harvest of marbled murrelet habitat:** The purpose of this scenario was to model how delaying harvest of marbled murrelet habitat that DNR otherwise would be authorized to harvest upon amendment of its incidental take permit until the end of the first decade following implementation may affect the population over time.[2] Subsequent consideration of this approach led DNR to incorporate metering into DNR's preferred alternative (Refer to Section 2.3, Alternative H).
- **Including a larger buffer (492 feet [150 meters]) on occupied sites**: This analysis was requested by the board to test the sensitivity of Alternative F and how larger buffers change the balance of impacts and mitigation.[3]
- **Excluding northern spotted owl habitat from long-term forest cover**: This analysis was requested by the board to minimize overlap of the marbled murrelet strategy and the northern spotted owl conservation strategy in the 1997 HCP.

All scenarios except the last two in the preceding bulleted list were analyzed using a population viability analysis (refer to Appendix C). Similar population modeling done for the action alternatives is more fully

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[2] Analysis of stringers and metering was presented to the board on June 7, 2016.

[3] Analysis of a larger buffer and excluding owl habitat were discussed with the board on August 11, 2016.

described in Section 4.6, "Marbled Murrelet." These supplementary analyses, although not incorporated into an action alternative, informed deliberations about the alternatives.

A new population viability analysis was conducted for the RDEIS. Results are described in Chapter 4 and an updated report is included in Appendix C of the RDEIS.

Alternatives Submitted in 2016 DEIS Comments

Several comments received on the 2016 DEIS suggested new alternatives to consider in the RDEIS or FEIS. Some of these suggestions were incorporated into the two new alternatives in this RDEIS, Alternatives G and H (board directed), as explained under the alternative profiles later in this chapter. The other suggested alternatives are addressed under "Alternatives Considered but not Analyzed in detail" near the end of this chapter.

■ Why Is a Long-Term Strategy Needed Now?

Approval of a long-term conservation strategy for the marbled murrelet is timely. Active forest management is ongoing on DNR-managed lands under the interim strategy, and approving a long-term strategy will avoid foreclosing future options for protecting strategically located marbled murrelet habitat. Approving a long-term conservation strategy also will help ensure sustainable management of state trust lands. Further delay in the development of a long-term conservation strategy would mean the data used to identify habitat and model habitat growth under the proposed alternatives would become out of date, and delay also could have consequences for DNR's compliance with federal permits under the 1997 HCP.

■ How Is Marbled Murrelet Habitat Identified?

Across the analysis area, the Joint Agencies identified DNR-managed forestlands that have the characteristics of murrelet habitat and those areas that should be considered for a long-term conservation strategy.

Habitat characteristics important to the marbled murrelet include large nesting platforms[4] on mature trees, adequate canopy cover, and sufficient interior forest to provide security to nesting murrelets from predation and other forest edge effects (forest edges will be discussed later in this chapter). To identify this habitat, the Joint Agencies built upon previous survey work, habitat relationship studies, and a habitat classification model known as "P-stage" that was first developed by a team of scientists convened by DNR in 2004. (The P-stage model is explained in the following section.)

Role of the Science Team Recommendations

In 2004, DNR convened a team of professionals to compile expert opinion, data, and research on marbled murrelet habitat conservation. These specialists, known as the Science Team, completed a set of

[4] A nesting platform is a large limb or structure at least 50 feet above the ground and at least 7 inches in diameter.

recommendations in 2008 for DNR to consider when developing a long-term conservation strategy for the marbled murrelet. Entitled *Recommendations and Supporting Analysis of Conservation Opportunities for the Marbled Murrelet Long-Term Conservation Strategy* (Science Team Report [Raphael and others 2008]), the report provides a landscape-level examination of proposed conservation areas on DNR-managed lands on the Olympic Peninsula and southwest Washington (with the exception of North and South Puget HCP planning units [DNR 1997]). The analysis was built upon objectives designed to recover marbled murrelets on DNR-managed lands and did not consider DNR's fiduciary responsibility to its trust beneficiaries, with the exception of special considerations for Wahkiakum and Pacific counties. The report's recommendations were not adopted as a long-term conservation strategy or policy by the board.

For the purposes of this RDEIS, concepts from the Science Team Report were applied to the North and South Puget HCP planning units and are included in the RDEIS as Alternative F. Additionally, the report was used extensively in the development of alternatives for this RDEIS:

- The Science Team examined the relationship of the structure and composition of forest stands and their potential contribution to carrying capacity for marbled murrelets. This analysis provided a critical foundation for the habitat model referred to as "P-stage," which the Joint Agencies used to estimate the area of current and future murrelet habitat for all of the alternatives described in this chapter (refer to Text Box 2.2.2).
- The Science Team evaluated occupied sites resulting from surveys on DNR-managed lands. They addressed concerns about the accuracy of occupied site boundaries by re-delineating the boundaries of specific occupied sites as necessary (adding approximately 16,000 acres to occupied sites). The Science Team also made conservation recommendations for occupied sites surveyed under Pacific Seabird Group survey protocols released before 2003. (Refer to Raphael and others 2008 and Appendix E for more information.) The Joint Agencies used these delineations and recommendations for occupied sites in Alternatives B through H, with an exception regarding buffer width for two alternatives.
- Conservation areas recommended by the Science Team on the Olympic Peninsula and in southwest Washington are incorporated into Alternative F. This alternative also included conservation areas designed using Science Team principles in North and South Puget HCP planning units.

Occupied Marbled Murrelet Sites

Previous survey work and habitat relationship studies done by DNR under the interim strategy (referred to as "HCP survey work") resulted in the identification of 42,976[5] acres of occupied sites on DNR-managed forestlands in the analysis area. Occupied sites are habitat patches of varying size in which murrelets are assumed to nest based on field observations. Occupied sites identified through HCP survey work are

[5] The overall acreage of occupied sites is lower in the RDEIS than what was shown in the DEIS because 1) DNR corrected its old growth query and some acres of old-growth forest are now reported under existing conservation and 2) occupied site verification in the North Puget HCP Planning Unit has resulted in boundary adjustments that have reduced the size of some occupied sites. Refer to Appendix O for more information.

maintained as habitat and currently are not subject to harvest. Work by the Science Team identified an additional 16,000 acres of occupied sites, and these sites are included in all of the action alternatives. (Refer to Appendix D for a detailed description of how occupied sites were identified.)

Applying the P-stage Model

In addition to occupied sites, the Joint Agencies identified where other habitat may currently exist on DNR-managed forestlands, or where it is likely to develop during the life of the 1997 HCP. To find these areas, DNR applied the Science Team's landscape-scale habitat classification model called "P-stage." Developed for the 2008 Science Team report (Raphael and others 2008), the P-stage model uses forest inventory data such as forest type, stand origin, and stand age to estimate the location and quality of murrelet habitat (refer to Text Box 2.1.2). Habitat is assigned a P-stage value based on its quality, ranging from relatively low-quality (P-stage 0.25 to 0.36) habitat to higher-quality (P-stage 0.47 to 0.89) habitat. P-stage values increase over time as the forest grows and develops more structure suitable for nesting and secure canopy cover (refer to Figure 2.1.1). Refer to Appendix E for a detailed description of the P-stage model, including a comparison of this model with other available habitat models.

P-stage was used to inform the development of alternatives. For example, P-stage was used to identify areas that currently contain marbled murrelet habitat or that could develop into marbled murrelet habitat over the next five decades. P-stage also was used to estimate the potential impacts of habitat removal and potential mitigation of habitat retention and recruitment of each alternative. (Refer to Chapter 4 and Appendix H for a detailed description.)

In this RDEIS, the terms "marbled murrelet habitat" or "current marbled murrelet habitat" mean forest stands that have a P-stage value of at least 0.25 (refer to Text Box 2.1.3).

When designing the alternatives, the Joint Agencies considered P-stage value in concert with other information, such as proximity of the habitat to marine populations of marbled murrelets, potential for habitat fragmentation, proximity to mature forests that could provide additional security to potential nest sites, and location of neighboring conservation areas (for example, protected federal lands).

Text Box 2.1.2. What Is the P-stage Model?

The P-stage model, developed for the 2008 Science Team Report, classifies DNR-managed forestlands based on their relative value as nesting habitat, both now and into the future. The model uses DNR's forest inventory data (including forest type, stand origin, and stand age) to estimate the location and quality of murrelet habitat throughout the analysis area. Forestland is classified based on the probability it will be used for nesting by marbled murrelets. Among available habitat models, P-stage appears to work best for identifying current and future habitat on DNR-managed forestlands.

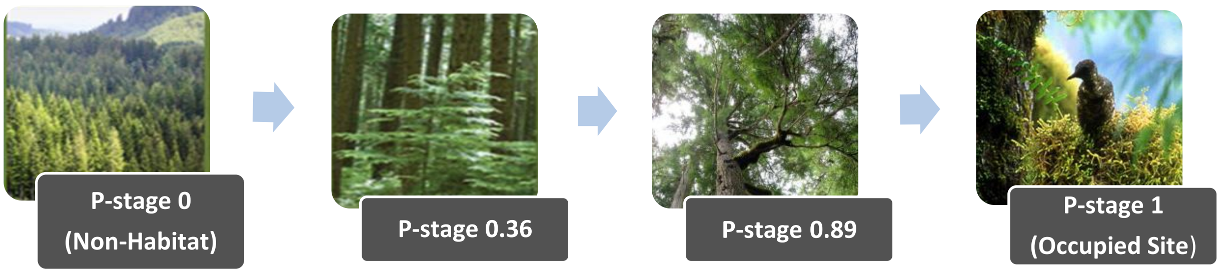
Text Box 2.1.3. Marbled Murrelet Habitat

Marbled murrelet habitat or current marbled murrelet habitat is any forest stand with a P-stage value of at least 0.25.

Future marbled murrelet habitat is any forest stand that, according to the P-stage model, develops into a stand with a P-stage value of at least 0.25 over the five-decade analysis period.

Low quality marbled murrelet habitat is any forest stand with a P-stage value of .25 to 0.36, and **high quality** marbled murrelet habitat is any forest stand with a P-stage value of 0.47 to 0.89.

Figure 2.1.1. Ascending P-stage Classes and Associated Habitat Development (P-stage 0.47 not Shown)



2.2 Elements Common to All Alternatives

The eight alternatives (a no action alternative and seven action alternatives) described in this chapter represent a range of conservation approaches for the marbled murrelet. Alternatives share a common framework: they each identify land for marbled murrelet conservation and apply conservation measures to that land. The elements common to all alternatives are described in this section.

■ How Much Land Is Designated for Murrelet Conservation?

Each alternative designates areas for conservation for the marbled murrelet, representing a range of options that are analyzed in this RDEIS. These categories are explained in the next section.

Table 2.2.1. Total Acres of Conservation by Alternative (Rounded to Nearest 1,000)

	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt G	Alt H
Acres of existing conservation under the 1997 HCP, *Policy for Sustainable Forests*, and Washington State Law	567,000	567,000	567,000	567,000	567,000	567,000	567,000	567,000
Acres of additional, marbled murrelet-specific conservation[6]	33,000	9,000	50,000	51,000	55,000	176,000	76,000	43,000

[6] Acres reported here are those which do not overlap other existing conservation lands.

	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt G	Alt H
Total approximate acres	600,000	576,000	617,000	618,000	622,000	743,000	643,000	610,000

Existing Conservation Under the 1997 HCP, *Policy for Sustainable Forests*, and Washington State Law

All alternatives include DNR-managed lands that are already deferred from harvest or otherwise conserved, meaning they are subject to existing policy or legal constraints and are excluded from variable retention harvest planning under the sustainable harvest calculation.[7] These lands are deferred from harvest or otherwise conserved under the conservation strategies in the 1997 HCP, to meet policy objectives in the 2006 *Policy for Sustainable Forests*, or in compliance with Washington state law. The strategies and policies under which these lands are managed provide long-term habitat benefits to the marbled murrelet, as described in the following section. The total amount of existing conservation is 567,000 acres, and when there is marbled murrelet habitat or security forest associated with these acres there are benefits to the marbled murrelet. (Because there is considerable overlap between the components, Table 2.2.1 does not provide acreages for the individual strategies.)

Text Box 2.2.1. Do Currently Conserved Lands Provide Habitat?

DNR-managed lands currently contain marbled murrelet nesting habitat that is conserved under the 1997 HCP or by other DNR policies. In addition, some DNR-managed lands contribute to murrelet conservation by increasing security forest or creating larger, more contiguous stands of structurally complex forest.

RIPARIAN CONSERVATION STRATEGIES

The 1997 HCP includes riparian conservation strategies to maintain or restore freshwater habitat for salmon on DNR-managed lands and to aid in the conservation of other riparian and aquatic species. There are two strategies: one for the five westside HCP planning units and another for the Olympic Experimental State Forest (OESF) HCP Planning Unit. Both strategies establish riparian management zones on all salmon-bearing streams and other streams of a certain size.[8] Both strategies specify the silvicultural treatments that can be used in riparian management zones (such as stand thinning) to speed the development of complex forests without sacrificing short-term ecosystem function. The main distinctions between the westside and OESF strategies is in how the riparian management zone is designed and what the specific management objective is to be achieved. In the westside strategy, buffer widths are set by stream type, and riparian forests are managed for a desired future condition of structural complexity including snags, down wood, and canopy layers. In the OESF strategy, buffer widths are based on both stream type and watershed analysis, and DNR manages riparian forests for riparian function (large woody debris recruitment, shade, and prevention of peak flow) at the watershed scale.

[7] The sustainable harvest calculation establishes the volume of timber to be scheduled for sale during a planning decade (RCW 79.10.300). Available at https://www.dnr.wa.gov/shc

[8] *DNR Proprietary HCP Substitution Agreement for Aquatic Resources*, 2008, Appendix 1.

Also, in the OESF, a small amount of variable retention harvest (a type of stand-replacement harvest, refer to Chapter 7) is allowed in the riparian management zone of some Type 3 watersheds. (For more information, refer to the *OESF HCP Planning Unit Forest Land Plan*.[9])

Riparian management zones in the OESF and the other westside HCP planning units are included as existing conservation lands in the alternatives analyzed in this RDEIS because they are managed to maintain forest cover on a long-term basis. Forest stands in these zones may, in some cases, provide habitat for marbled murrelets as well as insulate the habitat from other forest management activities.

DNR implements the westside riparian conservation strategy through the *Riparian Forest Restoration Strategy* (RFRS) and the OESF riparian conservation strategy through the *OESF HCP Planning Unit Forest Land Plan*.

OLD-GROWTH POLICY

The *Policy for Sustainable Forests* protects and defers timber harvests in all existing old-growth forests on forested state trust lands in western Washington as part of implementing the 1997 HCP and meeting other regulatory requirements and policy goals. Old-growth forests of 5 acres and larger that originated naturally before 1850 and are in a fully functional stage of stand development are deferred from harvest, as are very large and structurally unique trees.[10] Old-growth forests provide the types of nesting platforms used by marbled murrelets and are therefore a critical part of the overall long-term conservation strategy.

NORTHERN SPOTTED OWL STRATEGY

The 1997 HCP includes a landscape-scale conservation strategy to protect and restore habitat for the northern spotted owl in strategic locations near the Cascade Range and in the OESF on the west side of the Olympic Peninsula. Northern spotted owl habitat and marbled murrelet habitat often overlap, as both species are associated with mature and old-growth forests. The conservation objective of the HCP northern spotted owl conservation strategy in the five westside planning units is to create habitat that significantly contributes to the species' demography, distribution, and habitat contiguity by providing nesting, roosting, and foraging habitat as well as dispersal habitat in key areas. The northern spotted owl strategy for the OESF is to manage each landscape to maintain or restore threshold proportions of northern spotted owl habitat.

PROTECTION OF HABITAT FOR MULTIPLE SPECIES

As a multispecies document, the 1997 HCP employs additional strategies to ensure that uncommon habitats (such as large, structurally unique trees) are protected throughout the HCP planning units and to leave other trees (when harvests are conducted) to maintain habitat and biodiversity.

[9] Refer to https://www.dnr.wa.gov/oesf-forest-land-plan.
[10] *Policy for Sustainable Forests* (DNR 2006, p. 34).

NATURAL AREAS

Natural area preserves and natural resources conservation areas (briefly described in Chapter 1 and Chapter 3) often include mature forest habitat that is managed for long-term conservation for multiple species, including the marbled murrelet. Conservation, education, and low-impact recreation are some of the uses allowed in these areas, and harvest activities generally are not allowed.

OTHER CONSERVATION COMMITMENTS IN THE POLICY FOR SUSTAINABLE FORESTS

The *Policy for Sustainable Forests* (described in Chapter 1) provides for the identification and protection of genetic resources (stands of native trees well adapted to local conditions) and special ecological features (for example, rare ecosystem types) throughout the analysis area. These lands often contain marbled murrelet habitat or provide security forest functions or buffers to that habitat (Refer to Text Box 2.2.2).

Text Box 2.2.2. What Is Security Forest?

Security forest is a closed-canopy forested stands with trees that are greater than 80 feet tall. Located adjacent to P-stage habitat, security forest protects the habitat from edge effects including microclimate change, windthrow, and predation (Chen and others 1993, Van Rooyenand and others 2011, Raphael and others 2002, Malt and Lank 2009) and other types of disturbances.

EXISTING CONSERVATION BY TYPE

Table 2.2.2 provides a summary of the approximate number of acres providing existing multiple species conservation benefits within the analysis area. These lands form a general foundation of marbled murrelet conservation common to all of the alternatives. Some of these lands may not be forested or contain marbled murrelet habitat. But generally, when they are forested, these lands may contribute to murrelet conservation by providing security forest if next to an occupied site, or in other situations, future habitat. All acreage numbers are approximate based on current data from a variety of DNR databases.

Table 2.2.2. Designations of Types of Conservation Within the Range of the Marbled Murrelet (Rounded to Nearest 1,000; Only Non-Overlapping Acres Are Reported)

Type of conservation	Source	Approximate acres of long-term forest cover
Forested natural areas (Natural Area Preserves and Natural Resources Conservation Areas)	RCW 79.70, 79.71	89,000
Long-term conservation commitments for multiple species[11]	1997 HCP, *Policy for Sustainable Forests*	469,000

[11] Includes mostly forested habitat, with a small amount of non-forested habitat such as balds, cliffs, caves, cultural sites, historic sites, and talus slopes. These conservation commitments also include leave tree areas, inoperable areas, old growth, eagle roosts, research plots, areas of local ecological importance, riparian areas, and forested wetlands.

Type of conservation	Source	Approximate acres of long-term forest cover
Existing northern spotted owl Habitat—high-quality[12]	1997 HCP	8,000
Total		567,000[a]

[a] Throughout this RDEIS, numbers are rounded to the nearest thousand so totals may not always match.

DISPOSED LANDS

At times, DNR sells or otherwise transfers ownership or management of DNR-managed lands. Depending on the transaction agreement, a deed restriction may be placed on these lands requiring them to continue to be managed under the terms of the 1997 HCP. Disposed lands that continue the commitments of the HCP and contain current or future marbled murrelet habitat will continue to contribute to the long-term conservation strategy.[13] Although DNR receives mitigation credit (refer to Appendix H) for the disposed lands, these lands are not included in the acres of currently conserved land identified in Table 2.2.2.

Disposed lands being managed under the 1997 HCP include approximately 14,000 acres of long-term forest cover. Of these 14,000 acres, approximately 3,000 acres is marbled murrelet habitat. These 3,000 acres of habitat include 430 acres of occupied sites. Table 2.2.3 shows acres with a P-stage value receiving mitigation credit within the disposed lands.

Table 2.2.3. Acres With P-stage Value on Disposed Lands Carrying 1997 HCP Commitments

P-stage	Acres
0.25	1,069
0.36	602
0.47	155
.062	789
.089	86
1.0	429
Total	3,130

EXISTING CONSERVATION STRATEGIES AND THE MARBLED MURRELET LONG-TERM CONSERVATION STRATEGY

The existing strategies will continue, but also will be subject to the marbled murrelet long-term conservation strategy when the marbled murrelet strategy is more protective. For example, the current northern spotted owl strategy would allow harvest of high-quality northern spotted owl habitat once certain habitat thresholds are exceeded in (for example) nesting, roosting and foraging areas (although in

[12] Existing northern spotted owl high-quality habitat refers to the following DNR mapped habitat classes as of 2018: old forest, high-quality nesting habitat, and A and B habitat per the definitions in the 1997 HCP (DNR 1997, p. 12).

[13] 1997 HCP Implementation Agreement (DNR 1997, Appendix B), section 17.4.

most cases these habitat thresholds are decades from being reached). However, this high-quality habitat could not be harvested if it is in an area where such harvest is not allowed under the marbled murrelet long-term conservation strategy.

Marbled Murrelet-Specific Conservation Areas

Each alternative builds on the existing foundation of currently conserved lands described in the previous section by adding strategic conservation areas specifically for the marbled murrelet. These areas are generally referred to in the RDEIS as "marbled murrelet-specific conservation areas." These areas include occupied sites, buffers, special habitat areas[14], emphasis areas, marbled murrelet management areas, and other patches of high-quality habitat. The size of these different types of conservation areas ranges from the smallest of the existing occupied sites to the largest marbled murrelet management area. Each alternative designates one or more of these conservation areas, described as follows.

OCCUPIED SITES

Occupied sites are areas previously identified through surveys as showing signs of occupancy by murrelets (refer to Appendix D). Sites vary in size, depending on survey information, geographic location, and habitat quality. Alternative A uses those occupied sites that were identified during the HCP survey work. Alternatives B through H use occupied sites that were expanded from this original set by the Science Team Report.

OCCUPIED SITE BUFFERS

Alternative A, E, F, G, and H apply a 328-foot (100-meter) buffer to the outer extent of all occupied sites. Under alternatives C, D, and E, buffers are reduced to 164 feet (50 meters) for sites 200 acres or greater in size in the OESF HCP Planning Unit. All occupied sites in the other five planning units receive a 328-foot (100-meter) buffer. Alternative B does not apply any buffers to occupied sites.

RECLASSIFIED HABITAT IDENTIFIED UNDER THE INTERIM STRATEGY

The 1997 HCP required that DNR identify higher-quality habitat types that would receive murrelet surveys to determine occupancy (DNR 1997, p. IV.40)[15]. This habitat was called reclassified habitat. All habitat found to be occupied by marbled murrelets is protected under the interim strategy, and the majority of the un-occupied, reclassified habitat also is protected. Some habitat was released for harvest under the criteria defined in the interim strategy. Alternative A designates habitat not released under the interim strategy as long-term forest cover (defined in the next section). No other alternative specifically protects reclassified habitat.

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[14] In the draft amendment to the HCP for the marbled murrelet conservation strategy, DNR uses the term "marbled murrelet conservation area" instead of "special habitat area."

[15] Some of this habitat has not been surveyed; however, through concurrence letters from USFWS, DNR has been exempted from completing surveys. Refer to Appendix I.

SPECIAL HABITAT AREAS

Special habitat areas are designed to increase marbled murrelet productivity by reducing edge and fragmentation. In general, special habitat areas rely on the exclusion of active forest management to achieve a goal of reducing edge and fragmentation and growing new habitat over the long-term. Special habitat areas are designed to increase interior forest around occupied sites in specific geographic areas to benefit the species. Special habitat areas that include occupied site(s) also contain surrounding marbled murrelet habitat, modeled future murrelet habitat, and non-habitat that may function as security forest. Special habitat areas that do not contain occupied sites do contain high-quality current and modeled future murrelet habitat and non-habitat that may function as security forest. (Security forest provides additional protection to nesting habitat from wind, predators, and other types of disturbance.) Over the long term, additional marbled murrelet habitat is expected to develop in special habitat areas due to forest maturation.

The number of special habitat areas with associated occupied sites varies by alternative. The majority of special habitat areas have at least one marbled murrelet-occupied site within their borders, some have multiple occupied sites, and several do not contain an occupied site within their borders.

Alternatives C, D, E, G, and H designate special habitat areas, although the size and location of these areas varies by alternative (refer to Appendix F). Under Alternatives C, D, E, and G active forest management is excluded from special habitat areas to achieve the goal of reducing edge and fragmentation and growing new habitat over the long term. Under Alternative H, some thinning is allowed within special habitat areas. For example, thinning of non-habitat within occupied site buffers is allowed only to enhance or maintain security forest with windfirm canopies. Outside of occupied site buffers, thinning of non-habitat is allowed only within northern spotted owl habitat management areas with the goal of improving stands to develop into northern spotted owl habitat.

Individual special habitat areas are smaller in size than emphasis areas or marbled murrelet management areas.

EMPHASIS AREAS

The goal of emphasis areas is to protect occupied sites, reduce fragmentation, and grow new habitat over the long term in specific geographic areas to benefit the species. The majority of emphasis areas have multiple occupied sites within their borders and thus are larger than special habitat areas. In all emphasis areas, occupied sites receive a 0.5-mile buffer in which forest cover is maintained, improving and increasing the amount of security forest adjacent to the occupied sites. Emphasis areas also protect all existing habitat within their borders and have the goal of recruiting additional habitat, where the capability exists.

Emphasis areas allow some active forest management within their borders to achieve their goals. This active management includes both variable density thinning to facilitate the development of future habitat and variable retention harvest when such activities do not delay achievement of future habitat goals for the emphasis area. Alternatives C, E, and G designate emphasis areas.

MARBLED MURRELET MANAGEMENT AREAS

Marbled murrelet management area (MMMA) goals are to protect occupied sites and to increase future marbled murrelet habitat within their borders. MMMAs are larger in size than either special habitat areas or emphasis areas. MMMAs are located in geographic areas that will increase support for the species. MMMAs were originally designated in the Science Team Report, which includes maps of these areas for four of the six HCP planning units. For this RDEIS, MMMAs were added for North and South Puget HCP planning units (refer to Appendix F). MMMAs allow thinning that facilitates development of future marbled murrelet habitat. Only Alternatives F and G designate MMMAs. Some management activities are allowed in these areas, consistent with habitat development and protection.

HIGH-QUALITY HABITAT STANDS

High-quality habitat stands are existing stands of marbled murrelet habitat with P-stage values of 0.47 to 0.89. These stands are not otherwise identified as occupied sites or as part of the other conservation areas described in the preceding sections. Alternatives C, E, and G designate these habitat stands for conservation, in addition to special habitat areas and emphasis areas.

Polygons of Habitat Identified by WDFW

WDFW and USFWS conducted an analysis of DNR’s large data overlay outputs to identify areas in which the P-stage model did not identify potential existing habitat or applied a lower P-stage value than thought appropriate based on expert opinion. They used site visits and ortho-photographic imagery to conduct this analysis. The polygons identified through this analysis are only included in Alternative G.

The large data overlay is DNR’s complex geographic information system (GIS) model comprised of hundreds of individual data sources describing DNR-managed lands; refer to Chapter 7 for more information.

Current P-stage Habitat in the OESF

Alternative G includes *all* current marbled murrelet habitat in the OESF HCP Planning Unit.

Conservation Areas Comparison

Table 2.2.4 shows a comparison of acres by type of conservation area under the alternatives. Acres reported in this table are only those which do not overlap the existing conservation commitments reported in Table 2.2.2. For example, there are 43,000 (Alternative A) to 59,000 (alternatives B through H) total acres of occupied sites on DNR-managed lands, of which either 7,000 acres (Alternative A) or 9,000 acres (alternatives B through H) are not located in existing conservation areas.

Table 2.2.4. Approximate Acres of Marbled Murrelet-Specific Conservation, by Alternative (Rounded to the Nearest 1,000)

Murrelet-specific conservation acres (2016)	Alternative							
	A	B	C	D	E	F	G	H
Occupied sites	7,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Occupied site buffers	12,000	n/a	13,000	13,000	13,000	16,000	16,000	16,000
Habitat identified under interim strategy	14,000	n/a	n/a	n/a	n/a	3,000	n/a	n/a
Marbled murrelet management areas	n/a	n/a	n/a	n/a	n/a	76,000	13,000	n/a
Emphasis areas	n/a	n/a	14,000	n/a	14,000	n/a	16,000	n/a
Special habitat areas	n/a	n/a	9,000	29,000	14,000	n/a	12,000	18,000
High-quality P-stage (0.47 to 0.89) habitat patches	n/a	n/a	6,000	n/a	5,000	n/a	11,000	n/a
Existing northern spotted owl habitat—low-quality[16]	n/a	n/a	n/a	n/a	n/a	72,000	n/a	n/a
Total	**33,000**	**9,000**	**50,000**	**51,000**	**55,000**	**176,000**	**76,000**	**43,000**

■ Putting It All Together: Long-term Forest Cover

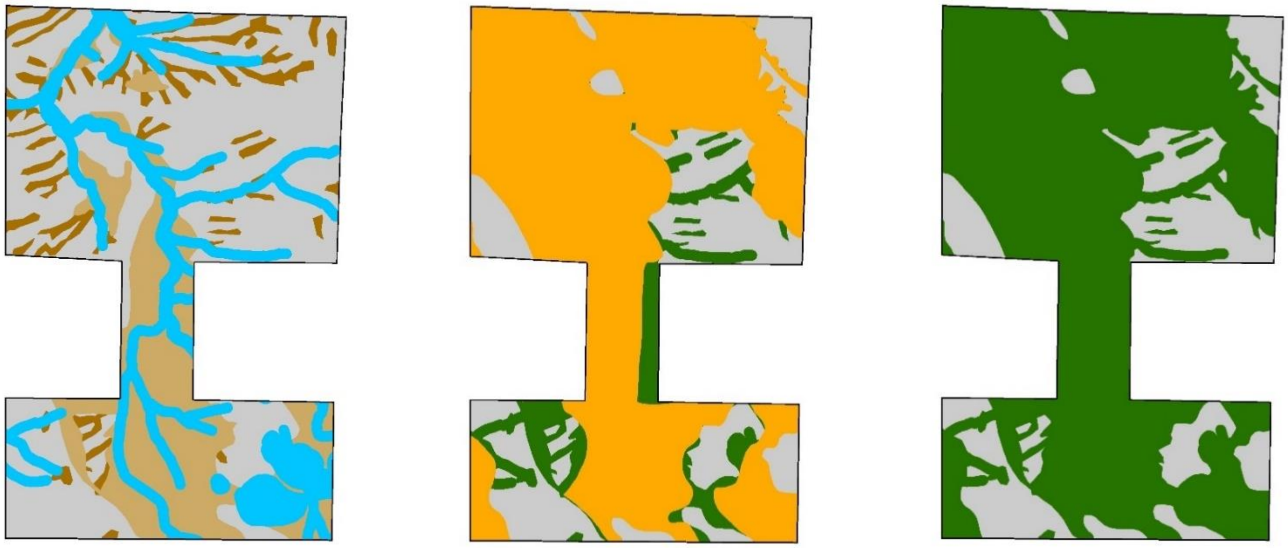
The combination of lands that provide marbled murrelet conservation through existing DNR policies (for example, riparian zones), plus marbled murrelet-specific conservation areas, provides a network of long-term forest cover for the murrelet on DNR-managed lands. Long-term forest cover means lands on which DNR maintains and grows forest cover for conservation purposes, including habitat conservation for the marbled murrelet, through the life of the 1997 HCP. (Refer to Figure 2.2.2 and Appendix G for a more detailed description of long-term forest cover.) The conservation lands included in long-term forest cover often overlap (refer to Figure 2.2.2). For example, some acres of high-quality northern spotted owl habitat also may be within a special habitat area. Summary data provided throughout the RDEIS does not double-count these overlapping acres for the purposes of assigning take or mitigation or analyzing impacts. Note that the amount of long-term forest cover that is mapped now may change over time as field inspections more accurately map lands in some categories. It is expected that these potential changes would not be significant.

Figure 2.2.2 illustrates this important long-term forest cover concept. For example, assume that the total DNR-managed acreage within the left map is 1,000 acres. The left map further identifies 200 acres in riparian areas, 100 acres in steep slopes, and 100 acres in northern spotted owl habitat. The map in the center then adds 300 acres of marbled murrelet-specific conservation, much of which overlaps these other

[16] For the purpose of this RDEIS, northern spotted owl low quality habitat refers to the following DNR mapped habitat classes as of 2018: dispersal habitat, movement plus habitat, structural habitat, sub-mature habitat, and next best stands.

areas. The map on the right combines all the different long-term forest cover designations, for a total of 700 acres of long term forest cover within the 1,000 acre block of DNR-managed land.

Figure 2.2.2. Illustration of Different Components of Long-term Forest Cover on a Block of DNR-Managed Land



Existing conservation areas: riparian (blue), steep slopes (brown), owl habitat (light brown)

+ Marbled murrelet-specific conservation areas (orange) layered on existing conservation (green)

= Long-term forest cover (green)

■ Do the Alternatives Include New Conservation Measures to Protect the Marbled Murrelet?

A variety of management and land use activities occur on DNR-managed forestlands, including lands within long-term forest cover. Some of these activities have the potential to negatively impact the marbled murrelet or its habitat.

Certain impacts to marbled murrelets can be classified as incidental take. Under the Endangered Species Act, the definition of take includes harm to a listed species.[17] The Endangered Species Act's implementing regulations define harm to include "an act which actually kills or injures wildlife. Such act 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). Incidental take as defined under the Endangered Species Act regulations is take of a listed species that results from, but is not the purpose of, carrying out an otherwise lawful activity. The harvest of marbled murrelet habitat is an example of incidental take. One approach to mitigate incidental take can be to provide habitat in other locations that offsets it temporally and spatially. The USFWS is responsible for conducting a detailed analysis of the take and mitigation prior to issuing an incidental take permit.

Existing and ongoing activities, such as use of recreation facilities and existing forest roads, are expected to continue throughout long-term forest cover, as defined in the 1997 HCP. The Joint Agencies conducted an analysis of common, ongoing forest management activities and incorporated a level of "disturbance take" into the take and mitigation framework for the long-term conservation strategy (refer to Appendix H for more information).

The Joint Agencies also identified new, intensified, or expanded forest management activities that could create new impacts to marbled murrelets through the life of the 1997 HCP, including disturbing the birds during nesting and breeding season. To address these potential impacts, the action alternatives propose new conservation measures. Most conservation measures apply specifically to marbled murrelet conservation areas. Where other HCP conservation strategies, DNR requirements or policies, or state law

Text Box 2.2.3. What Activities Occur on DNR-Managed Lands?

A variety of activities and land uses occur on the 1.38 million acres of DNR-managed forestlands in the analysis area. These activities include but are not limited to the following:

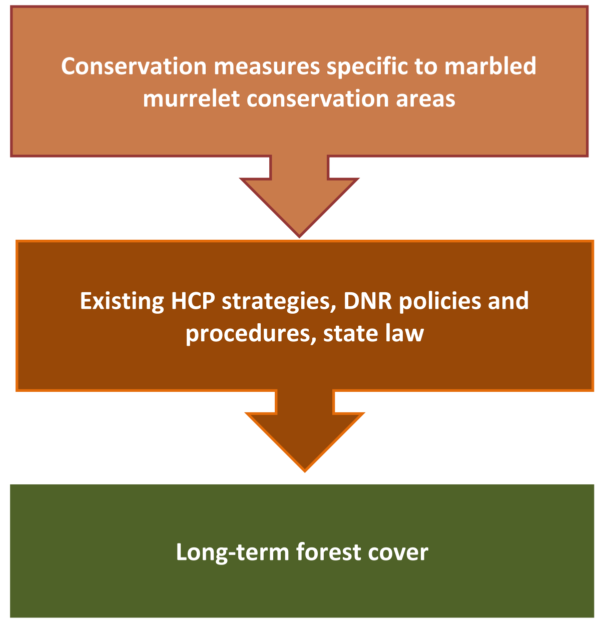
- Timber management and timber harvest
- Road building and maintenance
- Forest health treatments and salvage
- Wildfire control
- Passive and active recreation (hiking, biking, camping, hunting and fishing, off-road vehicle use)
- Leases for exploring valuable minerals and energy sources
- Development of utilities transportation corridors
- Tribal and cultural uses including collection of timber and non-timber products
- Research

The Joint Agencies took these many diverse activities and uses into account when designing conservation measures to reduce impacts to marbled murrelets.

[17] 16 U.S.C. §1532(19).

also apply to long-term forest cover, the most restrictive requirement will be followed (refer to Figure 2.2.3).

Figure 2.2.3. Hierarchy of Requirements Applicable to Long-Term Forest Cover



Alternative A, the no action alternative, does not include these proposed new conservation measures. Management and land use activities under Alternative A would instead be governed by the existing management strategies in the 1997 HCP.

■ Proposed Conservation Measures (Action Alternatives)

The following conservation measures are common to all the action alternatives, with some variation where noted in the following sections. The measures address activities that are most likely to cause impacts to nesting murrelets or their young, including activities that could attract predators or activities that generate noise.

For purposes of these conservation measures, **the nesting season is defined as April 1 through September 23** (USFWS 2013). Daily timing restrictions are used to minimize potential impacts of an activity during daily peak activity periods for the murrelet during this nesting season. The daily timing restrictions are one hour before official sunrise to two hours after official sunrise and from one hour before official sunset to one hour after official sunset.

Harvest and Harvest-Related Infrastructure and Forest Management

HARVEST

Timber harvest activities on lands located inside long-term forest cover but outside murrelet conservation areas will be consistent with the specific management objectives of those lands. Those objectives are defined by the conservation strategy or policy applicable to the land (for example, the westside riparian conservation strategy or old-growth forest policy in the *Policy for Sustainable Forests*). Variable retention harvest will be prohibited in the following:

- Occupied sites and their buffers, including the 0.5 mile buffer of occupied sites in emphasis areas
- Special habitat areas
- MMMAs (except where harvest is consistent with the Science Team recommendations for the OESF HCP Planning Unit)
- Other blocks of high-quality habitat identified by an alternative

Where different strategies overlap, the most restrictive requirement will apply (Figure 2.2.3).

THINNING AND RELATED SILVICULTURE

Thinning and related silviculture prescribed by an underlying plan or policy, such as the HCP riparian conservation strategies, *OESF HCP Planning Unit Forest Land Plan*, or natural areas management plans, will continue if these areas are not otherwise part of a designated marbled murrelet conservation area. Some thinning and related silviculture may be allowed in marbled murrelet conservation areas when those activities are consistent with maintaining murrelet habitat and providing security forest. Specific measures for thinning and silviculture are summarized in Table 2.2.5 and are described under each alternative profile in the next section.

Table 2.2.5. Thinning Requirements in Long-Term Forest Cover (LTFC)
(Variable Density Thinning or Pre-Commercial Thinning)

Element of LTFC	LTFC outside of emphasis areas, special habitat areas, and MMMAs	Emphasis areas	Special habitat areas	MMMAs
Occupied sites	Not allowed	Not allowed	Not allowed	Not allowed
Occupied site buffers	Allowed to enhance or maintain security forest with windfirm canopies	Allowed to enhance or maintain security forest with windfirm canopies	Not allowed in habitat in any alternative. Under Alternative H, allowed in non-habitat only to enhance or maintain security forest with windfirm canopies	Allowed to enhance marbled murrelet habitat with windfirm canopies
0.5-mile occupied site buffers	n/a	Allowed to enhance or maintain security forest	n/a	n/a
Current murrelet habitat	Not allowed	Not allowed	Not allowed	Not allowed
Future murrelet habitat	Allowed	Allowed	Not allowed	Allowed
Non-murrelet habitat	Allowed	Allowed	Not allowed for alternatives C, D, E and G Allowed for Alternative H and must be within a northern spotted owl habitat management area	Allowed

Element of LTFC	LTFC outside of emphasis areas, special habitat areas, and MMMAs	Emphasis areas	Special habitat areas	MMMAs
Potentially unstable slopes	Allowed consistent with geologic assessment	Allowed consistent with geologic assessment	Not allowed for alternatives C, D, E and G Allowed for Alternative H consistent with geologic assessment and to accelerate development of northern spotted owl habitat	Allowed consistent with geologic assessment
Riparian areas	Allowed consistent with riparian conservation strategies	Allowed consistent with riparian conservation strategies	Not allowed for alternatives C, D, E and G Allowed for Alternative H to accelerate development of northern spotted owl habitat	Allowed consistent with riparian conservation strategies
Northern spotted owl habitat (refer to Table 2.4.1 for northern spotted owl habitat definitions)	Allowed in low-quality owl habitat. Allowed in high quality owl habitat only if thinning maintains habitat conditions	Allowed in low-quality owl habitat. Allowed in high quality owl habitat only if thinning maintains habitat conditions	Not allowed	Allowed in low-quality owl habitat. Allowed in high quality owl habitat only if thinning maintains habitat conditions
Natural area preserves and natural resources conservation areas	Allowed consistent with management plan	Allowed consistent with management plan	Not allowed	Allowed consistent with management plan

FOREST HEALTH TREATMENTS

Forest health treatments will be allowed throughout long-term forest cover in accordance with site-specific management prescriptions, other marbled murrelet conservation measures, and state law. Daily timing restrictions during the nesting season will be followed. Prescribed burning will be kept greater than 0.25 miles from occupied sites during the nesting season.

FOREST ROADS

DNR builds and maintains forest roads throughout long-term forest cover to provide access to harvestable timber stands. These roads also are used for access to fishing, hunting, and camping sites and hiking trails; and for motorized and non-motorized recreational activities. Forest roads create forest edges, which can attract common predators of murrelet eggs and young, including Steller's jays and other corvids. Motorized vehicle use also may cause noise disturbance to nesting murrelets. Use of existing forest roads is covered by the 1997 HCP. Construction or reconstruction of forest roads in marbled murrelet conservation areas would be subject to the conservation measures in Table 2.2.6.

Table 2.2.6. Forest Road Conservation Measures for New Road Construction and Existing Road Reconstruction in Conservation Areas

Activity	LTFC outside of marbled murrelet conservation areas	Occupied sites and buffers	Emphasis areas	Special habitat areas	MMMAs
New road construction, waste area construction, or rock pit expansion	Allowed consistent with other conservation strategies and policies	Allowed under alternatives B, E, F, and H only if necessary; consult with USFWS to minimize impacts. Not allowed under alternatives C, D, and G unless otherwise required by state or federal laws or emergency (for example, a culvert or bridge replacement)	Allowed consistent with other conservation strategies and policies, refer to restrictions for occupied sites and buffers	Allowed under alternatives E, F, and H only if necessary; consult with USFWS to minimize impacts. Not allowed under alternatives C, D, and G unless otherwise required by state or federal laws or emergency (for example, a culvert or bridge replacement).	Allowed consistent with other conservation strategies and policies, refer to restrictions for occupied sites and buffers
Road reconstruction	Allowed consistent with other conservation strategies and policies	Allowed only if necessary; consult[17] with USFWS to minimize impacts. Must meet forest practices road standards. If within 328 feet (100 meters) of an occupied site, must follow daily timing restrictions if the activity takes place within the nesting season.			

Activity	LTFC outside of marbled murrelet conservation areas	Occupied sites and buffers	Emphasis areas	Special habitat areas	MMMAs
Road decommissioning and abandonment	Allowed consistent with other conservation strategies and policies	Allowed. If within 328 feet (100 meters) of an occupied site, must follow daily timing restrictions if the activity takes place within the nesting season.			

HARVEST-RELATED INFRASTRUCTURE

The building and installation of infrastructure needed for harvest activities are limited in conservation areas as follows:

- Tailholds, guylines, and rigging in occupied sites must be installed outside the nesting season. In occupied sites, occupied site buffers, and special habitat areas, impacts to platform trees from tailholds, guylines, and rigging must be avoided when possible.
- New landings are prohibited in occupied sites, occupied site buffers, and special habitat areas under Alternatives A through G. Under Alternative H, landings are allowed in occupied sites and occupied site buffers when no other location is feasible, however if the landing is within habitat, DNR will consult with USFWS to minimize and mitigate impacts. Landings should be avoided in other conservation areas; otherwise, landings should be installed outside the nesting season or follow daily timing restrictions if installing during nesting season. Landing installation will minimize removal of platform trees and require approval by the DNR regional manager in the region in which the installation takes place.
- Yarding corridors should not be located in conservation areas unless no other route is feasible. If a yarding corridor through an occupied site or special habitat area is deemed necessary, DNR will consult with USFWS.

Refer to Chapter 7 for definitions of common logging terms such as tailholds and yarding.

SALVAGE AND RECOVERY

Sometimes, natural disturbance events such as a wind event can result in forest stands being blown down or otherwise damaged or killed. Salvage and restoration within marbled murrelet-specific conservation areas may occur under the proposed alternatives, if such action will contribute to the recovery of habitat or security forest. Salvage or recovery will require a site-specific restoration plan prepared with input from the region's wildlife biologist. Salvage must take place outside the nesting season when feasible. When not feasible, the activity will follow daily timing restrictions. If standing platform trees must be removed, DNR will consult with USFWS. DNR may conduct reforestation or regeneration activities after salvage consistent with the site-specific marbled murrelet habitat restoration plan. These activities may include silvicultural treatments such as site preparation and vegetation management.

Noise-Generating Activities

In 2013, USFWS published a biological opinion (USFWS 2013) that contained an analysis of noise-generating activities with the potential to disturb or disrupt nesting marbled murrelets. The action alternatives were designed with consideration of the analytical approach used in the 2013 biological opinion and include the following conservation measures as a result.

BLASTING

Impulsive noise can negatively impact murrelets (USFWS 2013) by affecting the hearing of the young or adults and/or disrupting normal nesting behaviors. Blasting of hard rock materials occurs throughout DNR-managed lands, associated either with DNR's own rock pits (sources of material for road building and maintenance), road construction activities, or resource extraction from leased rock pits. Two different conservation measures are proposed to address potential impacts from blasting in long-term forest cover (refer to Table 2.2.7).

Table 2.2.7. Conservation Measures to Address Blasting Impacts
(Associated With Forest Road Construction, Maintenance, or Extraction of Valuable Materials)

Alternatives B, E, and F	Alternatives C, D, G, and H
If needed during the nesting season, blasting is allowed within the following, but DNR will consult with USFWS to avoid, minimize, and mitigate impacts to murrelet nests. • Special habitat areas • The 0.5-mile buffer of occupied sites within emphasis areas • 0.25 mile of occupied sites	During the nesting season, blasting is prohibited within the following: • Occupied sites • Occupied site buffers • Special habitat areas • The 0.5-mile buffer of occupied sites within emphasis areas • 0.25 mile of occupied sites

CRUSHING AND PILE-DRIVING

Within 360 feet (110 meters) of occupied sites, crushing and pile-driving activities will take place outside the nesting season when feasible; if the activity must take place during the nesting season, it must follow daily timing restrictions.

AERIAL ACTIVITIES

Low-flying airplanes and helicopters are operated or contracted by DNR for a number of activities in or adjacent to marbled murrelet conservation areas, including aerial spraying of herbicides or fertilizers to prepare sites or manage vegetation, helicopter logging operations, maintenance of communication towers, and road and trail maintenance such as bridge replacement. Under some circumstances, aircraft overflights can disrupt the normal nesting behaviors of marbled murrelets. To reduce the likelihood of those potential impacts, all action alternatives except Alternative H apply the USFWS-recommended disturbance distance buffers during the nesting season from occupied sites, special habitat areas, and the 0.5-mile buffer of occupied sites in emphasis areas as follows:

- **Chinook 47d helicopters**: 265 yards or less
- **Boeing Vertol 107, Sikorsky S-64 (SkyCrane) helicopters**: 150 yards or less
- **Other small helicopters and fixed-wing aircraft**: 110 yards or less

Alternative H applies the USFWS-recommended disturbance distance buffers during the nesting season to occupied sites.

Aerial application of herbicides will follow daily timing restrictions during the nesting season.

Recreation

A wide variety of recreational activities occur on DNR-managed lands. Existing recreation is covered under the HCP as a *de minimis* use, and DNR regularly consults with USFWS for new activities that could potentially impact murrelet habitat. The action alternatives propose three approaches to avoid, minimize, and mitigate the impacts from *new or expanded* recreation activities for the murrelet as follows:

Table 2.2.8. Conservation Measures to Address Recreation Impacts

(Recreation Facilities, Trails and Leases Include New or Expanded Facilities, Such as Campgrounds, Day Use Areas, Sno-park Sites, and Trailheads; New or Expanded Motorized Trails; and New or Expanded Non-motorized Trails)

Alternative	Conservation Measure
Alternative H	Existing facilities, trails, and recreation leases are allowed within occupied sites, occupied site buffers, and special habitat areas. All proposed new or expanded recreation facilities, trails, and recreational leases in occupied sites, occupied site buffers, and special habitat areas will be evaluated by DNR for potential murrelet habitat impacts, including potential removal of habitat and disturbance to nesting birds from facility or trail development or use in these areas. If impacts are identified, and DNR decides to pursue these activities, DNR will consult with USFWS. Facility or trail siting and design may be restricted or conditioned by the agencies to avoid, minimize, and mitigate murrelet impacts. Conversion of any existing non-motorized trails to motorized use within these areas is prohibited. DNR may decommission or abandon illegal trails in occupied sites, occupied site buffers, and special habitat areas. Maintenance or improvements is allowed within the footprint of existing facilities, trails, trailheads, and recreational leases within occupied sites, occupied site buffers, and special habitat areas (including upgrades to deal with health and safety or environmental damage). These activities should take place outside the nesting season, or following daily timing restrictions during the nesting season.
Alternatives B, E, and F	All proposed new or expanded recreation facilities, trails, and recreational leases in special habitat areas and MMMAs occupied sites and their buffers, including the 0.5-mile occupied site buffer within emphasis areas, will be evaluated by DNR for potential murrelet habitat impacts,

Alternative	Conservation Measure
	including potential removal of habitat and disturbance to nesting birds from facility or trail development or use in these areas. If impacts are identified, and DNR decides to pursue these activities, DNR will consult with USFWS. Facility or trail siting and design may be restricted or conditioned by the agencies to avoid, minimize, and mitigate murrelet impacts. Routine maintenance, as well as maintenance and improvements to facilities and trails located in these areas, is allowed to deal with health, safety, or environmental issues. Illegal facilities and trails may be decommissioned or abandoned within murrelet habitat. All construction, decommissioning, and maintenance activities within occupied sites, buffers, special habitat areas, or MMMAs shall follow daily timing restrictions during the nesting season, or take place outside the nesting season when feasible.
Alternatives C, D, and G	No development of any new or expanded recreation facilities, trails, and recreational leases is allowed in special habitat areas, occupied sites, or their buffers, including the 0.5-mile occupied site buffer within emphasis areas. Conversion of any existing non-motorized trails to motorized use is prohibited within these areas. DNR, in consultation with USFWS, may decommission or abandon illegal trails in these areas. Maintenance or improvements are allowed within the footprint of existing facilities, trails, and recreational leases within special habitat areas, emphasis areas, and occupied sites and buffers (including upgrades to deal with health and safety or environmental damage). These activities should take place outside the nesting season, or following daily timing restrictions during the nesting season.

Other Non-Timber Harvest Land Uses

In addition to the activities described in the preceding sections, DNR-managed lands accommodate uses that have the potential to result in impacts to nesting murrelets or removal of potential murrelet habitat. For all action alternatives, the following conservation measures are proposed to avoid, minimize, and mitigate potential impacts from non-timber harvest activities.

EASEMENTS AND RIGHTS-OF-WAY

DNR grants easements and rights-of-way for federal and non-federal projects (for example, utility corridors, public roads, or private road access to inholdings). Easements are subject to the conditions of their contracts and the 1997 HCP and are not affected by the alternatives in this RDEIS.

LEASES AND CONTRACTS

DNR grants leases, contracts, and special use permits on its lands to external parties for a variety of activities, including valuable materials sales, oil and gas exploration, mining and prospecting, recreational events, communications facilities, and other special uses. Contracts and leases are subject to the conditions of their contracts and the 1997 HCP and are not affected by the alternatives in this RDEIS.

RESEARCH

Non-invasive research will be allowed in long-term forest cover at all times. Invasive activities (those causing prolonged audiovisual disturbance or involving heavy equipment) must occur outside the nesting season within conservation areas and current and future habitat in long-term forest cover. Cutting of trees for research purposes is prohibited in conservation areas and current and future habitat in long-term forest cover, unless approved by both DNR and USFWS.

EMERGENCY OPERATIONS

All fire suppression activities, including aerial fire operations and aircraft, are allowed in long-term forest cover following "minimum impact suppression tactics" guidance.[18]

Other Forest Management Activities

For activities not listed in this section, DNR will follow the existing language of the 1997 HCP and the 1997 HCP Implementation Agreement.

■ How Will New Conservation Measures be Applied to Lands Already Managed Under an Existing HCP Strategy, Law, or Policy?

Management of lands already deferred from harvest or otherwise conserved will generally continue under their governing laws, policies, and management strategies as described earlier in this chapter. The 1997 HCP defines what levels of activity are *de minimis* or otherwise covered (DNR 1997, p. IV.191 through 210). Under Alternative A, the no action alternative, the current 1997 HCP, and subsequent concurrence letters (refer to Appendix I) define how forests are managed for conservation purposes. DNR frequently consults with USFWS on management activities that could impact marbled murrelet habitat.

If, as described in the preceding section, a marbled murrelet conservation area with special conservation measures overlaps one of these existing deferred lands, then the most restrictive measure will apply. If, for example, a new road would be allowed through a riparian management zone in accordance with the RFRS but there is a restriction on road building through an occupied site within that riparian management zone (as in Alternatives C and D), road building would avoid that occupied site. Conversely, if some riparian harvest is allowed under the RFRS, and the land is not otherwise designated as murrelet habitat, the harvest may proceed, with mitigation provided.

[18] Refer to *NWCG Guidance on Minimum Impact Suppression Tactics*, 2003.

What Happens Outside Long-Term Forest Cover?

Forestlands outside long-term forest cover will continue to be managed per DNR policies and rules, including the 1997 HCP, sustainable harvest calculation, forest practice rules, and other state and federal laws (refer to Chapter 1). Once the board approves a final HCP amendment that includes a long-term marbled murrelet conservation strategy and amended incidental take permit from USFWS, all DNR-managed lands within the planning area will be subject to the incidental take permit. Any harvest of murrelet habitat in areas outside of long-term forest cover will be considered potential incidental take that is mitigated by habitat within long-term forest cover (now and in the future) and other marbled murrelet-specific conservation approaches through the life of the 1997 HCP. Section 2.4 and Chapter 4 summarize potential impacts and mitigation expected under each alternative.

Text Box 2.2.4. Is All Forestland Outside Long-term Forest Cover Subject to Harvest?

Not necessarily. The sustainable harvest calculation (refer to Chapter 1) determines the harvest level for lands that are not otherwise deferred by state law or DNR policy, including the 1997 HCP. There are many constraints on harvest, including policies that require hydrologic maturity or protect habitat for other species. Operational costs also affect where and when a harvest will occur.

2.3 Profiles of the Alternatives

This section describes each alternative in detail. Descriptions will focus on the location, composition, distribution, and quality of marbled murrelet conservation among the HCP planning units in the analysis area.

Location

In the following section, maps showing where long-term forest cover is located, as well as the location of any murrelet-specific conservation areas (for example, special habitat areas), are provided at the scale of the entire analysis area. Appendix F includes maps for each planning unit or at smaller scales when necessary. The maps provided in this section were created using DNR geographic information system GIS data from 2018. The polygons drawn to represent the boundaries of long-term forest cover are based on the best estimates of the location of these areas for purposes of environmental analysis. These maps are built with the expectation that the final marbled murrelet long-term conservation strategy that the board adopts and USFWS evaluates for the HCP amendment will include more precisely refined polygons.

■ Where Are Strategic Locations for Marbled Murrelets?

For Alternatives C through H, DNR-managed lands can be segregated into two types of landscapes: high value landscapes and marginal landscapes. The high value landscapes can be further separated into strategic locations and other high value landscapes.

Strategic locations are geographic areas within Washington that the Joint Agencies view as having a disproportionately high importance for murrelet conservation. These areas are important for one or more of the following reasons:

- Proximity to marine waters (within 40 miles), including proximity to marine "hotspots" (Raphael et al. 2015), which are areas with higher-than-average murrelet density
- Proximity to known occupied sites
- Abundance of habitat
- Abundance and distribution of occupied sites
- Capacity for developing future habitat based on forest types
- Protection from disturbance
- Proximity to federal lands

The Joint Agencies identified strategic locations for the marbled murrelet through the process of developing the analytical framework for the long-term conservation strategy (refer to Appendix B) and DNR's preferred alternative (Alternative H). The strategic locations are as follows (Refer to Figure 2.3.1):

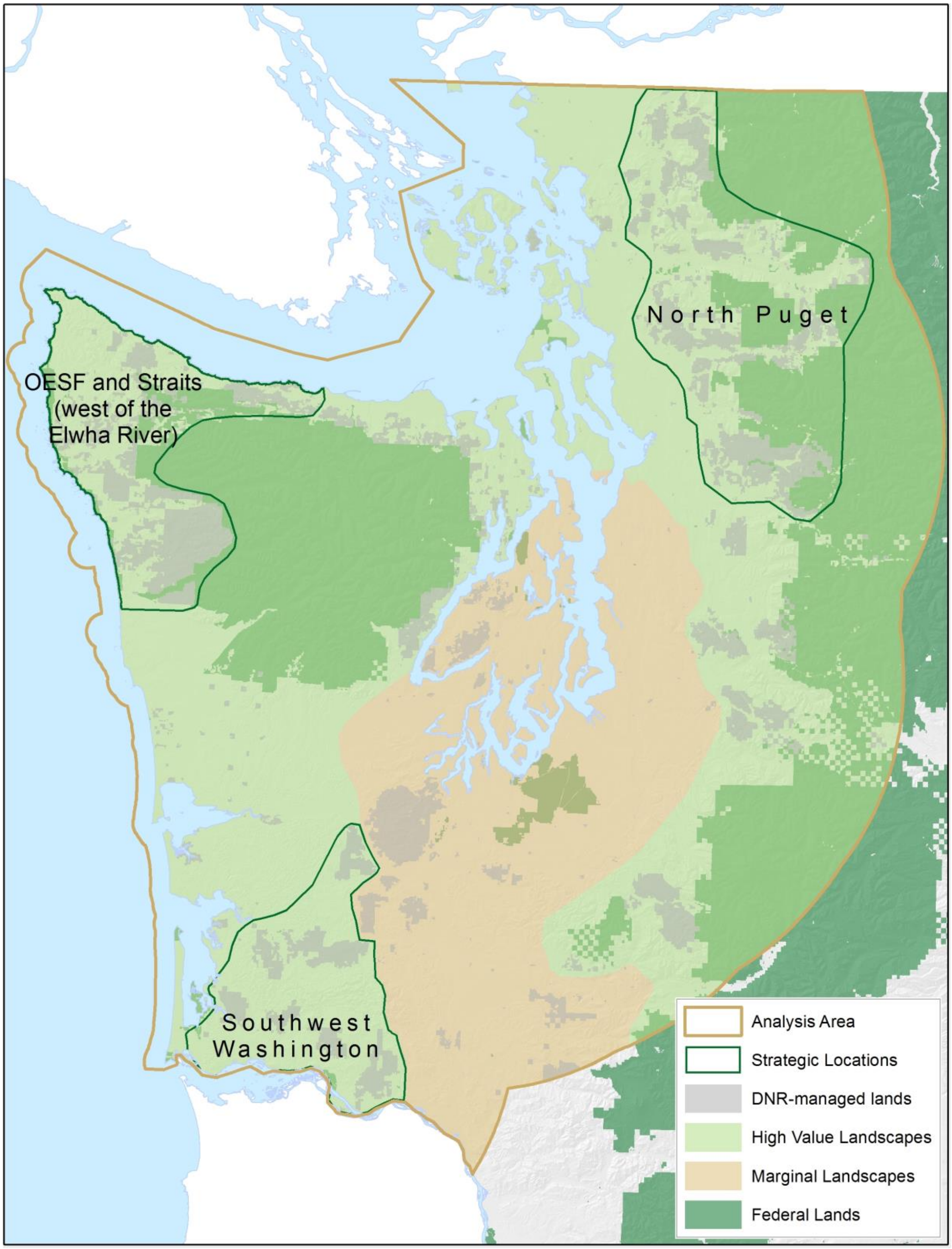
- Southwest Washington
- OESF and Straights (west of the Elwha River)
- North Puget

Strategic locations were identified based on the specific characteristics of each geographic location:

- The Southwest Washington strategic location captures areas that are in close proximity to marine waters, but where federal ownership is lacking.
- The OESF and Straits west of the Elwha River strategic location contains an abundance of high quality habitat, is in close proximity to marine waters, and also is close to areas identified by Raphael and others (2015) as "marine hot spots."
- The North Puget strategic locations provides forested landscapes within commuting distance to nest sites from marine foraging areas around the San Juan Islands, which were identified by Raphael and others (2015) as "hot spots" due to heavy murrelet use and prey availability.

The OESF and Straits west of the Elwha strategic location and the North Puget strategic location contain the most acres of land contributing to marbled murrelet conservation.

Figure 2.3.1 Landscapes and Strategic Locations for the Marbled Murrelet



The 1997 HCP did not reflect these strategic locations because insufficient information was available on the murrelet at that time. Instead, the 1997 HCP subdivided DNR-managed lands into ecological units called "HCP planning units." These planning units were delineated by clustering Water Resource Inventory Areas that drain to common water bodies. HCP planning units encompass all DNR-managed lands covered by the 1997 HCP, but do not emphasize strategic locations for the marbled murrelet specifically. Refer to Figure 1.3.1 for a map depicting the HCP planning units.

Other high value landscapes may also contain important marbled murrelet habitat and are located within 3 miles (five kilometers) of an occupied site.

Marginal landscapes are less valuable for long-term marbled murrelet conservation. To define marginal murrelet landscape, the Joint Agencies considered multiple factors:

- Areas that are further than three miles (five kilometers) from known occupied sites
- Areas with fewer observations of murrelet nesting behavior
- Areas that are further from murrelet critical habitat on federal lands
- Current habitat distribution
- Areas with diminished capability for developing future habitat

There is only one marginal landscape identified in the RDEIS (Figure 2.3.1). This marginal landscape include more than 224,000 acres of DNR-managed lands located primarily in the Puget Trough lowlands from the Kitsap Peninsula south to the Columbia River (refer to Figure 2.3.1). This landscape currently contain low amounts of murrelet habitat (about two percent) in small, scattered patches; is located further than three miles (five kilometers) from any known occupied murrelet sites; and has a relatively low capacity for developing future habitat within the life of the 1997 HCP.

An example of what makes this landscape marginal for marbled murrelet habitat is Capitol State Forest, a large block of DNR-managed land within the landscape. Capitol State Forest encompasses more than 95,000 acres of DNR-managed lands, but currently contains relatively little murrelet habitat (less than 2,000 acres). DNR conducted marbled murrelet surveys at more than 450 survey stations located within Capitol State Forest. Murrelet presence was detected at only one survey station, and no murrelet occupancy behaviors were observed during any of the surveys. Capitol State Forest has been intensively managed for timber production for many decades, and is comprised of forest dominated by second-growth Douglas-fir plantations, which have a low capability to develop into murrelet habitat during the life of the 1997 HCP. Due to the limited and fragmented nature of habitat in Capitol State Forest, and no known occupied murrelet sites, the Joint Agencies consider Capitol State Forest to be marginal for murrelet conservation.

Quality and Quantity of Habitat

Long-term forest cover includes both habitat (forested areas with a P-stage value) and non-habitat. Non-habitat might be young or immature forest that may not develop into habitat through the life of the 1997 HCP, but still provides security to habitat by buffering interior forest stands from predation, wind, and other disturbances. Some areas of non-habitat in the first decade of the analysis period will mature into habitat by the final decade of the 1997 HCP. The quality of habitat (measured by P-stage value) also improves over time within long-term forest cover.

Under every alternative, more habitat becomes available through the life of the 1997 HCP.

Text Box 2.3.1. Does More Habitat Develop Over Time?

Yes. Under every alternative, more and higher-quality nesting habitat becomes available through the life of the 1997 HCP as forests grow and mature within long-term forest cover.

Alternative Descriptions

The following section contains a description of each of the alternatives. For each alternative, a description of amount of long-term forest cover, types of conservation areas included, and acres of both marbled murrelet specific and total murrelet habitat are provided. Each alternative description also includes a chart showing starting and final decade habitat by landscape and a map showing the conservation areas for that alternative. As described in Section 2.2 and shown in Table 2.2.1, there are 567,000 acres of existing conservation common to all of the alternatives.

Alternative A

Alternative A is the no action alternative. It continues DNR operations as authorized under the 1997 HCP and incidental take permits for all of the west-side planning units. It conserves habitat identified under the HCP interim strategy and also continues implementation of the 1997 HCP as described in subsequent joint concurrence letters for marbled murrelet conservation. This alternative includes approximately **600,000** acres of long-term forest cover, with specific murrelet conservation lands that include the following:

- All HCP-surveyed occupied sites, with 328-foot (100-meter) buffers
- All reclassified habitat in the OESF HCP Planning Unit
- Resumption of inventory surveys where they were not completed
- All reclassified habitat in the Straits, South Coast, and Columbia HCP planning units that has not been identified as "released" for harvest under the interim strategy
- In the North Puget and South Puget HCP planning units, all suitable habitat that has not been identified as "released" for harvest subject to the 2007 and 2009 concurrence letters, all newly identified habitat, and all potential habitat.[19] Refer to the following section for further information on this habitat.

Table 2.3.1 provides a summary of marbled murrelet conservation acres and total conservation acres under Alternative A.

Table 2.3.1. Marbled Murrelet-Specific Conservation Acres, Acres in Existing Conservation, and Total Acres by Conservation Area Type in Long-term Forest Cover, Alternative A

Type of conservation area	Marbled Murrelet Specific Conservation Acres (estimated)	Acres in Existing Conservation by Conservation Area Type	Total Acres in each Conservation Area Type
Occupied sites	7,000	36,000	43,000
Occupied site buffers	12,000	16,000	28,000
Habitat identified under the interim strategy	14,000	72,000	86,000
Total acres	33,000	n/a	n/a

[a] Total conservation acres cannot be summed because there is overlap between the types of conservation areas.

[19] The P-stage model was not used under the 1997 HCP to identify habitat. To allow Alternative A to be compared with the action alternatives, the P-stage model was applied to North and South Puget planning unit habitat to approximate suitable habitat located in these planning units.

FOREST MANAGEMENT UNDER THE NO ACTION ALTERNATIVE

Timber harvest in and adjacent to occupied sites is limited under the no action alternative, but these limits vary by HCP planning unit. Common elements to all HCP planning units include the following:

- All HCP-surveyed occupied sites are deferred from harvest.
- 328-foot (100 meter) buffers are applied to all occupied sites.
- Daily timing restrictions may be applied for forest management activities during the critical nesting season adjacent to all occupied sites. (These restrictions are evaluated on a case-by-case basis.)
- Forests in the OESF HCP planning unit will be managed under the OESF forest land plan.

HOW IS MURRELET HABITAT DEFINED UNDER THE INTERIM STRATEGY?

Depending on the planning unit, the interim strategy identifies areas of "reclassified habitat" and "potential" or "suitable habitat" for marbled murrelet conservation. For the four westernmost planning units, habitat types were designated based on habitat relationship studies in which DNR collected a wide variety of forest data from 54 study plots located in stands with a range of habitat quality characteristics. DNR then surveyed each of these plots to determine which were occupied by marbled murrelets and used that relationship between forest characteristics and occupancy to predict occupancy across the west side using a habitat relationship study predictive model (Prenzlow Escene 1999). DNR sorted the acres identified by the model to determine habitat quality from low to high. As explained earlier in this chapter, higher-quality habitat types that would receive murrelet surveys to determine occupancy (DNR 1997, p. IV.40) were called reclassified habitat.

Southwest Washington, the OESF, and the Straits Planning Units

All reclassified habitat within the OESF and Southwest Washington, defined as those portions of the Columbia and South Coast HCP planning units west of Interstate 5 and that portion of the South Coast planning unit south of Highway 8 and south of Highway 12 between the towns of Elma and Aberdeen, is deferred from harvest. Reclassified habitat in Straits, the northwestern portion of South Coast, and the far eastern portion of the Columbia HCP planning unit *is* available for harvest if 50 percent of the habitat will remain within the watershed administrative unit and if the habitat is greater than 0.5 mile from an occupied site. Per Step 4 of the interim strategy DNR has, on a case by case basis, released for harvest reclassified habitat in the area where this release is allowed.

North and South Puget Planning Units

In the North and South Puget HCP planning units, the habitat relationship study predictive model did not accurately predict habitat. An alternative approach to using this model was developed by the Joint Agencies in 2007 and 2009 in "concurrence letters." These concurrence letters (Appendix I) established a stepwise process for how murrelet habitat is identified and managed in the North and South Puget HCP planning units. Habitat meeting the definition of "suitable habitat" that has not been surveyed for marbled murrelet presence is deferred from harvest. Suitable habitat is defined as a forested area 5 acres in size or larger with at least two platforms per acre and within 50 miles of marine waters.

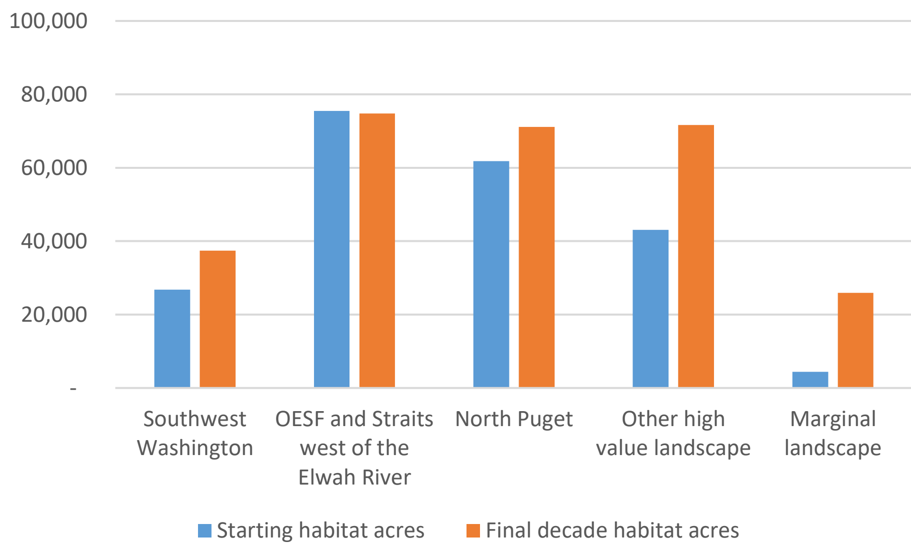
All un-surveyed suitable habitat is protected with a 300-foot managed buffer, or a 165-foot no-touch buffer until surveys are complete.[20] Once surveys are complete, buffers and timing restrictions on forest management activities are not required for areas found to be unoccupied by murrelets. Surveyed suitable habitat within the North Puget HCP planning unit can be released for harvest if 50 percent of the habitat will remain within the watershed administrative unit, and if the habitat is greater than 0.5 mile from an occupied site.

For all new forest management activities, DNR will screen project areas to locate and conserve newly identified suitable habitat. Newly identified suitable habitat is managed slightly different from known suitable habitat. Prior to adoption of a long-term conservation strategy, any newly identified suitable habitat will not require buffers or harvest timing restrictions. Unique to the North Puget HCP planning unit, limited road construction or yarding corridors are allowed within low-quality, newly identified suitable habitat if, after survey, the site is not found to be occupied.

HABITAT COMPOSITION AND DISTRIBUTION

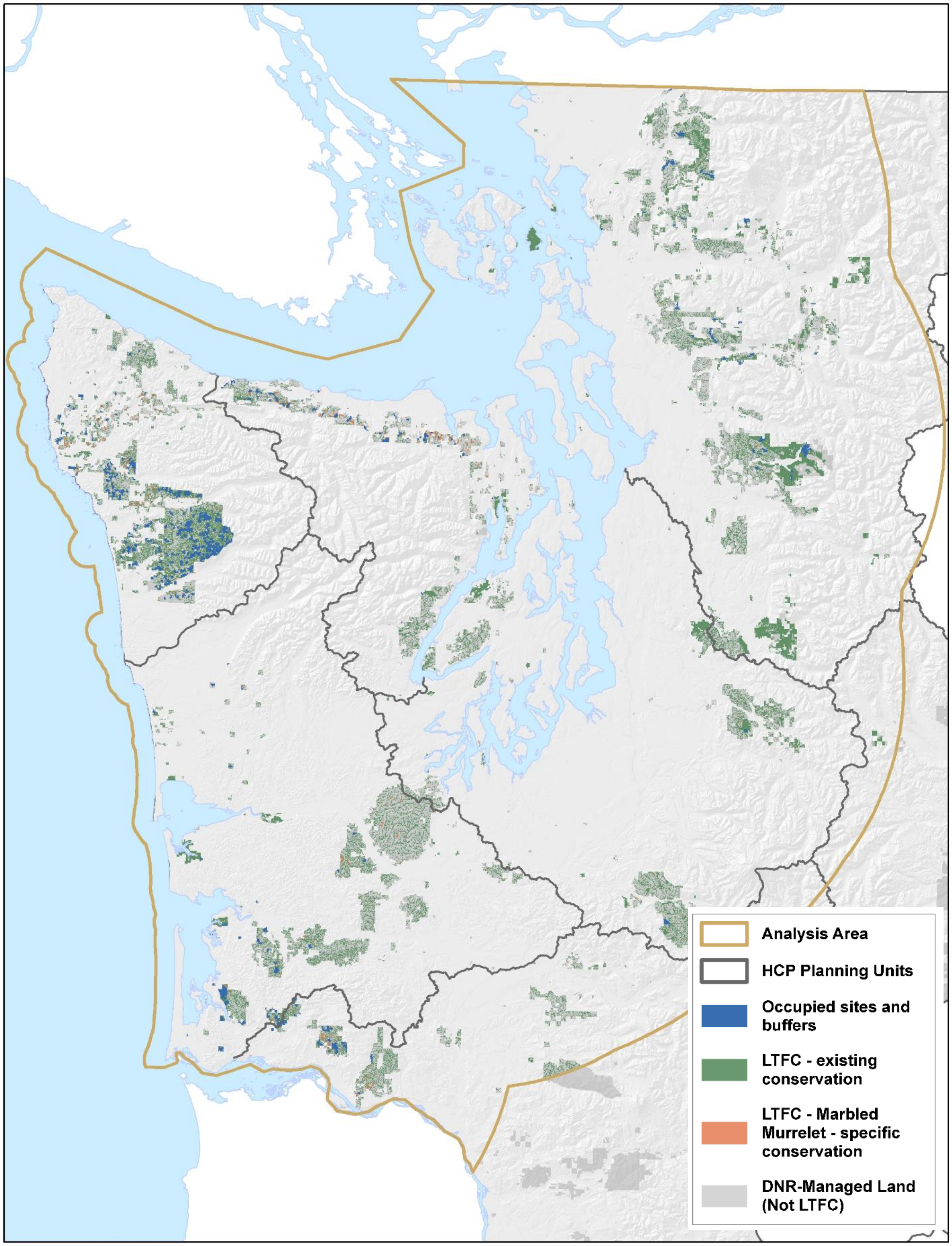
Figure 2.3.2 depicts the quantity of habitat (acres of land with a P-stage value) at the beginning of the planning period (2015) compared with the final decade of the planning period (beginning 2057). In order to compare Alternative A with the other alternatives, this information is reported by landscapes instead of HCP planning unit.

Figure 2.3.2. Habitat Growth by Strategic Location and Landscape, Alternative A



[20] WAC 222-16-080(1)(h)(v).

Figure 2.3.3. Habitat Location, Alternative A



Alternative B

Alternative B focuses on protecting the known locations of marbled murrelet-occupied sites on DNR-managed lands. Under this alternative, long-term forest cover totals approximately **576,000** acres and includes occupied sites delineated by the Science Team recommendations, as well as occupied sites identified by DNR staff in the North and South Puget HCP planning units (Table 2.3.2). Table 2.3.2 also shows acres of habitat in existing conservation and total acres of habitat by conservation type (occupied sites in this alternative) under Alternative B. This alternative is the only one that does not provide buffers on occupied sites. Harvest and thinning would be prohibited in occupied sites. Impact exceeds mitigation by 6,325 adjusted acres[21] (refer to Table 4.6.5).

Table 2.3.2. Marbled Murrelet-specific Conservation Acres, Acres in Existing Conservation, and Total Acres by Conservation Area Type in Long-term Forest Cover, Alternative B

Type of conservation area	Marbled Murrelet Specific Conservation Acres (estimated)	Acres in Existing Conservation by Conservation Area Type	Total Acres in each Conservation Area Type
Occupied sites	9,000	50,000	59,000
Total	9,000	n/a	n/a

[a] Total conservation acres cannot be summed because there is overlap between the types of conservation areas.

HABITAT COMPOSITION AND DISTRIBUTION

Figure 2.3.4 depicts the quantity of habitat (acres of land with a P-stage value) at the beginning of the planning period (2018) compared to the final decade of the planning period (beginning in 2057). The figure also illustrates the distribution of habitat acres among the landscapes. Although Alternative B contains the lowest total number of acres of habitat among the alternatives, the amount of habitat conserved still increases over time.

[21] In calculating the balance between take and mitigation, the Joint Agencies "discount" or "adjust" acres of habitat for factors that influence the benefit of habitat to murrelets, for example whether the acres are in an edge condition, where they are located on the landscape, when the new habitat development occurs, and whether the habitat is subject to disturbance. Refer to Appendix H for more information.

Figure 2.3.4. Habitat Growth by Strategic Location and Landscape, Alternative B

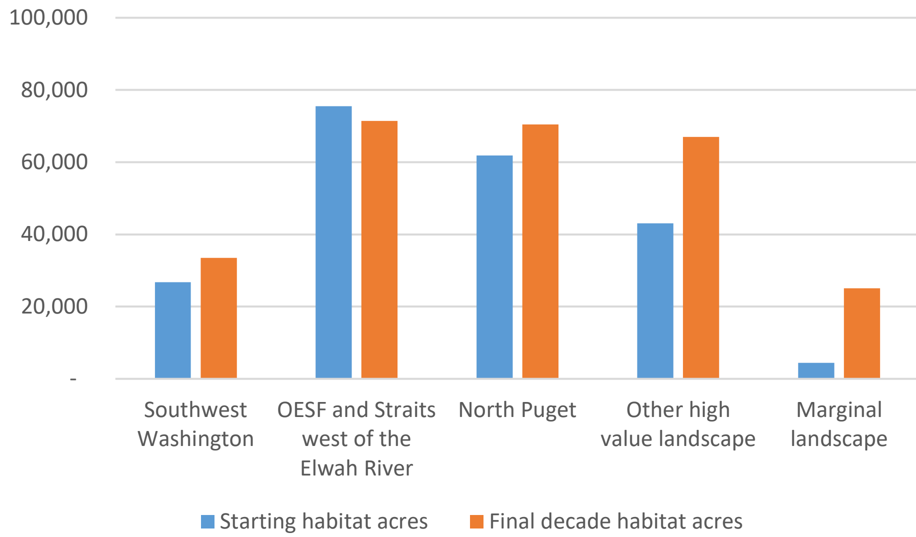
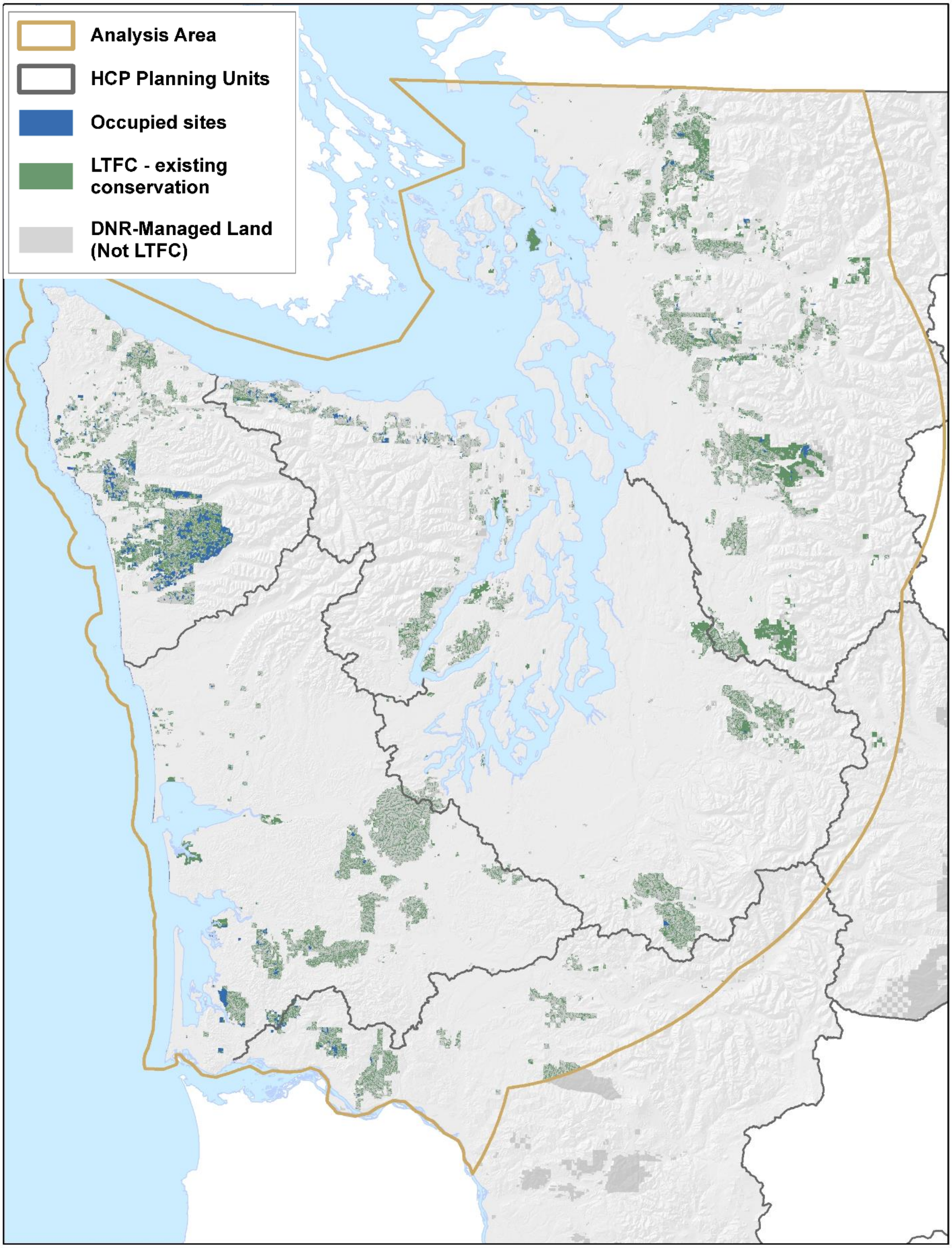


Figure 2.3.5. Habitat Location, Alternative B



Alternative C

Alternative C includes approximately **617,000** acres of long-term forest cover. This alternative contains both marbled murrelet emphasis areas and special habitat areas, as well as other high-quality habitat patches (with a P-stage value of 0.47 or greater). This alternative also applies a 328-foot (100 meter) buffer to all occupied sites except in the OESF HCP planning unit, where this buffer is 164 feet (50 meters) for occupied sites greater than 200 acres. Mitigation exceeds impact by 3,339 adjusted acres (refer to Table 4.6.5). Within each of the seven emphasis areas:

- Lands within 0.5 mile of occupied sites are conserved to provide security forest conditions that function to reduce the effects of habitat fragmentation.
- All current habitat (P-stage value of at least 0.25) is conserved.
- All future habitat (all lands that will reach a P-stage value by the final decade of the HCP) is conserved.
- Thinning is allowed in occupied site buffers (outside of special habitat areas) to develop security forest or enhance habitat.
- Thinning is allowed in areas expected to develop into future habitat.
- Active management (including variable retention harvest) is allowed on lands that are not designated as future habitat or long-term forest cover.

Table 2.3.3. Marbled Murrelet-Specific Conservation Acres, Acres in Existing Conservation, and Total Acres by Conservation Area Type in Long-term Forest Cover, Alternative C

Type of conservation area	Marbled Murrelet Specific Conservation Acres (estimated)	Acres in Existing Conservation by Conservation Area Type	Total Acres in each Conservation Area Type
Occupied sites	9,000	50,000	59,000
Occupied site buffers	13,000	14,000	27,000
Emphasis areas	14.000	24,000	38,000
Special habitat areas	9,000	20,000	29,000
High-quality murrelet habitat (P-stage 0.47 through 0.89)	6,000	38,000	44,000
Total	50,000	n/a	n/a

[a] Total conservation acres cannot be summed because there is overlap between the types of conservation areas.

Special habitat areas are smaller than emphasis areas and are designed to reduce edge and fragmentation around more isolated occupied sites that are not within an emphasis area. Within the 20 special habitat areas under Alternative C, no harvest or thinning activities are allowed.

HABITAT COMPOSITION AND DISTRIBUTION

Figure 2.3.6 depicts the quantity of habitat (acres of land with a P-stage value) at the beginning of the planning period (2018) compared with the final decade of the planning period (beginning of 2057). The figure also illustrates the distribution of habitat acres among the strategic locations. All landscapes either maintain or increase acres of habitat by the final decade in comparison to the starting amount.

Figure 2.3.6. Habitat Growth by Strategic Location and Landscape, Alternative C

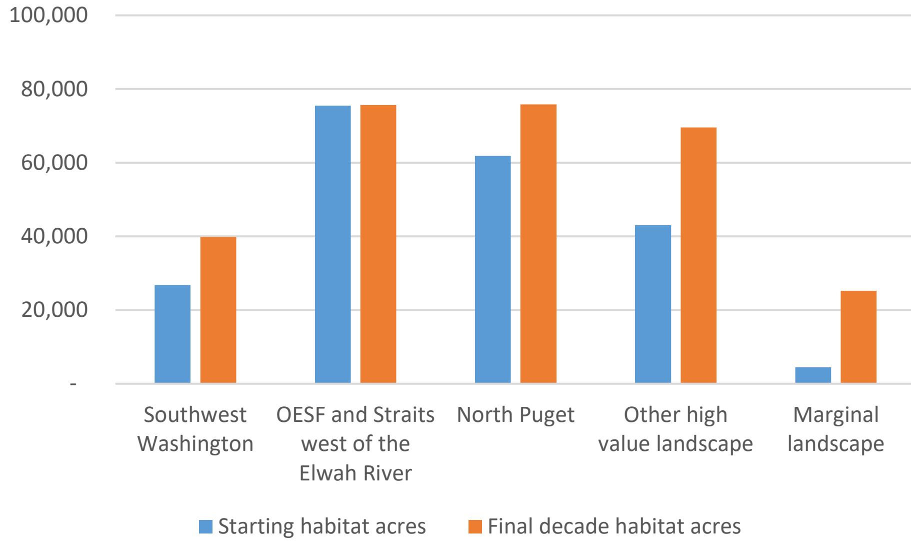
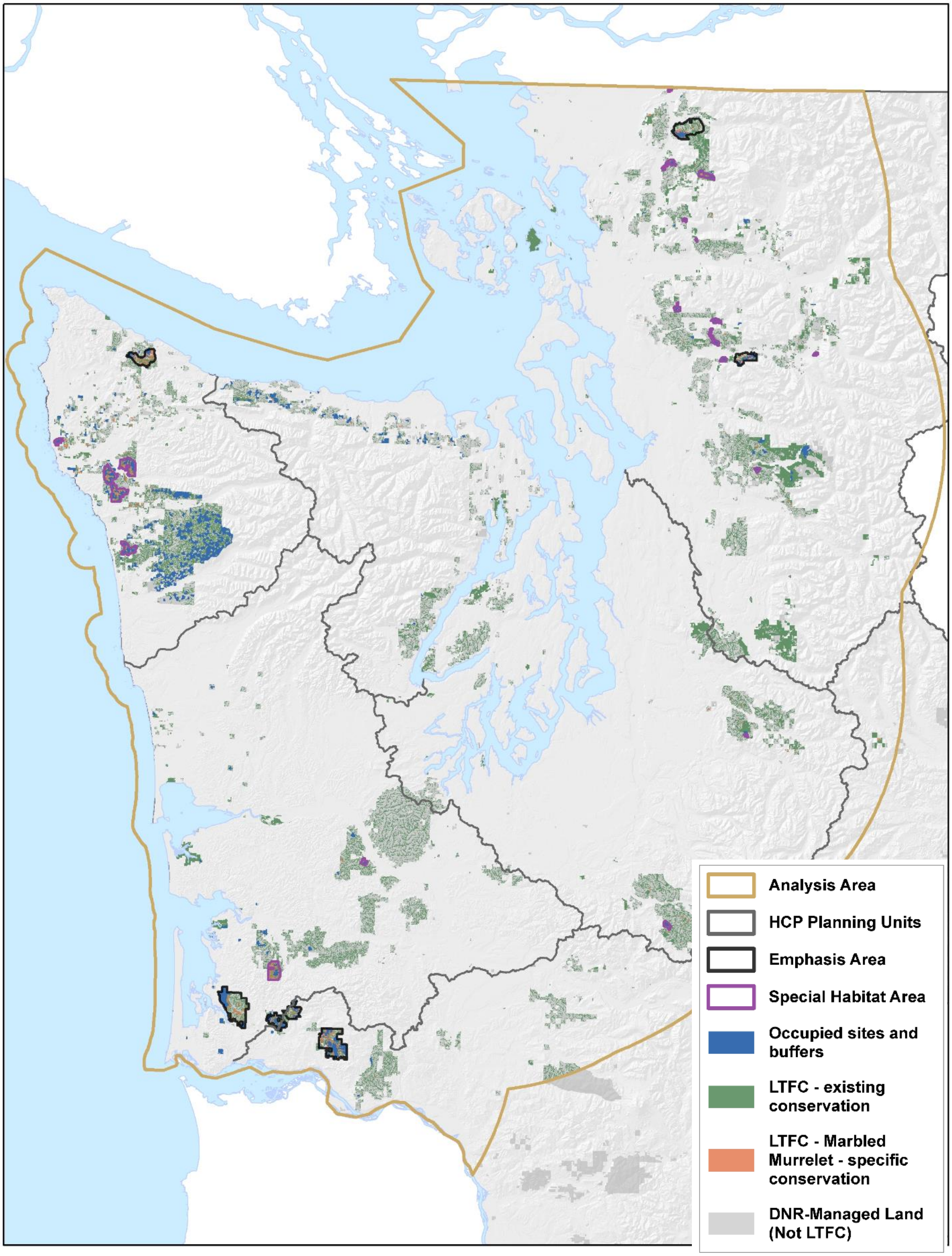


Figure 2.3.7. Habitat Location, Alternative C



Alternative D

Alternative D concentrates marbled murrelet conservation into 32 special habitat areas. Long-term forest cover totals approximately **618,000** acres. The boundaries of the special habitat areas were identified based on existing landscape conditions (management history, watershed boundaries, and natural breaks or openings). These special habitat areas were designed to reduce edge and fragmentation effects. They are generally smaller but more numerous than emphasis areas and reduce fragmentation and edge effects by prohibiting variable retention harvest and thinning treatments. Special habitat areas include the following:

- Occupied sites with 328-foot (100-meter) buffers, except in the OESF HCP Planning Unit in which sites greater than or equal to 200 acres have 164-foot (50-meter) buffers.
- Adjacent P-stage habitat (both existing and expected to develop through 2067).
- Adjacent non-habitat areas intended to provide security to existing and future habitat (security forests).

Alternative D focuses on reducing fragmentation around occupied sites and would allow more acres of current or future habitat (habitat that has or will develop a P-stage value) to be harvested outside long-term forest cover than Alternative C. Impact exceeds mitigation by 651 adjusted acres (refer to Table 4.6.5).

Table 2.3.4 provides a summary of the acres in each type of murrelet conservation area and the total amount of conservation by conservation type under Alternative D.

Table 2.3.4. Marbled Murrelet-Specific Conservation Acres, Acres in Existing Conservation, and Total Acres of Conservation by Conservation Area Type in Long-Term Forest Cover, Alternative D

Type of conservation area	Marbled Murrelet Specific Conservation Acres (estimated)	Acres in Existing Conservation by Conservation Area Type	Total Acres in each Conservation Area Type
Occupied sites	9,000	50,000	59,000
Occupied site buffers	13,000	14,000	27,000
Special habitat areas	29,000	54,000	83,000
Total	51,000	n/a	n/a

[a] Total conservation acres cannot be summed because there is overlap between the types of conservation areas.

HABITAT COMPOSITION AND DISTRIBUTION

Figure 2.3.8 depicts the quantity of habitat (acres of land with a P-stage value of at least 0.25) at the beginning of the planning period 2018) compared with the final decade of the planning period (beginning of 2057). The figure also illustrates the distribution of habitat acres among the landscapes

Figure 2.3.8. Habitat Growth by Strategic Location and Landscape, Alternative D

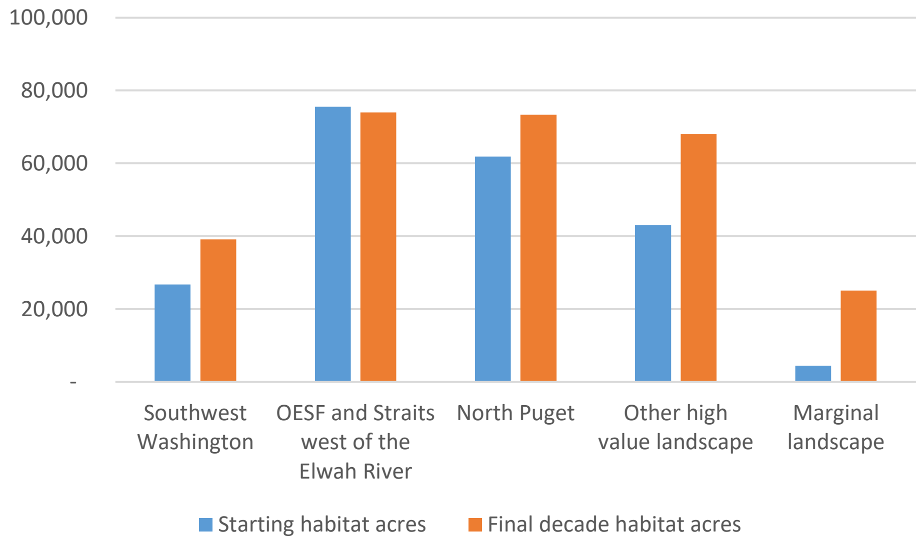
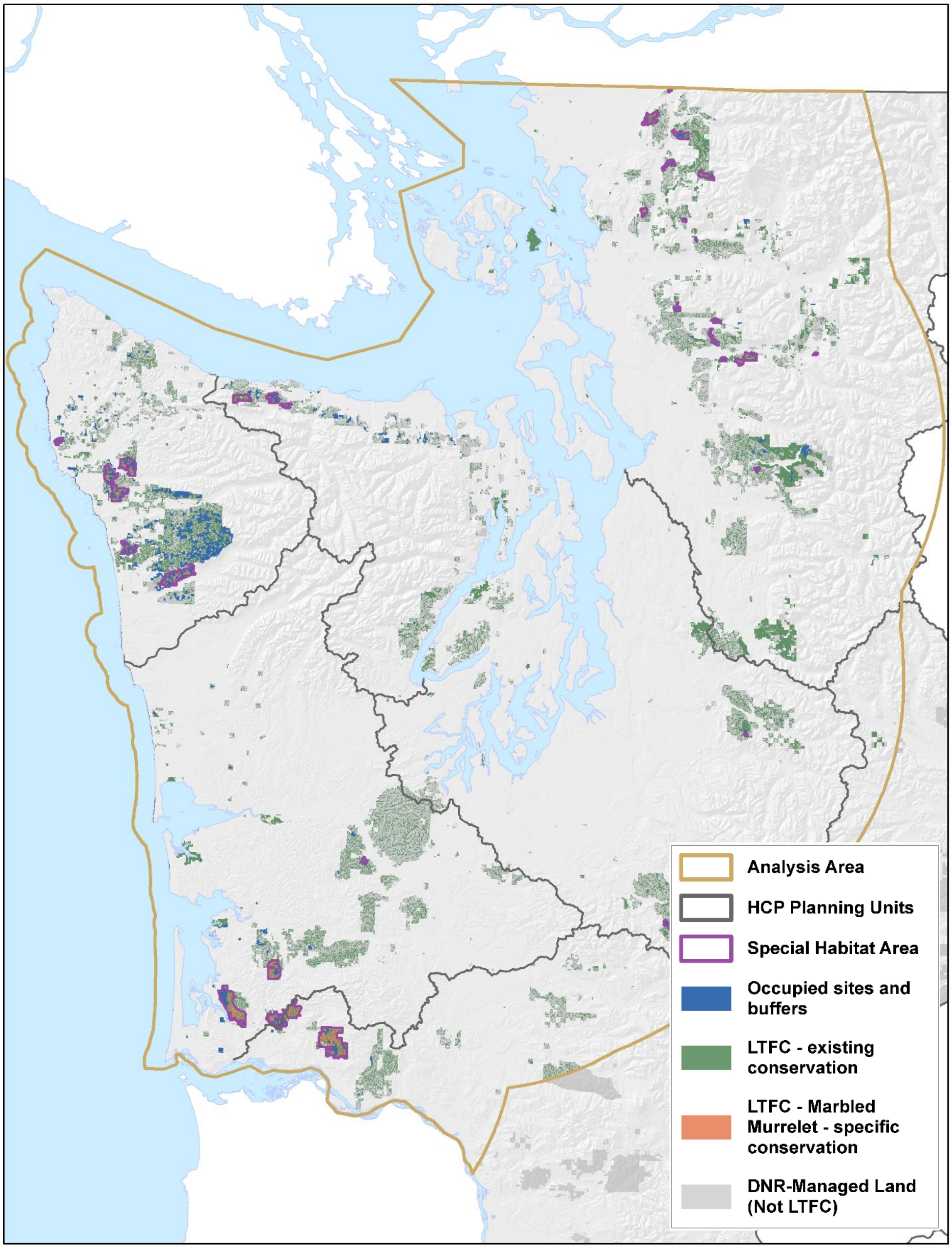


Figure 2.3.9. Habitat Location, Alternative D



Alternative E

Alternative E combines the conservation approaches of Alternatives C and D (including conservation measures) for a total of approximately **622,000 acres** of long-term forest cover. Mitigation exceeds impact by 4,116 adjusted acres (refer to Table 4.6.5). This alternative includes the following murrelet-specific conservation lands:

- Occupied sites with 328-foot (100-meter) buffers, except in the OESF where sites greater than or equal to 200 acres have 164-foot (50-meter) buffers.
- All habitat with a P-stage value of 0.47 and greater throughout the analysis area.
- Emphasis areas as designated under Alternative C.
- Special habitat areas as designated under Alternative D. (Where emphasis areas and special habitat areas overlap, an emphasis area will be the designation.)

Table 2.3.5 provides a summary of the acres in each type of murrelet conservation area, acres of existing conservation by conservation area type, and total conservation acres under Alternative E.

Table 2.3.5. Marbled Murrelet-Specific Conservation Acres, Acres in Existing Conservation, and Total Acres by Conservation Type in Long-Term Forest Cover, Alternative E

Type of conservation area	Marbled Murrelet Specific Conservation Acres (estimated)	Acres in Existing Conservation by Conservation Area Type	Total Acres in each Conservation Area Type
Occupied sites	9,000	50,000	59,000
Occupied site buffers	13,000	14,000	27,000
Emphasis areas	14,000	24,000	38,000
Special habitat areas	14,000	31,000	45,000
High-quality murrelet habitat (P-stage 0.47 through 0.89)	5,000	39,000	44,000
Total	**55,000**	**n/a**	**n/a**

[a] Total conservation acres cannot be summed because there is overlap between the types of conservation areas.

HABITAT COMPOSITION AND DISTRIBUTION

Figure 2.3.10 depicts the quantity of habitat (acres of land with a P-stage value) at the beginning of the planning period (2018) compared with the final decade of the planning period (beginning of 2057). The figure also illustrates the distribution of habitat acres among the landscapes.

Figure 2.3.10. Habitat Growth by Strategic Location and Landscape, Alternative E

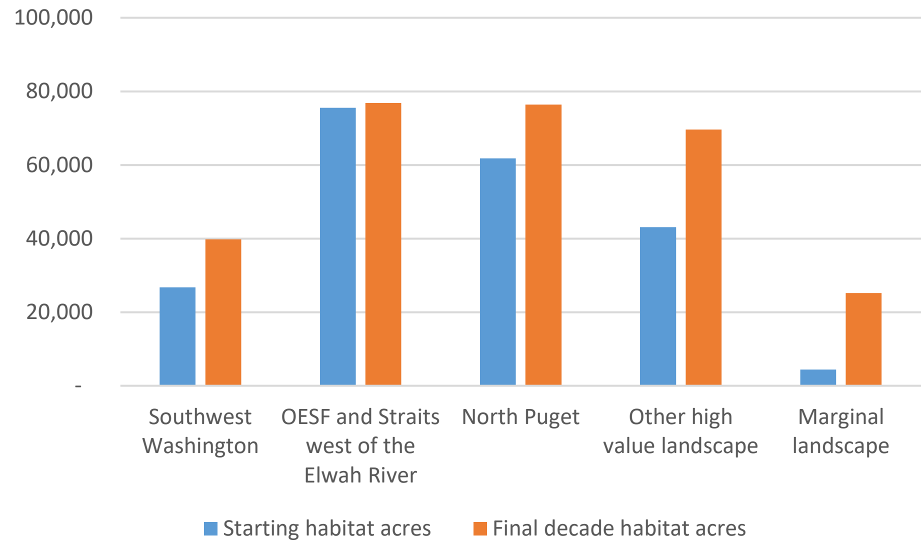
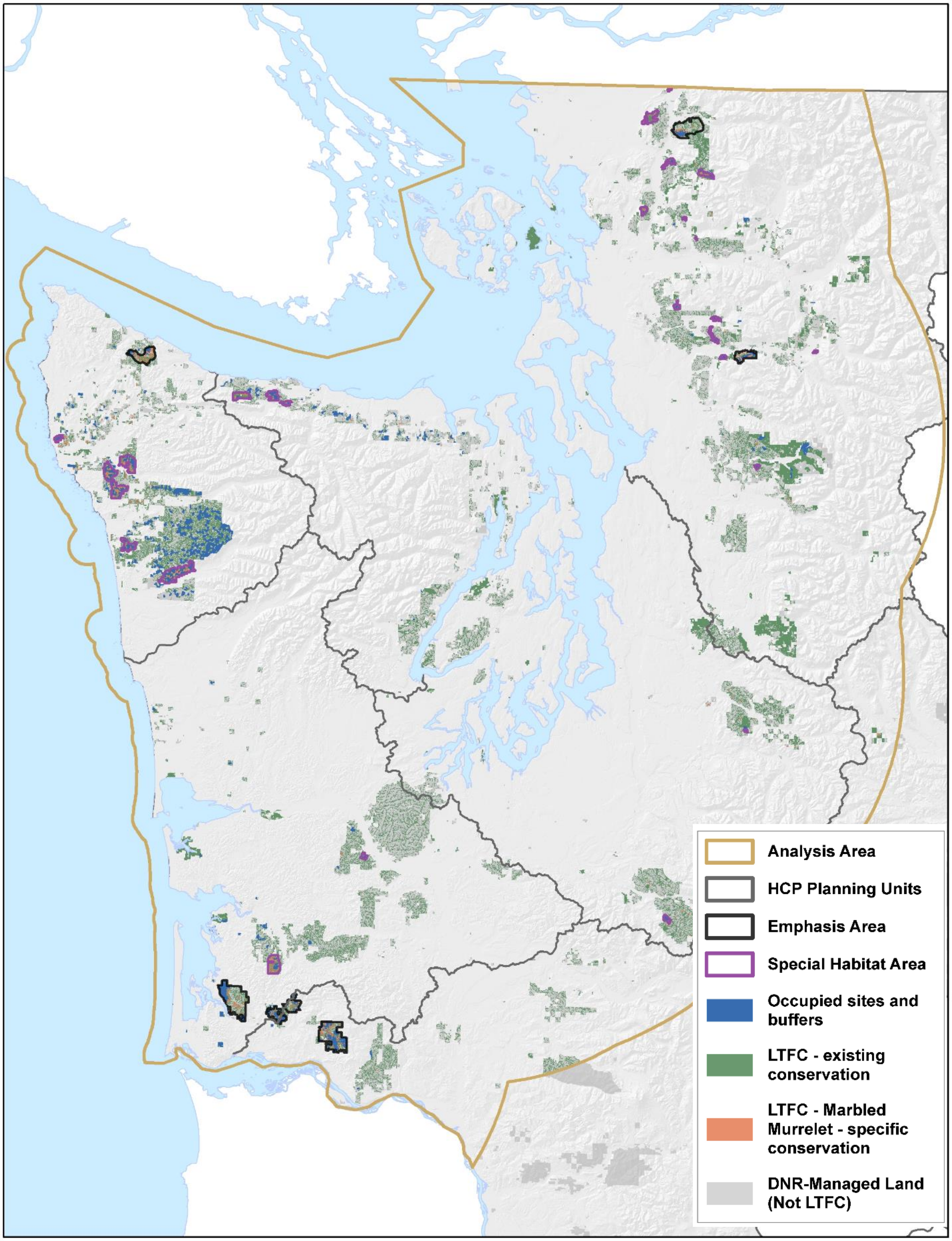


Figure 2.3.11. Habitat Location, Alternative E



Alternative F

Alternative F proposes to protect approximately **743,000** acres of long-term forest cover by designating the marbled murrelet management areas recommended in the Science Team Report and establishing marbled murrelet management areas (MMMAs) in the North and South Puget planning units (which were not part of the Science Team Report). All occupied sites would also be protected, including a 328-foot (100 meter) buffer. Additionally, all northern spotted owl old forest habitat (as defined in the 1997 HCP) in the OESF HCP Planning Unit would receive a 328-foot (100 meter) buffer. Existing mapped low-quality northern spotted owl habitat in designated owl conservation areas (nesting/roosting/foraging, dispersal, and OESF) is included as long-term forest cover. (Alternatives A through E only include high-quality owl habitat as long-term forest cover.)[22] Thinning would not be allowed in occupied sites but would be allowed within buffers to enhance habitat or maintain canopy cover. Elsewhere in MMMAs, thinning would be allowed in future P-stage habitat to enhance habitat development. Mitigation exceeds impact by 12,726 adjusted acres (refer to Table 4.6.5).

Table 2.3.6 provides a summary of the acres in each type of murrelet conservation area, acres of existing conservation, and total conservation acres by conservation area type for Alternative F.

Table 2.3.6. Marbled Murrelet-Specific Conservation Acres, Acres in Existing Conservation, and Total Acres by Conservation Area Type in Long-Term Forest Cover, Alternative F

Type of conservation area	Marbled Murrelet Specific Conservation Acres (estimated)	Acres in Existing Conservation by Conservation Area Type	Total Acres in each Conservation Area Type
Occupied sites	9,000	50,000	59,000
Occupied site buffers	16,000	17,000	33,000
MMMAs	79,000	128,000	207,000
Northern spotted owl low-quality habitat	72,000	113,000	185,000
Total	**176,000**	**n/a**	**n/a**

[a] Total conservation acres cannot be summed because there is overlap between the types of conservation areas.

[22] Note that "settlement" northern spotted owl habitat would not be included as long-term forest cover.

HABITAT COMPOSITION AND DISTRIBUTION

Figure 2.3.12 depicts the quantity of habitat (acres of land with a P-stage value) at the beginning of the planning period (2018) compared with the final decade of the planning period (beginning of 2057). The figure also illustrates the distribution of habitat acres among the landscapes.

Figure 2.3.12. Habitat Growth by Strategic Location and Landscape, Alternative F

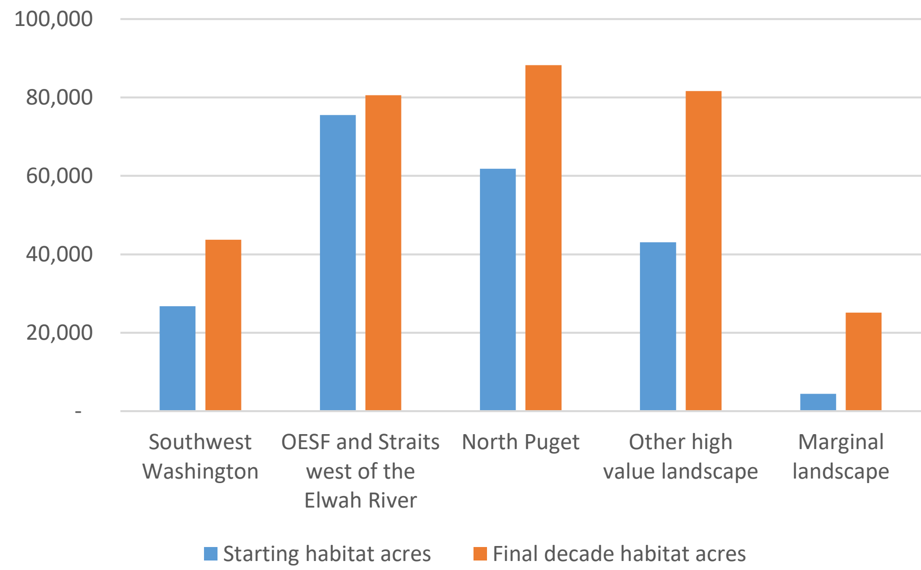
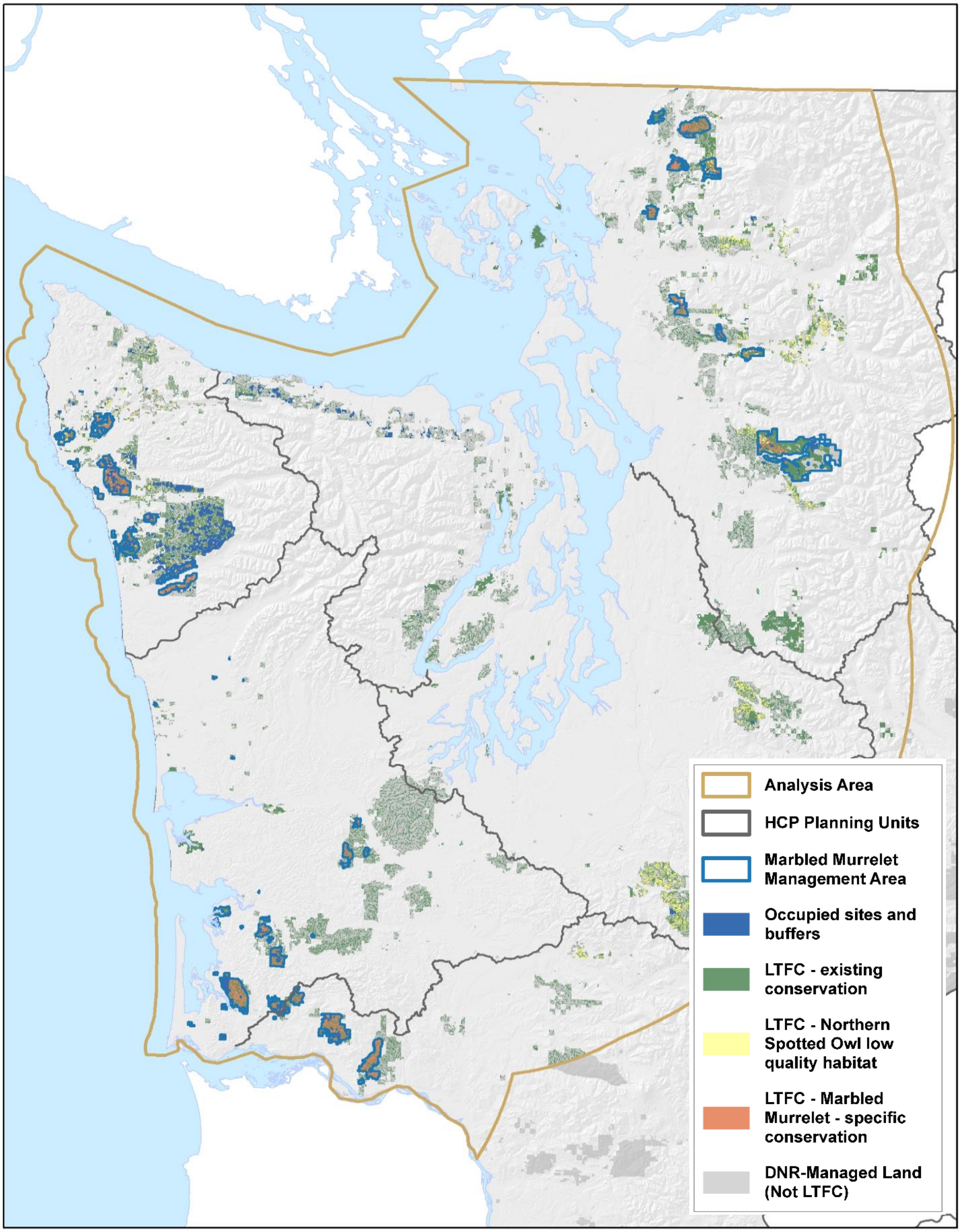


Figure 2.3.13. Habitat Location, Alternative F



Alternative G

Alternative G is a new alternative for the RDEIS. This alternative was developed in response to comments received, predominately from WDFW and USEPA, on the 2016 DEIS.

Alternative G includes approximately **643,000** acres of long-term forest cover. This alternative includes both emphasis areas and marbled murrelet management areas and applies 328-foot (100 meter) buffers to all occupied sites. Mitigation exceeds impact by 8,626 adjusted acres (refer to Table 4.6.5). Alternative G includes the following murrelet specific conservation lands:

- Occupied sites with 328-foot (100 meter) buffers
- All habitat with a P-stage value of 0.47 and higher throughout the analysis area
- In the OESF, all current habitat (P-stage at least 0.25 in decade zero)
- Emphasis areas as designated under Alternative C
- Special habitat areas as designated under Alternative D (Where emphasis areas and special habitat areas overlap, an emphasis area will be the designation.)
- Areas where the P-stage model did not identify potential existing habitat or applied a lower P-stage value than thought appropriate based on expert opinion (polygons of habitat identified by WDFW)
- The marbled murrelet management area in the Elochoman block, as drawn for Alternative F, managed as an emphasis area
- The following marbled murrelet management areas in the North Puget HCP Planning Unit:
  - Spada Lake/Morningstar (numbers 113 to 117)
  - Whatcom (numbers 104 and 105)
  - Middle Fork Hazel/Wheeler Ridge (number 102)
  - Marmot Ridge (numbers106 and 109)

Table 2.3.7 provides a summary of the acres of murrelet-specific conservation area, acres in existing conservation, and total conservation by conservation area type under Alternative G.

Table 2.3.7. Marbled Murrelet Specific Conservation Acres, Acres in Existing Conservation, and Total Acres by Conservation Area Type in Long-term Forest Cover, Alternative G

Type of conservation area	Marbled Murrelet Specific Conservation Acres (estimated)	Acres in Existing Conservation by Conservation Area Type	Total Acres in each Conservation Area Type
Occupied sites	9000	50,000	59,000
Occupied site buffers	16,000	17,000	33,000
High-quality murrelet habitat (P-stage 0.47 through 0.89), and low-quality habitat (P-stage 0.25 to 0.36) in the OESF	11,000	53,000	64,000
Emphasis areas	12,000	32,000	44,000

Type of conservation area	Marbled Murrelet Specific Conservation Acres (estimated)	Acres in Existing Conservation by Conservation Area Type	Total Acres in each Conservation Area Type
Special Habitat Areas	16,000	29,000	45,000
Polygons identified by WDFW	160	1,300	1,500
Marbled murrelet management areas	13,000	37,000	50,000
Total	76,000	n/a	n/a

[a] Total conservation acres cannot be summed because there is overlap between the types of conservation areas.

HABITAT COMPOSITION AND DISTRIBUTION

Figure 2.3.14 depicts the quantity of habitat (acres of land with a P-stage value) at the beginning of the planning period (2018) compared with the final decade of the planning period (beginning of 2057). The figure also illustrates the distribution of habitat acres among the landscapes.

Figure 2.3.14. Habitat Growth by Strategic Location and Landscape, Alternative G

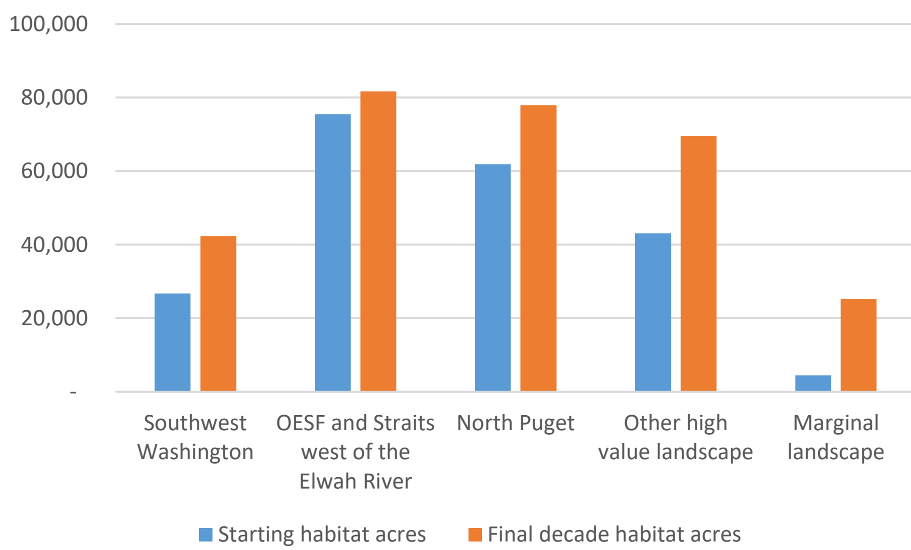
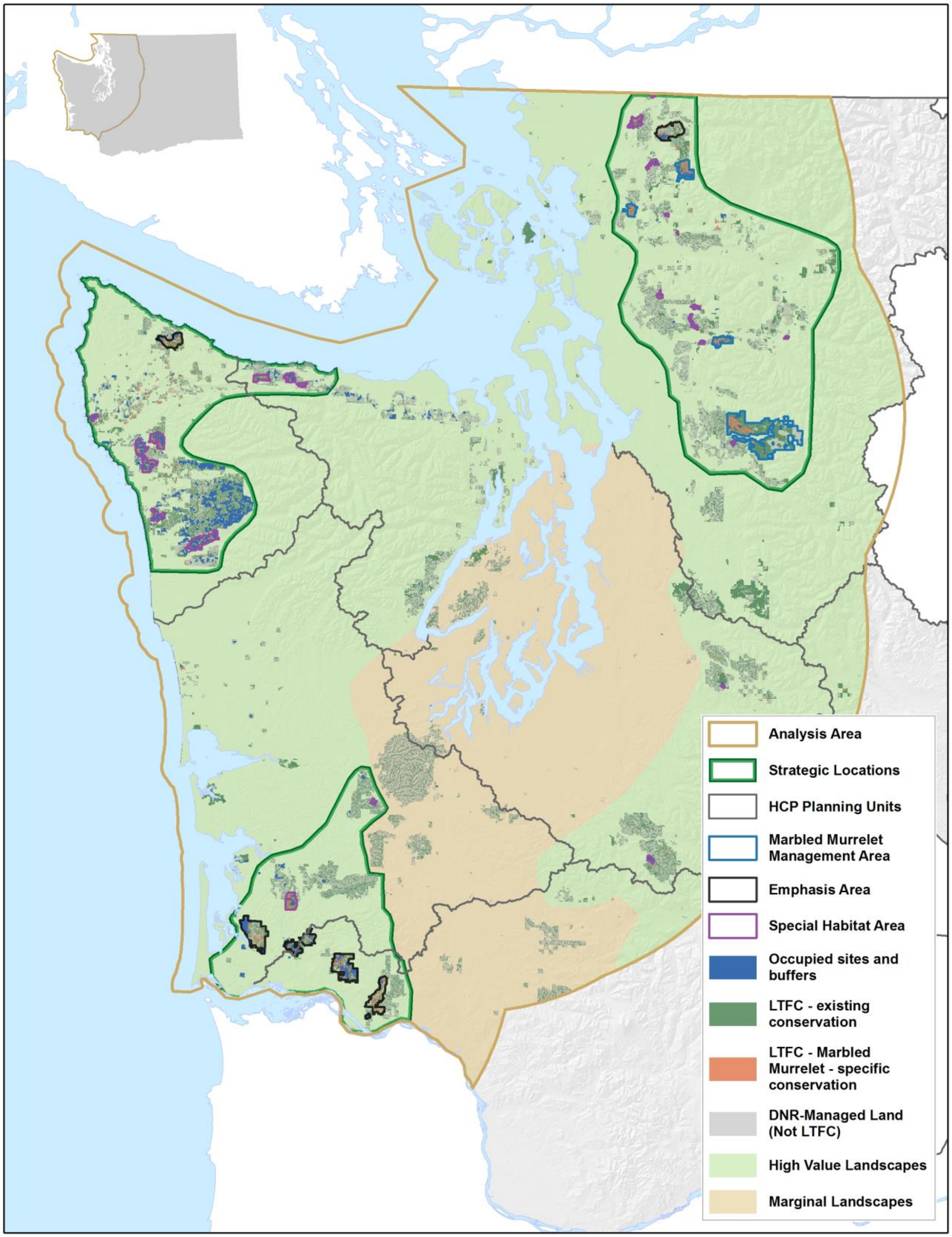


Figure 2.3.15. Habitat Location, Alternative G



Alternative H

Alternative H, DNR's preferred alternative, best meets DNR's need, purpose and objectives of the project by integrating DNR's obligations to provide marbled murrelet conservation under the Endangered Species Act with DNR's fiduciary obligations to provide revenue to its trust beneficiaries. Alternative H is based on direction from the board to minimize impacts to murrelets, offset impacts and address uncertainty, and reduce disproportionate financial impacts to trust beneficiaries. Alternative H protects all existing occupied sites, captures existing habitat within special habitat areas, and meters harvest of habitat outside conservation areas in strategic locations.

Alternative H focuses its marbled murrelet-specific conservation into 29 special habitat areas that are distributed across strategically important locations for the marbled murrelet (refer to Section 2.3 for a description of strategic locations). Of the 29 special habitat areas, 23 contain an occupied site. All the special habitat areas include current habitat, future habitat, and security forest. Alternative H also applies 328-foot (100 meter) buffers on all occupied sites and increasing the amount of interior forest habitat in long-term forest cover.

Alternative H accounts for uncertainties that were not addressed in the analytical framework. Those uncertainties include the possibility of natural disturbances impacting P-stage habitat protected in long-term forest cover in the future such as windthrow, fire, and disease. To account for the possibility of these natural disturbances occurring, the mitigation in Alternative H exceeds impact by 735 adjusted acres (refer to Table 4.6.5).

In addition, Alternative H delays (meters) harvest of approximately 3,600 adjusted acres of current habitat that DNR otherwise would authorize for harvest upon amendment of its incidental take permit until the end of the first decade following implementation. The specific location and quality of habitat to be metered will be at DNR's discretion. Metering will maintain habitat capacity while additional habitat is developed under the long-term conservation strategy. These metered acres will become available for harvest at the beginning of the second decade.

Alternative H includes approximately **610,000 acres** of long-term forest cover. Table 2.3.8 provides a summary of the acres of murrelet-specific conservation area, acres in existing conservation, and total conservation acres by conservation area type under Alternative H.

Table 2.3.8. Marbled Murrelet Specific Conservation Acres, Acres in Existing Conservation, and Total Acres by Conservation Area Type in Long-term Forest Cover, Alternative H

Type of conservation area	Marbled Murrelet Specific Conservation Acres (estimated)	Acres in Existing Conservation by Conservation Area Type	Total Acres in each Conservation Area Type
Occupied sites	9,000	50,000	59,000
Occupied site buffers	16,000	17,000	33,000
Special Habitat Areas	18,000	40,000	58,000
Total	43,000	n/a	n/a

[a] Total conservation acres cannot be summed because there is overlap between the types of conservation areas.

HABITAT COMPOSITION AND DISTRIBUTION

Figure 2.3.16 depicts the acres of habitat (acres of land with a P-stage value) at the beginning of the planning period (2018) compared with the final decade of the planning period (beginning of 2057). The figure also illustrates the distribution of habitat acres among the landscapes.

Figure 2.3.16. Habitat Growth by Strategic Location and Landscape, Alternative H

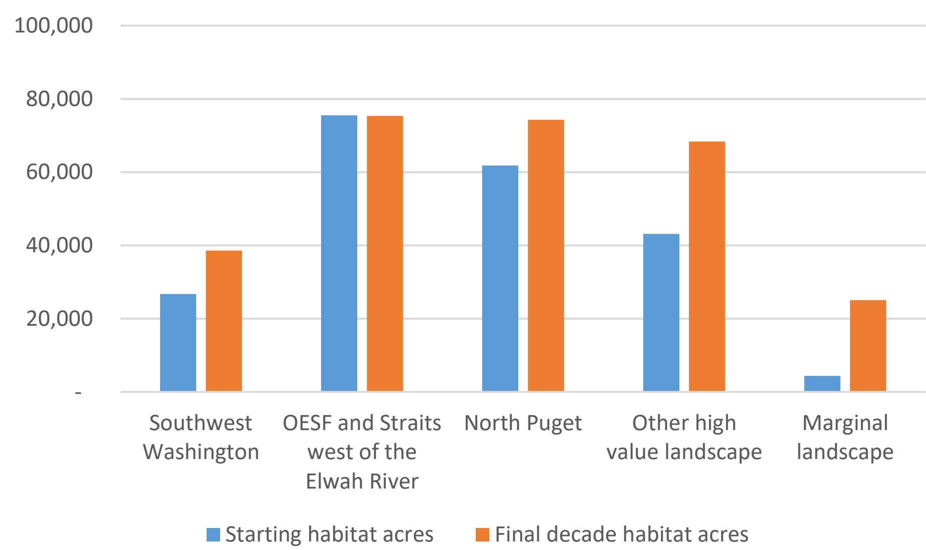
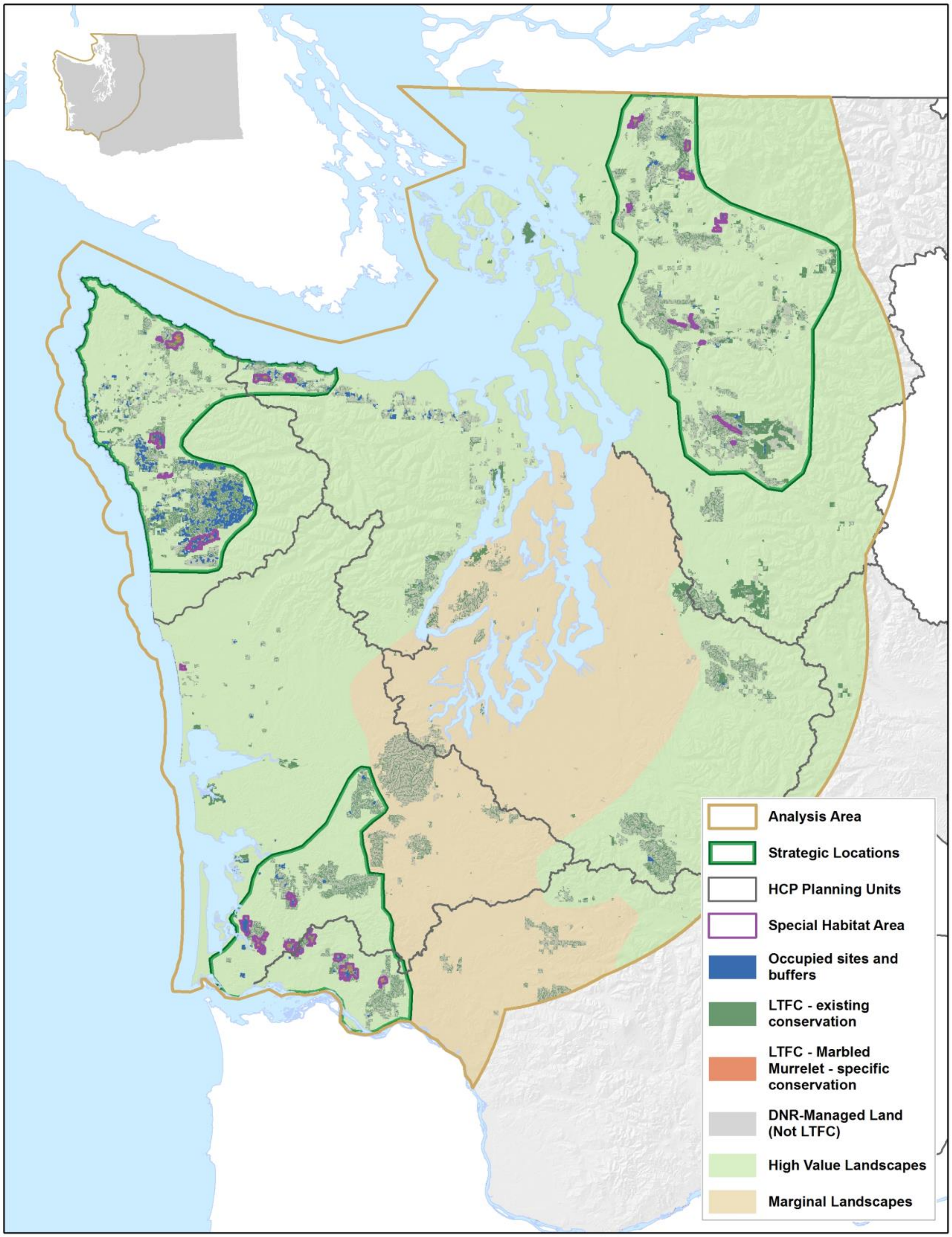


Figure 2.3.17. Habitat Location—Alternative H



2.4 Comparing the Alternatives

This section provides a summary of how long-term forest cover is composed under each alternative, including acres conserved and acres available for harvest.

■ Comparing Major Components of the Alternatives

Table 2.4.1. Comparing the Proposed Alternatives

		Alternative							
Contributing components of the marbled murrelet conservation strategy		**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
Approximate acres of long-term forest cover		600,000	576,000	617,000	618,000	622,000	743,000	643,000	610,000
Existing conservation	Natural areas[a]	✓[b]	✓	✓	✓	✓	✓	✓	✓
	Riparian management zones[c]	✓	✓	✓	✓	✓	✓	✓	✓
	Conservation commitments made in the *Policy for Sustainable Forests*	✓	✓	✓	✓	✓	✓	✓	✓
	Existing northern spotted owl habitat – high quality[d]	✓	✓	✓	✓	✓	✓	✓	✓
	Existing northern spotted owl habitat – low quality[e]						✓		
Marbled murrelet habitat conservation areas	Occupied sites – HCP surveyed[f]	✓							
	Occupied sites – Science Team mapped[g]		✓	✓	✓	✓	✓	✓	✓
	Buffers on occupied sites	328 feet (100 meters)	0	328 feet (100 meters) on all, except in OESF where sites greater ≥200 acres have 164 feet (50 meters)			328 feet (100 meters)	328 feet (100 meters)	328 feet (100 meters)
	Habitat types identified under the interim strategy[h]	✓							

Contributing components of the marbled murrelet conservation strategy		A	B	C	D	E	F	G	H
		Alternative							
	Marbled murrelet management areas						✓	✓	
	High-quality murrelet habitat (P-stage 0.47 through 0.89)			✓		✓		✓	
	Emphasis areas[i]			✓		✓		✓	
	Special habitat areas[j]			✓	✓	✓		✓	✓
	WDFW/USFWS identified polygons							✓	
	Current P-stage habitat							✓	
Forest management *within* long-term forest cover	Harvests that create large openings, such as variable retention harvest		No harvests allowed						
	Limited management (includes silvicultural treatments such as thinning, salvage, and reforestation)		Treatments are generally allowed in operable, non-marbled murrelet habitat (outside of special habitat areas under Alternatives C, D, and E; thinning allowed in special habitat areas in non-murrelet habitat under Alternative H)						
	Marbled murrelet habitat enhancement treatments	✓	✓	Habitat enhancement treatments are allowed in non-habitat within emphasis areas, with the objective of developing habitat within the life of the HCP			✓	✓	✓
	Non-timber harvest land uses	Per 1997 HCP and concurrence letters	Management of existing land uses and related infrastructure will continue per existing law and policy, with ongoing disturbance impacts to long-term forest cover identified and mitigated. New or expanded non-timber land uses are subject to conservation measures (described in Section 2.2).						
Forest management *outside* long-term forest cover	Harvest, thinning, silviculture, and non-timber uses	Forest stands managed consistent with the Sustainable Harvest Calculation, RFRS, 1997 HCP, *Policy for Sustainable Forests,* forest practices rules, forest land plans, and Multiple Use Act.							

[a] Natural areas include natural areas preserves and natural resource conservation areas.

[b] The "✓" symbol represents the land included in the long-term forest cover definition for the alternative. Notes are added to clarify the inclusion or exclusion of an area.

[c] Riparian management zones per the RFRS for the five westside HCP planning units and per the riparian conservation strategy for the OESF.

[d] Existing northern spotted owl high-quality habitat refers to the following DNR mapped habitat classes as of 2015: old forest, high-quality habitat, and A and B habitat per the definitions in the 1997 HCP (DNR 1997, p. 12).
[e] Existing northern spotted owl low-quality habitat refers to the following DNR-mapped habitat classes as of 2015: sub-mature, movement roosting and foraging, movement, young forest marginal and dispersal habitat per the definitions in the 1997 HCP (DNR 1997, p. 12) and the 2008 *South Puget Forest Land Plan*.
[f] Occupied sites as defined by DNR survey boundaries where murrelet breeding behaviors are observed or there is evidence of nesting consistent with the *Pacific Seabird Group Survey Protocol*.
[g] Occupied sites as mapped by the Science Team (Raphael and others 2008).
[h] Refers to “reclassified habitat” in Step 4 of the interim strategy (DNR 1997, p. 40) and various marbled murrelet habitat types defined in the 2007 concurrence letters for North and South Puget HCP planning units. Long-term forest cover for Alternative A includes all reclassified habitat in the OESF and Straits HCP planning units, as well as all reclassified habitat with a current P-stage value in southwest Washington.
[i] Emphasis areas represent larger blocks of habitat and non-habitat areas that will be managed for both marbled murrelet conservation and harvest.
[j] Special habitat areas augment acres of long-term forest cover around certain occupied sites and create blocks of cohesive habitat with reduced fragmentation.

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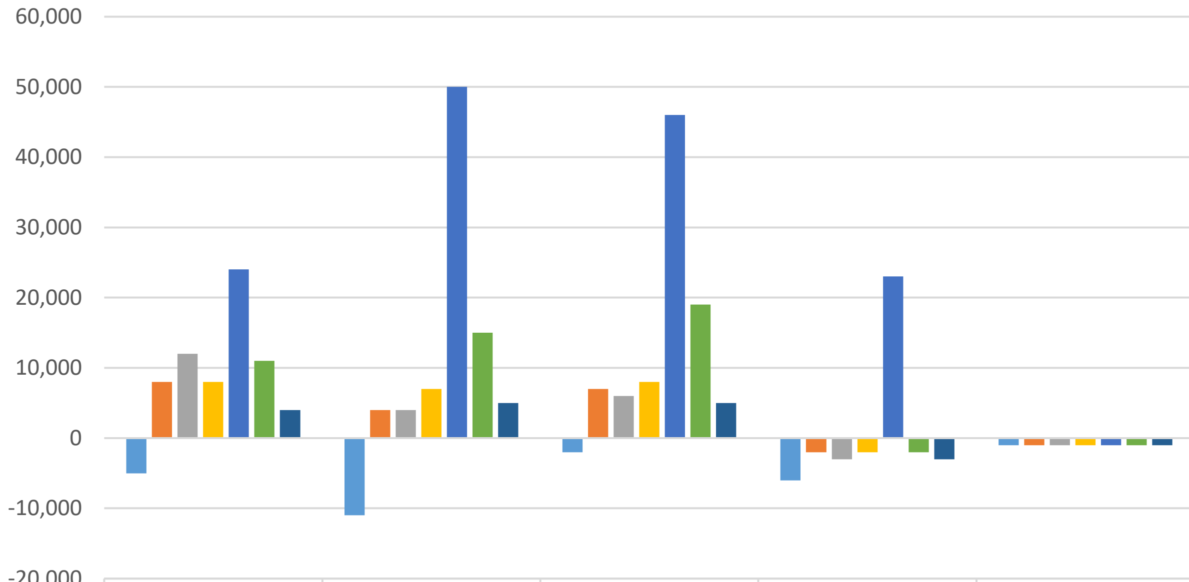
How Much Land is Available for Harvest?

Under each alternative, a full range of management options (harvest, thinning, and related silviculture) (active management) is expected to be available on DNR-managed forestland *outside* long-term forest cover. Within long-term forest cover, harvest is generally prohibited, and thinning is limited as described in the conservation measures in the previous section. Sections 3.11 and 4.11, “Socioeconomics,” analyze in detail what lands may be available for harvest in the analysis area under each alternative. Figure 2.4.1 shows the estimated change in total acres of long-term forest cover under each alternative by landscape compared with the no action alternative. (Acres are from the final decade of the planning period.)

Text Box 2.4.1. Under the Action Alternatives, Could DNR Harvest in Some Areas That Are Currently Protected?

Yes. Some land currently deferred from harvest under the no action alternative may become available for harvest under one or more of the action alternatives because of a shifting emphasis in conservation to areas with potentially higher habitat value to the murrelet.

Figure 2.4.1. Estimated Change in Long-Term Forest Cover Acres From Alternative A (No Action), by Alternative and Landscape



	Southwest Washington	OESF and Straits west of the Elwah River	North Puget	Other high value landscape	Marginal landscape
Alt B	-5,000	-11,000	-2,000	-6,000	-1,000
Alt C	8,000	4,000	7,000	-2,000	-1,000
Alt D	12,000	4,000	6,000	-3,000	-1,000
Alt E	8,000	7,000	8,000	-2,000	-1,000
Alt F	24,000	50,000	46,000	23,000	-1,000
Alt G	11,000	15,000	19,000	-2,000	-1,000
Alt H	4,000	5,000	5,000	-3,000	-1,000

Alt B Alt C Alt D Alt E Alt F Alt G Alt H

Compared to the no action alternative, Alternative B would increase the land available for active forest management by approximately 25,000 acres. Alternatives C through E and Alternative H reduce the land available for harvest by approximately 10,000 to 20,000 acres, Alternative G reduces the land available for harvest by approximately 42,000 acres, and Alternative F reduces available land by approximately 142,000 acres. Appendix F contains maps for each HCP planning unit showing strategic locations and where changes in land available for active forest management occur on the landscape.

It is important to understand that some acres currently deferred from harvest under the no action alternative (generally, reclassified murrelet habitat) may become available for harvest under one or more of the action alternatives. These acres may become available because the action alternatives change the emphasis of conservation, focusing in some cases on areas with higher-quality habitat than are identified under Alternative A or, in the case of Alternative B, focusing only on occupied sites and not broader habitat conservation areas.

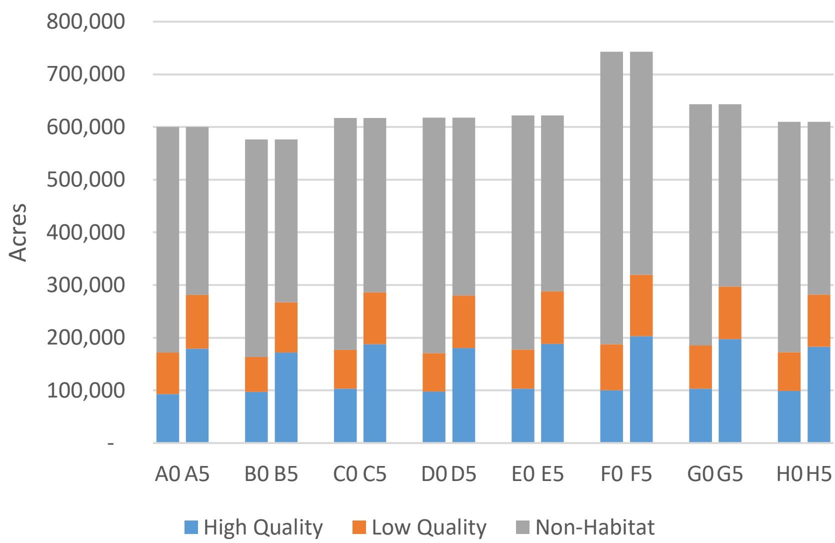
■ How Does Habitat Compare Across the Alternatives?

In Chapter 4, differences in habitat quality and configuration among the alternatives as they relate to the marbled murrelet are explored in detail. This section provides a more general comparison of habitat quality among the alternatives.

Habitat Composition and Quality

As illustrated in the previous sections, long-term forest cover contains both habitat (forestlands with a P-stage value) and non-habitat (forestlands with no P-stage value, but that contribute to conservation as security forest or buffers). As forests mature and develop into habitat through time, how much habitat is "captured" by long-term forest cover increases, and the quality of that habitat changes. Figure 2.4.2 demonstrates how habitat quality in long-term forest cover among alternatives changes between the start of the planning period (2018) and the end decade of the planning period (2057–2067). In the figure, the alternative is indicated by letter and the decade by number, such that A0 means Alternative A, Decade 0 and A5 means Alternative A, Decade 5.

Figure 2.4.2. Increases in Habitat Quality in Long-Term Forest Cover Over Time, by Alternative



Under all of the alternatives, the amount and quality of marbled murrelet habitat increases significantly by the end of the planning period. As shown in Figure 2.4.2, the largest increase in habitat quantity comes from stands of non-habitat (P-stage value of 0) developing into low-quality habitat. On average, under all of the alternatives between 24 and 26 percent of non-habitat within long-term forest cover develops into low-quality habitat by the end of the planning period.

Habitat Configuration

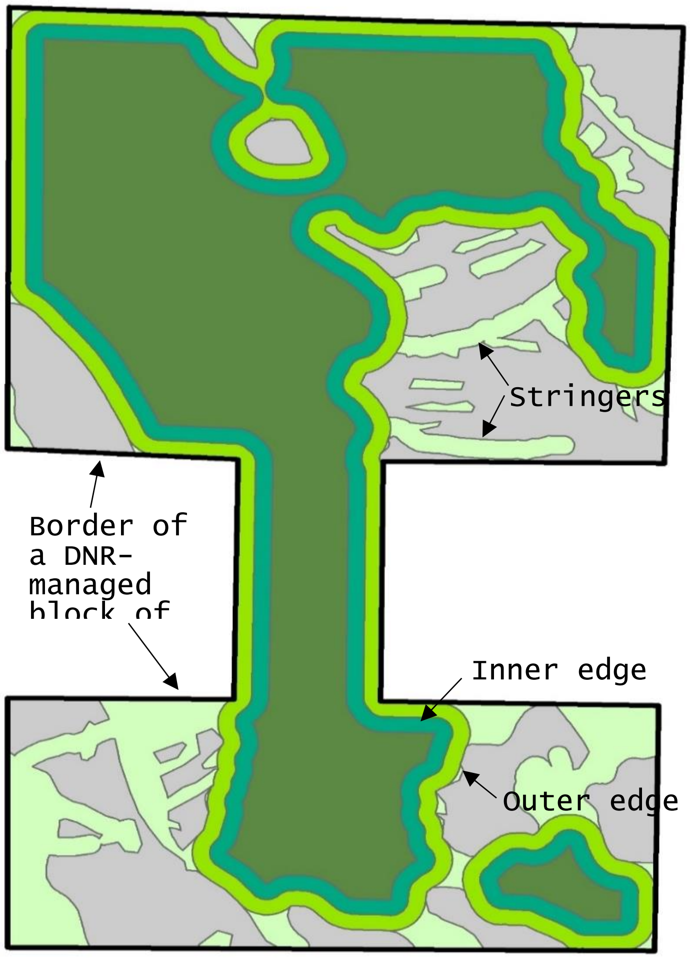
The configuration of habitat conserved in long-term forest cover also varies among the alternatives. A measure of configuration is the size of interior forest habitat patches relative to edge habitat. For the purposes of this RDEIS, long-term forest cover has been categorized into one of the following configurations (refer to Figure 2.4.3):

- **Interior forest:** The interior forest is comprised of forested area (patch) that is at least 328 feet (100 meters) from any type of edge. These interior forest areas are protected from effects associated with harvest edges.
- **Inner edge:** The inner edge is a forested area 167 to 328 feet (51 to 100 meters) from the edge of the actively managed forest and is adjacent to the interior forest patch.
- **Outer edge:** The outer edge of the interior forest patch is located between 0 and 164 feet (0 to 50 meters) from the edge of the actively managed forest. The literature indicates that edge effects from the actively managed forest extend further than 50 meters into the stand but diminish until there is minimal effect after 328 feet (100 meters) from the managed area (Burger and others 2004).
- **Stringer:** This term refers to long, relatively narrow (less than 656 feet [200 meters] wide) corridors of long-term forest cover, primarily associated with riparian areas. These areas can still provide security forest for the marbled murrelet and are not subject to take. However, because they lack interior forest, they are unlikely to be used for successful nesting and are therefore not assigned mitigation value for purposes of calculating the balance between potential take and mitigation under each alternative (refer to Appendix H).

Text Box 2.4.2. What Is “Edge” and How Does It Affect Murrelets?

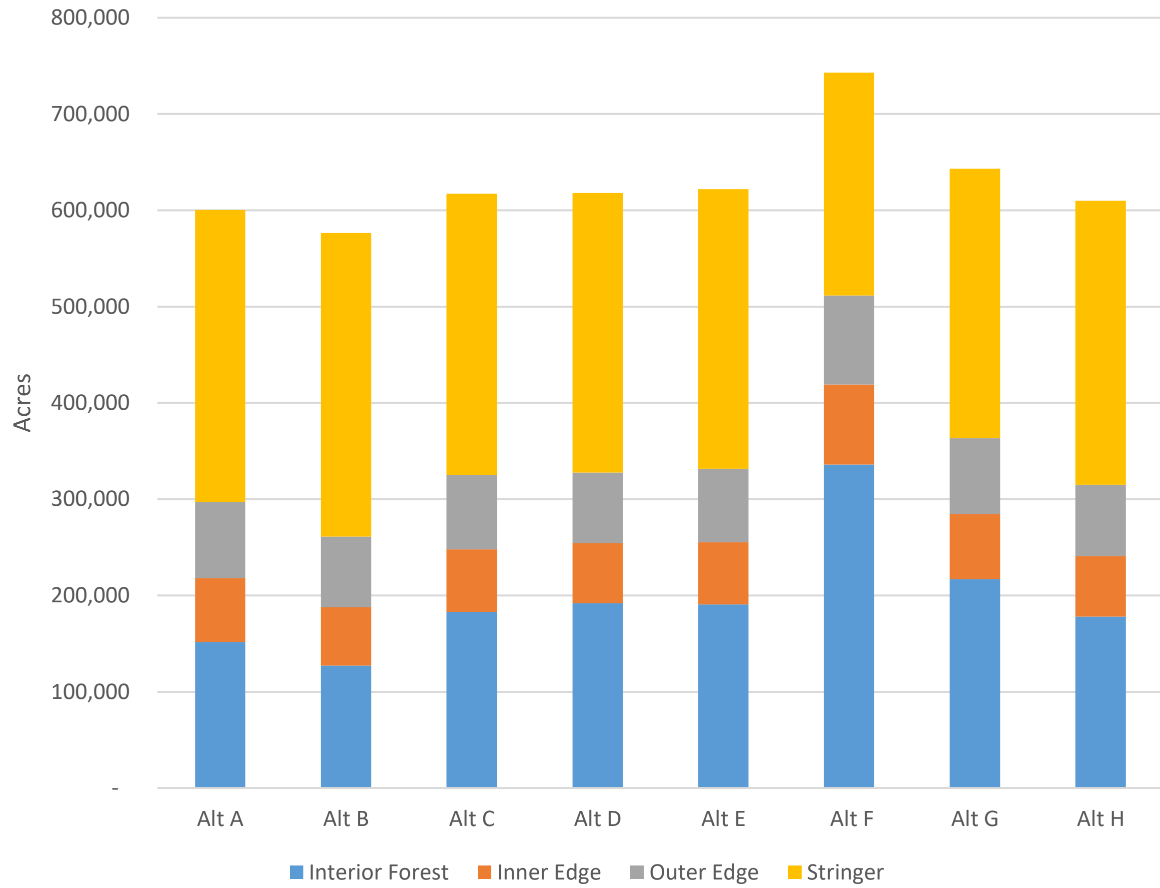
An edge is an abrupt transition or boundary between two habitat types. Forest edges are created by roads, harvests, changes in species composition, and physical changes in the landscape. Studies (for example, Burger and others 2004, Malt and Lank 2009) have shown that predation risk at marbled murrelet nests is likely higher near forest edges and in fragmented landscapes. Refer to Chapter 4 and Appendix H for more information about edges and their potential impacts.

Figure 2.4.3. Illustration of Long-term Forest Cover and Categories of Edge on a Block of DNR-Managed Land



The configuration of long-term forest cover under different alternatives is used in the analysis of potential environmental consequences (Chapter 4) for elements of the environment sensitive to habitat configuration. Comparisons can be made of species diversity found in interior forests compared to edge environments. The type and amount of edge are also major factors in assigning mitigation values to the different alternatives (refer to Chapter 4 and Appendix H for a more detailed explanation of the mitigation "discounts" given for edges and stringers). As illustrated in Figure 2.4.4, long-term forest cover under each alternative has different amounts of interior forest and different proportions of interior forest to edge or stringer forest.

Figure 2.4.4. Comparison of Long-Term Forest Cover Interior, Edge, and Stringer Acres, by Alternative



■ Alternatives Considered But Not Analyzed in Detail

The Joint Agencies received several comment letters proposing new alternatives for consideration in this NEPA/SEPA process. An alternative proposed by WDFW and one of two alternatives proposed by USEPA were within the range of alternatives analyzed in the 2016 DEIS and were incorporated into Alternative G in the RDEIS.

However, the Joint Agencies eliminated from further review the alternatives proposed by the American Bird Conservancy, Pacific Seabird Group, Marbled Murrelet Coalition, and the second alternative from USEPA. These four alternatives proposed by commenters would modify Alternative F. Each of these alternatives would create marbled murrelet conservation areas of varying sizes and configurations, and prohibit timber harvest of current and future habitat for the remaining initial term of the incidental take permit. All of these four alternatives contain significantly more marbled murrelet-specific conservation than Alternative F, which was found to have significant adverse impacts to trust beneficiaries when compared to all other alternatives analyzed in detail (refer to Section 4.11, "Socioeconomics"). Refer to "Impacts and Mitigation of Proposed Alternatives" at the end of this section and Figure 2.4.5 for more information. USFWS determined, based on DNR's analysis of impacts to trust beneficiaries, that these four alternatives are not economically feasible and thus are not reasonable alternatives pursuant to 43 CFR 46.420(b).

American Bird Conservancy

The alternative provided by the American Bird Conservancy combines Alternatives E and F from the 2016 DEIS. It also prohibits all harvest of existing and future marbled murrelet habitat for 50 years and provides 492-foot (150-meter) buffers around all occupied sites and old forest mapped by the 2008 Science Team (Raphael and other 2008). To avoid disturbance, the alternative prohibits salvage in MMMAs and special habitat areas during the nesting season. This alternative would include approximately 267,000 acres of marbled murrelet-specific conservation and 834,000 acres of long-term forest cover (60 percent of the analysis area).

USEPA

The second USEPA alternative that would modify Alternative F would include all of the conservation areas identified in Alternative F and would conserve all current and future habitat, any special habitat areas not included in Alternative F, and any emphasis areas not included in Alternative F. Current habitat is defined as having a P-stage value of at least 0.25. Future habitat is defined as "all lands that will reach a P-stage value by the final decade of the Habitat Conservation Plan." This alternative would include 261,000 acres of marbled murrelet specific conservation and 832,000 acres in long-term forest cover (60 percent of the analysis area).

Pacific Seabird Group

The alternative recommended by the Pacific Seabird Group is a modification of Alternative F from the 2016 DEIS. Alternative F would be modified by prohibiting harvest of any occupied, suitable, or "near suitable" habitat for 50 years; providing 492-foot (150-meter) or larger buffers around all occupied, current and future suitable, and older-forest habitat; and adding buffered special habitat areas and emphasis areas from Alternative E. This alternative would include 445,000 acres of marbled murrelet-specific conservation and over one million acres in long-term forest cover (73 percent of the analysis area).

Marbled Murrelet Coalition

The alternative proposed by the marbled murrelet coalition is a modification of Alternative F. This alternative would add to Alternative F all current and future habitat within the next 50 years, all emphasis areas and special habitat areas from Alternative E, and 492-foot (150-meter) buffers around all occupied sites and in the OESF old forest northern spotted owl habitat as mapped by the Science Team (Raphael and others 2008). Current and future habitat is defined as having a P-stage of at least 0.25. The Coalition suggests combining special habitat areas, emphasis areas and MMMAs into one category referred to as "Conservation Areas." This alternative would include 265,000 acres of marbled murrelet specific conservation and 832,000 acres in long-term forest cover (60 percent of the analysis area).

This alternative also includes conservation measures for forest management activities, recreation, leases and contracts, land disposition, research, fire suppression, and wind energy development.

Impacts and Mitigation of Proposed Alternatives

The analytical framework used in the 2016 DEIS and RDEIS includes an assumption that the loss of habitat from harvest in the managed forest over time (impacts) will be offset by habitat gains that occur in areas protected by the conservations strategy (mitigation). However, each habitat acre harvested and each acre grown have different values, depending on their P-stage value, their location relative to forest edges, distance from other habitat areas, and in which decade they are harvested, develop into habitat, or increase in P-stage value. Figure 2.4.5 shows acres of impact and mitigation based on these factors (refer to Appendix H for a more detailed description).

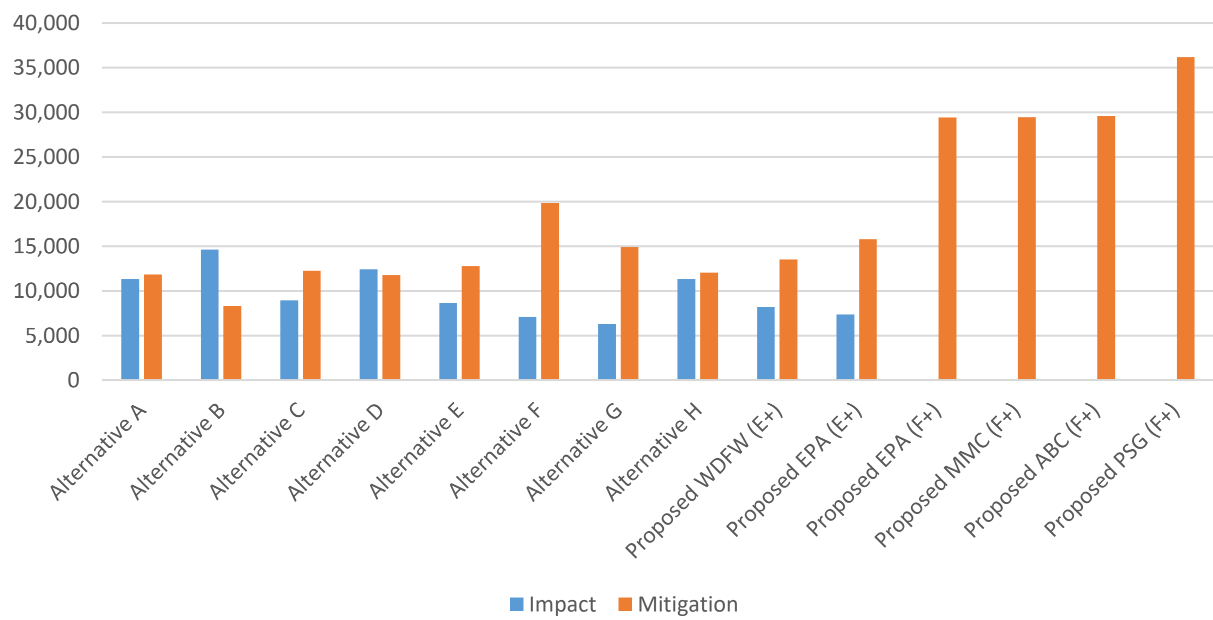
The impacts from habitat removal for each of the proposed alternatives considered but not analyzed in detail in Figure 2.4.5 is zero because these alternatives severely restrict harvest activities in all areas that may impact murrelets (60 to 73 percent of the analysis area). In addition, the mitigation imposed in adjusted acres is as follows:

- USEPA alternative (EPA F+): 29,426 acres
- Marbled Murrelet Coalition (MMC) alternative: 29,471 acres
- American Bird Conservancy (ABC) alternative: 29,600 acres
- Pacific Seabird Group (PSB) alternative: 36,181 acres

This mitigation is approximately 50 percent more than Alternative F. Socioeconomic impacts are closely related to the change in acres available for harvest (known as "operable acres") because of additional conservation (refer to the evaluation criteria discussion in Section 4.11 and Table 4.11.6). As shown in Table 4.11.6, Alternative F has approximately three times as much marbled murrelet-specific conservation as Alternative D and approximately 3 times as much impact on operable acres. Alternative F has 176,000 acres of marbled murrelet-specific conservation. The proposed alternatives considered but not analyzed in detail have between 261,000 and 445,000 acres of marbled murrelet-specific conservation. The socioeconomic impacts of the proposed alternatives considered but not analyzed in detail are expected to be proportionally higher, or between 50 percent more and 250 percent more impact on operable acres than Alternative F.

The proposed alternatives are not reasonably related to, and do not accomplish, DNR's project purpose and need, which includes obtaining long-term certainty for timber harvest and other management activities on forested state trust lands consistent with DNR's fiduciary responsibility to the trust beneficiaries as defined by law. The proposed alternatives are not consistent with DNR's project objectives because of impacts to trust beneficiaries from the harvest restrictions and because the mitigation imposed greatly exceeds impacts from DNR activities. Based on its analysis of impacts to trust beneficiaries, DNR concludes that these alternatives are not economically feasible in view of its trust obligations, and thus are not reasonable alternatives. Consequently, the Joint Agencies decided not to analyze the four proposed alternatives in detail.

Figure 2.4.5. Impacts and Mitigation Summary for all Alternatives, Including Those Considered but Not Analyzed in Detail



■ How Do the Alternatives Address DNR's Project Objectives?

The need, purpose, and objectives statements in Chapter 1 includes five objectives that guided the development of alternatives. This section provides a brief summary of DNR's evaluation of how the alternatives address each of DNR's project objectives.

1) **Trust Mandate:** Generate revenue and other benefits for each trust by meeting DNR's trust responsibilities, including making trust property productive, preserving the corpus of the trust, exercising reasonable care and skill in managing the trust, acting prudently with respect to trust property, acting with undivided loyalty to trust beneficiaries, and acting impartially with respect to current and future trust beneficiaries.

All alternatives allow continued generation of revenue for trust beneficiaries. Revenue streams may be impacted differently depending on the alternative. The alternatives would generate revenue in the following order, from the most revenue to the least revenue: Alternative B, A, H, D, C, E, G, F. Alternatives that generate the least revenue, such as Alternatives F and G, may not achieve DNR's Trust Mandate objective. Revenue estimates are discussed in more detail in Section 4.11, "Socioeconomics." Specific impacts to trusts and counties are also discussed in Section 4.11.

2) **Marbled Murrelet Habitat:** Provide forest conditions in strategic locations on forested trust lands that minimize and mitigate incidental take of marbled murrelets resulting from DNR forest management activities. In accomplishing this objective, we expect to make a significant contribution to maintaining and protecting marbled murrelet populations.

Marbled murrelet-specific conservation areas, in combination with existing 1997 HCP conservation strategies, maintain areas in long-term forested condition. These forested areas are designed to minimize and mitigate incidental take. The proposed conservation measures are designed to avoid, minimize, and mitigate the impacts of certain forest management activities.

Alternatives C through H modify the current interim approach to murrelet conservation (approximated by Alternative A) by designating strategically important locations for conservation of marbled murrelet habitat. Alternatives C through H identify strategic locations for marbled murrelet conservation on DNR-managed lands as areas with documented occupied sites and concentrations of murrelet habitat in context of the existing conservation network provided by federal lands. For example, certain DNR-managed lands in southwest Washington were considered strategically important because of their concentrations of documented occupied habitat, and because the absence of habitat on federal lands in this area could result in a gap in the otherwise continuous coastal distribution of marbled murrelets in Washington. Some specific areas in the North Puget HCP Planning Unit were considered strategic locations because they provide forested landscapes within commuting distance to nest sites from marine foraging areas around the San Juan Islands, which were identified by Raphael and others (2015) as "hot spots" due to heavy murrelet use and prey availability. And the OESF and Straits west of the Elwha River strategic location contains an abundance of high quality habitat, is in close proximity to marine waters, and also is close to areas identified by Raphael and others (2015) as "marine hot spots."

Although Alternative B protects known occupied sites, no additional marbled murrelet-specific conservation areas are identified.

Refer to Section 4.6, "Marbled Murrelets," for an evaluation of how these alternatives may affect marbled murrelet populations. Figure 2.4.5 provides a summary of impacts and mitigation by alternative. An alternatives may not achieve DNR's marbled murrelet habitat objective if mitigation greatly exceeds impacts, such as Alternatives F and G, or if impacts greatly exceeds the mitigation, such as Alternative B.

3) **Active Management:** Promote active, innovative, and sustainable management on the forested trust land base.

Each alternative allows continued, sustainable harvest of timber, consistent with existing laws, policies, and the 1997 HCP. Harvest of some marbled murrelet habitat also is permitted. Underlying regulations and policies promoting innovation remain in place unless otherwise constrained by specific conservation measures. For example, riparian restoration treatments may be prohibited in special habitat areas but are allowed elsewhere in the analysis area.

The proposed conservation measures also allow innovative thinning treatments that could be used to accelerate the development of marbled murrelet habitat in some areas of long-term forest cover. Impacts to active, innovative, and sustainable management is discussed primarily in Sections 4.6 through 4.9.

4) **Operational Flexibility:** Provide flexibility to respond to new information and site specific conditions.

All alternatives would allow DNR to continue to respond to emergency situations and would not change the existing practice of consultation with USFWS. Site-specific consultation with USFWS is expected under the proposed conservation measures for some forest management activities. For four types of operations within long-term forest cover (thinning, roads, blasting, and recreation), the conservation measures differ among alternatives, with some limiting DNR's operational flexibility more than others. Alternatives B, E, and F generally allow more flexibility and site-specific assessments (with consultation where necessary) to avoid, minimize, and mitigate potential habitat impacts. However, Alternative F would restrict harvest operations on the greatest number of acres and would subject the greatest number of acres to site-specific consultation. Alternatives C, D, and H would prohibit new road and new recreation facility development in marbled murrelet conservation areas and propose more restrictions on where thinning and blasting activities can occur.

5) Implementation Certainty: Adopt feasible, practical, and cost-effective actions that are likely to be successful and can be sustained throughout the life of the 1997 HCP.

The action alternatives all share a feasible, practical, and cost-effective, basic approach to conservation by increasing certainty about where and how much marbled murrelet habitat will be conserved over time and by building a strategy around areas that are already deferred from harvest by existing DNR policies and regulations. Lands already assumed to be unavailable for harvest make up the majority of the proposed marbled murrelet conservation areas, which will control DNR's costs for implementing a long-term strategy. The conservation measures largely acknowledge the need for most DNR routine operations to continue to occur within long-term forest cover and limit restrictions or prohibitions to within specific marbled murrelet habitat areas. Thus active management of forest resources could largely continue, following clear parameters for seasonal timing restrictions, disturbance buffers, and need for consultation. Thinning to accelerate habitat development under the alternatives would increase implementation costs for those alternatives. Alternative F allows the most thinning within MMMAs. While the conservation measures common to the action alternatives add some implementation cost and/or time delay for projects compared with the no action alternative, these impacts are not expected to be significant.

3

Chapter 3

AFFECTED ENVIRONMENT

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Chapter 3

Affected Environment

This chapter describes the current conditions for the elements of the natural and built environment most likely to be impacted by the proposed action. Current conditions are described so that an evaluation of potential impacts can be conducted in Chapter 4, "Environmental Consequences."

Elements of the Environment Included

This chapter describes the elements of the natural and built environment within the analysis area, which is defined as all Washington State Department of Natural Resources (DNR)-managed lands within 55 miles of all marine waters in western Washington (refer to Figure 1.3.1 in Chapter 1) that could be affected by the proposed alternatives. Each section will describe a different element of the environment, its current condition on the landscape, and the policy and regulatory context for management of the element. The environmental impacts of the action alternatives on these current conditions are analyzed over time in comparison to the no action alternative (refer to Chapter 4, "Environmental Consequences").

The State Environmental Policy Act (SEPA) and National Environmental Policy Act (NEPA) provide guidance on what elements to consider in environmental impact statements.[1] Only those elements of the environment most likely to be impacted by the proposed action are included in this chapter. Elements were chosen based on the likelihood of impact and from information gathered during the scoping process (as described in Chapter 1 and summarized in Appendix A). The following elements will be described in this chapter and analyzed for potential impacts in Chapter 4:

- Earth (geology and soils)
- Climate
- Vegetation
- Aquatic resources (water quality and quantity , riparian habitats, and fish)
- Wildlife and biodiversity
- Marbled murrelet
- Recreation
- Forest roads
- Public services and utilities
- Environmental justice
- Socioeconomics
- Cultural resources

[1] WAC 197-11-444, 40 CFR 1508.14.

DNR and U.S. Fish and Wildlife Service (USFWS), referred to as the Joint Agencies, determined that the following elements of the environment would not be analyzed in this revised draft environmental impact statement (RDEIS) because of the low likelihood of impacts:

- **Air quality (other than climate):** No new emissions or increases in emissions of pollutants that could affect air quality are proposed under the alternatives.
- **Visual/scenic resources/light and glare**: None of the alternatives will affect scenic views. All alternatives set aside forested lands for conservation in addition to the acres that currently provide scenic views.
- **Water (runoff, absorption, flooding, groundwater, and public water supplies)**: Increasing forested acres set aside for conservation has no anticipated impact on runoff or absorption. (Water quality impacts are addressed in Section 3.4, "Aquatic Resources"). No public water supply sources will be affected by the proposal or any alternatives.
- **Traffic and transportation**: Only forest roads and associated infrastructure are evaluated. The proposal will not impact traffic or transportation on public roadways. Recreational trails will be analyzed in the RDEIS.
- **Noise**: None of the alternatives include activities that would increase or cause new sources of noise. Ongoing noise from forest management activities is addressed by conservation measures; the effects of noise disturbance on murrelets is discussed in Section 4.6 of this RDEIS.
- **Urban land uses (including population and housing impacts), sewer, solid waste:** The conservation strategy alternatives all take place in non-urban environments. No urban land uses will be affected. Impacts to trusts (which fund some urban services) will be analyzed under Sections 3.11 and 4.11, "Socioeconomics," of this RDEIS.
- **Environmental health**: No activities proposed by any alternative would impact environmental health generally. Impacts to water quality and quantity will be addressed.
- **Agricultural lands/crops**: There are no significant agricultural lands within the analysis area.

■ Data Sources

DNR's 2018 large data overlay is the primary source of data for describing the current conditions of each element of the environment (refer to Chapter 7, Key Definitions, for a description of the large data overlay). Additional databases maintained separately by DNR or other federal, state, or local sources were used as appropriate. Previously adopted plans, policies, and regulations also are sources of data for describing each element of the environment. Expert knowledge from DNR staff is another source of information for describing the policy and regulatory context for each element of the environment.

Scope and Scale of Analysis

The analysis area can be broken up into subareas for purposes of describing different elements of the environment. Some elements are best described at larger scales, such as the entire analysis area, planning units, or (for the marbled murrelet) landscapes. Other elements might be described at a county or other subarea level. Decisions about the appropriate scope and scale of analysis to use relate to the types of data available and the context and intensity of potential impacts. Each section will be explicit about the scope and scale of analysis used to describe the element of the environment.

It is important to recognize that these SEPA and NEPA analyses are for the purpose of amending the *State Trust Lands Habitat Conservation Plan* (1997 HCP) with a long-term marbled murrelet conservation strategy. There are no changes proposed to the other HCP conservation strategies or how their objectives are to be accomplished. The following objectives and conservation strategies will remain unchanged under this proposed amendment:

- Objectives and conservation strategies for northern spotted owls (DNR 1997, p. IV.1)
- Objectives and conservation strategies for riparian habitats (DNR 1997, p. IV.55)
- The integrated approach to production and conservation for the Olympic Experimental State Forest (OESF) HCP Planning Unit (DNR 1997, p. IV.81)
- The northern spotted owl conservation strategy for the OESF HCP Planning Unit (DNR 1997, p. IV.86)
- The riparian conservation strategy for the OESF HCP Planning Unit (DNR 1997, p. IV.106)
- The multispecies conservation strategy for the OESF HCP Planning Unit (DNR 1997, p. IV.134) and the westside planning units (DNR 1997, p. IV.145)

The only 1997 HCP conservation strategy change being considered is replacing the interim strategy with a long-term conservation strategy for the marbled murrelet.

3.1 Earth: Geology and Soils

This section provides a brief description of geology and soils within the analysis area and how DNR manages these resources.

Why Are Geology and Soils Important?

The marbled murrelet long-term conservation strategy depends on sustainable, mature forests to provide long-term habitat. Healthy soils are a foundation of healthy, productive forests. Understanding how the alternatives could potentially affect soil stability, erosion, and productivity is an important part of determining environmental impacts.

Current Conditions

The soils and geology of DNR-managed lands within the analysis area have been previously described in several DNR documents, including the *South Puget Forest Land Plan* (DNR 2010), *Sustainable Harvest Calculation Final Environmental Impact Statement* (DNR 2004), the *Final Environmental Impact Statement for the Proposed Issuance of Multiple Species Incidental Take Permits or 4(d) Rules for the Washington State Forest Practices Habitat Conservation Plan* (Chapter 3.4, National Marine Fisheries Service [NMFS] and USFWS 2006), and Appendix B of the *Forest Practices Board Manual*, Section 16 (DNR 2016c). These conditions are briefly summarized here.

Soil characteristics vary throughout the analysis area because of the diversity of soil-forming factors. The type of parent material (mineral or rock material from which a soil develops) largely determines the susceptibility of the resulting soil to land use impacts.

In the Puget Lowlands and North Cascade Foothills, past glaciation has formed thick layers of fine-grained glacial lake sediments, coarse-grained outwash, and till. Many of these sediments are very compact, having been overridden by thousands of feet of ice. Glacial meltwater and river and marine erosion have left over-steepened slopes on the margins of river valleys and marine shorelines, which are often highly susceptible to a large variety of landslide types.

Rock falls and complex rock slides are dominant in the steep bedrock slopes of the North Cascade Range. In the South Cascade Range, shallow landslides generating debris avalanches and flows are common on steep slopes and drainages. Soils on mountain slopes and ridge tops can compact easily because of coarse textures. Volcanic ash is a common parent material and compacts easily when wet.

On the Olympic Peninsula, lowlands and major river valleys are underlain by sediments derived by glaciation, which are in turn underlain by very weak sedimentary and volcanic rocks. Large landslide complexes are widespread along Hood Canal and lower reaches of the major river valleys. Landslides are also abundant in the very weak marine sedimentary rocks in western and northwestern portions of the Olympic Peninsula.

In southwest Washington, which was largely never glaciated, soils are older, deeper, and finer. The Willapa Hills are comprised primarily of very weak marine sedimentary and volcanic rocks, with weak residual soils subject to widespread landslides. Thick and deeply weathered loess deposits along the lower Columbia River valley are subject to shallow landslides and debris flows.

Soil Productivity

Soil productivity refers to a soil's capacity to support vegetation. Productivity depends on many factors, including amount of organic matter and organisms, density or porosity, and levels of carbon, nitrogen, and other beneficial nutrients. Processes affecting soil productivity include landslides, surface erosion, and soil compaction. These processes are described in detail in the *Final Environmental Impact Statement on Alternatives for Sustainable Forest Management of State Trust Lands in Western Washington* (DNR 2004) and are summarized briefly in this section as they relate to the proposed alternatives. Timber harvest and road-building activities can adversely affect soil productivity by compacting soils, changing soil temperature, removing organic layers, changing nutrient dynamics, or increasing the risk of landslide or surface erosion.

Surface Erosion

Forest practices, including harvest activities, timber hauling, and road construction, can be a source of sediment delivery to aquatic resources when they loosen or disturb sediments near or upslope of aquatic resources. Forest vegetation stabilizes soils and reduces erosion, minimizing management-induced sediment delivery to aquatic resources. Surface erosion also may impact general forest productivity over long time frames.

Soil Compaction

Water, air, and nutrients enter soils through pore spaces. Compaction is the loss of or decrease in pore space due to an external force, such as heavy machinery and road or trail construction and use. Compaction reduces the amount of water and nutrients that can be delivered to plants and also increases the risk of overland flow of water, resulting in erosion. Compaction can also result in shallow rooting, increasing the risk of windthrow or impacts of disease on forest stands.

Landslides

Landslides are the movement of a mass of rock, debris, or earth down a slope caused by natural events such as high precipitation, river bank erosion, or earthquakes. Management actions such as timber harvest and road building on potentially unstable slopes can make these slopes more susceptible to landslides.[2]

[2] The types of landslides commonly found in the analysis area are described in the *South Puget HCP Forest Land Plan* (DNR 2010, p. 78-79). How harvest and road-building activities relate to mass wasting are analyzed in Chapter 4 of the *Forest Practices Habitat Conservation Plan FEIS* (NMFS and USFWS 2006).

Protection of potentially unstable slopes is a major consideration in DNR's planning for timber harvests, road building, and road removal because landslides pose significant risks to human safety, state trust assets, public resources, and overall forest productivity. DNR identifies and verifies areas of landslides and potentially unstable slopes on forested trust lands at the site scale during individual timber sale planning and layout. For landscape-scale planning projects, DNR uses the best available information from a variety of screening tools to estimate the occurrence of potentially unstable landforms. Screening tools include slope hazard models, watershed scale inventory data, light detection and ranging (LiDAR), and other mapping tools. The features identified using these tools reflect places in which DNR suspects there could be potentially unstable slopes.

The availability and accuracy of screening tools varies across DNR-managed land. Inventory and remotely sensed data are intended to trigger field verification at the time of harvest planning. Field verification may find that no potentially unstable slope actually is present, may find new areas of potential instability, or may change the extent of the mapped hazard. Potentially unstable areas are present throughout the analysis area. In long-term forest cover, a majority of the land identified as potentially unstable is already in a long-term deferral or conservation status.[3] Unstable slopes continue to be identified as screening tools are updated through remote sensing and field assessment.

■ Existing Policies and Regulations

DNR manages its forestlands to reduce the risk of increasing landslide potential, surface erosion, and compaction, and loss of soil productivity.

All forest management activities occurring on DNR-managed lands must comply with *Washington's Forest Practice Rules* (Title 222 of the Washington Administrative Code (WAC)), which regulate all activities that would affect slope stability, erosion, and productivity. The *Washington State Forest Practices Board Manual*,[4] *Policy for Sustainable Forests*, and the 1997 HCP also guide DNR's management activities that may impact potentially unstable slopes and soils.

Regulating Activities That Can Damage Soils

Timber harvest and road and trail building, maintenance, and use can damage soils. DNR timber sales contracts include clauses requiring equipment limitations for timber harvesting to minimize or avoid soil compaction. The state forest practices rules and board manual are designed to ensure that DNR road construction, maintenance, and abandonment do not cause damaging soil erosion that will affect the stream network or contribute to the frequency or severity of slope failure. DNR's *Policy for Sustainable Forests* also sets the expectation that DNR will minimize the extent of the road network and that the design, location, and abandonment of forest roads be carefully considered in regard to the impacts to the

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[3] Areas identified using the "UNSTABSLPS" field in DNR's large data overlay created in September 2015. The "UNSTABSLPS" field indicates the type/presence of an "important" unstable slope polygon originating from the Forest Practices Landslide Inventory and Hazard Zonation and DNR's Trismorph GIS layer.

[4] Refer to Section 3, Guidelines for Forest Roads, and Section 16, Guidelines for Evaluating Potentially Unstable Slopes and Landforms.

environment. Trail construction and maintenance follow U.S. Forest Service (USFS) guidelines,[5] which are designed to minimize potential soil erosion. SEPA may require additional review of projects with potential operational effects on soil and water quality.

Preventing Landslides in Potentially Unstable Areas

For proposed timber harvests and road building projects, DNR geologists assist foresters and engineers in identifying and protecting areas that are potentially unstable to reduce the risk of management-related landslides. When a DNR geologist identifies potentially unstable slopes in a proposed project area based on available screening tools such as geographic information system (GIS), aerial photos, or other data sources, he or she works with the forester or engineer to do a preliminary field visit and look for indicators of instability on the ground. During the field visit, the geologist assesses the risk of slope failure. If risks are deemed too high, the project will be halted or redesigned to avoid and mitigate the risks.

[5] Refer to *USFS Standard Trail Plans and Specifications* (2014) and *Trail Construction and Maintenance Notebook* (2007).

3.2 Climate

This section describes the major drivers of climate change and how DNR-managed resources and other elements of the environment within the analysis area are expected to be affected by potential climate change.

Why Is Climate Change Important?

Forest resources are vulnerable to climate change. It is important to understand the potential effects of climate change on environmental conditions for a long-term conservation strategy. A long-term conservation strategy depends on structurally complex long-term forest cover, and it is therefore also important to understand how a change in DNR management activities proposed under the alternatives may or may not exacerbate potential effects of climate change.

Current Conditions

Natural drivers alone cannot explain recently observed warming at the global scale (Gillett and others 2012). There are multiple lines of evidence that humans have been a primary driver of recent warming over the past 50 years and will continue to be the primary driver of climate change into the future (Intergovernmental Panel on Climate Change [IPCC] 2013, Walsh and others 2014). Most greenhouse gas emissions from human activities have originated from the burning of fossil fuels. Deforestation (both the replacement of older forest with younger forests and conversion of forest to non-forest) has also contributed to increased atmospheric carbon dioxide.

IPCC released their fifth assessment report on climate change in 2013 (IPCC 2013). Within the report, the IPCC examined a range of potential future trends in greenhouse gas concentrations in the atmosphere, called representative concentration pathways (RCPs).[6] Unless otherwise noted, this RDEIS reports on trends informed by two of these pathways, a pathway that assumes greenhouse gas emissions peak around 2040 before declining (RCP 4.5) and a pathway that assumes greenhouse gas emissions continue to rise throughout the century (RCP 8.5, Van Vuuren and others 2011).[7]

The RCPs represent different greenhouse gas scenarios, which in turn were used as input into general circulation models. These models incorporate current understanding of key elements and drivers of the climate system to project future climate dynamics, such as trends in precipitation and temperature. Different general circulation models will model distinct climate trends even under the same RCP because

[6] Each RCP describes a distinct, plausible climate future that varies in its assumptions of land use, population growth, economic development, and energy use and demand, among other considerations (IPCC 2013). In part, the intent of these futures is to help identify potential adaptation needs and strategies, and mitigation strategies, under a range of possible futures (Moss 2010).

[7] RCP 8.5 represents the current greenhouse gas emissions trajectory.

all processes that drive climate are not completely understood, and each model uses different assumptions. For this reason, the discussion on projected future climate trends examines not only a range of RCPs when possible, but also a range of general circulation models. The majority of general circulation model trends described in the following section have been statistically downscaled to finer resolutions. Regional climate models, which use a dynamic downscaling method to better incorporate simulated general circulation models' climate patterns with local terrain, are currently limited in the Pacific Northwest in part because of modeling cost. Consequently, the assessment exclusively relies on statistically downscaled general circulation models output. Although RCP and global circulation model outputs are produced every year, projections for any given year are uncertain. Climate-related trends are therefore typically reported over 30-year periods, which is also what this RDEIS uses to inform the analysis. Our analysis also focuses on trends through approximately 2070, encapsulating the life of the 1997 HCP.

Future climate across the northwest is projected to be an exaggeration of current seasonal trends in precipitation and temperature (Rogers and others 2011, Mote and others 2013). All climate models project increases in temperatures, with the greatest temperature increases occurring during the summer months (Mote and others 2013). For the 2040 through 2069 period, average air temperatures in the Puget Sound region are projected to increase 4.2° F under RCP 4.5 and 5.9° F under RCP 8.5 relative to the 1970 through 1999 timeframe (Mauger and others 2015).

Precipitation projections are much less certain than temperature projections. Precipitation projections for 2041 through 2070 vary from a 4.5 percent decrease to a 13.5 percent increase relative to 1950 through 1999. (Mote and others 2013). However, model projections of seasonal precipitation patterns show greater consistency: the majority of models project less precipitation during the summer and more precipitation in the winter (Mote and others 2013, Mauger and others 2015). Temperature and precipitation extreme events are also projected to increase by mid-century (Mote and others 2013). These trends in precipitation and temperature will likely have environmental and ecological consequences for many of the elements of the environment analyzed in this RDEIS. These consequences are discussed in Chapter 4, "Environmental Consequences."

Effects of Climate Change on Elements of the Environment

The anticipated effects of climate change on DNR-managed elements of the environment within the analysis area are described briefly here in order to provide context for the question of how the proposed alternatives interact with a changing climate. This question will be examined in Chapter 4.

VEGETATION

Forest Conditions

Climate plays a key role in driving vegetation dynamics and bounding vegetation occurrences at broad spatial scales. Vegetation in Washington can be classified broadly as moisture- or energy-limited (Milne and others 2002, McKenzie and others 2003, Littell and Peterson 2005). In moisture-limited systems, a lack of moisture constrains vegetation growth. Productivity in moisture-limited forests is likely to become even more limited as plant water needs are exceeded by available atmospheric and soil moisture (Littell and others 2010, McKenzie and Littell 2017). In energy-limited systems, light or cold temperatures constrain vegetation growth. Examples of energy-limited forests in western Washington are productive forests in which cloud cover or competition limits available light for individuals, and higher elevation forests in which temperatures are colder. Productivity in energy-limited systems may increase at higher elevations as temperatures warm but could decline in lower elevations due to increased summer drought stress (Littell and others 2008). This potential shift in forest productivity illustrates how different factors (for example, energy and moisture) can limit vegetation within a species' range and across seasons (Peterson and Peterson 2001, Stephenson 1990, 1998).

Plant species will respond individually to a changing climate, resulting in changes to plant communities. Both statistical and mechanistic models have been used in the Northwest to examine trends in individual species (Littell and others 2010, Rehfeldt and others 2006) and broader vegetation types (Rogers and others 2011, Conklin and others 2015, Sheehan and others 2015, Halofsky and others in review). All modeling efforts project drying in the Puget Sound Lowlands, but the degree of projected changes in species composition and/or structure vary by modeling approach, assumptions in how vegetation types may respond to changes in precipitation and temperature, and climate projections used.

Studies that cover all vegetation types in western Washington project a decline in subalpine parkland[8] area due to increasing temperatures and decreased snow. Lower elevation vegetation types are likely to move upward in elevation, and species composition may shift to favor more drought-tolerant species in those locations that become more water-limited. The timing of such changes is uncertain and will at least partially depend on annual and seasonal trends in temperature and moisture and the timing and frequency of stand-replacing disturbances (refer to next section). While such changes are less likely over the next decade, changes in forest composition will occur over longer time periods with changes in climate and shifts in disturbance regimes.

Disturbances

Higher temperatures and/or below average precipitation can result in drought conditions, which can increase tree stress and mortality risk, reduce tree growth and productivity, and increase the frequency of drought-related disturbances such as insect outbreaks and wildfire occurrence (Allen and others 2015, Littell and others 2016, Vose and others 2016). Drought also can influence the regeneration success of species, potentially resulting in novel forest assemblages (Vose and others 2016). Drought severity could be amplified (Allen and others 2015, Vose and others 2016), exacerbating physical plant responses and disturbance-related events, especially in moisture-limited systems. While future temperature projections for western Washington consistently project a warmer future, precipitation projections are less certain when viewed annually. Yet future precipitation patterns are more consistent when examined seasonally, typically projecting less precipitation during the summer (refer to preceding current conditions section for additional detail). It is therefore likely that summer drought frequency and severity will be greater in the future in western Washington. However, the timing and duration of such future events is unknown (days versus months or longer), and thus, the magnitude of effects on western Washington forests is uncertain.

[8] Subalpine parkland is a high-elevation vegetation type without continuous tree cover.

In addition to drought, warmer temperatures and reduced summer precipitation will increase the likelihood of wildfire. Several studies project an increase in area burned under a changing climate (Littell and others 2010, Rogers and others 2011, Conklin and others 2015, Sheehan and others 2015, Halofsky and others in review). Most studies project at least a doubling in area burned relative to the historical fire return intervals,[9] even after accounting for some level of fire suppression. It is likely that future wildfires in western Washington will contain large patches of stand-replacing fire, given the fuel density found west of the Cascade Range (Halofsky et al. 2018) and examples from the past (Henderson and others 1989).

While wildfire is the primary mechanism of broad-scale forest renewal in western Washington, historically and currently, many coastal, westside forests are more frequently disturbed by wind than wildfire. There is little literature examining trends in episodic wind events, which disturb a larger area of the landscape in a short period of time. The only known study did not find a consistent trend in future episodic wind events for western Washington across ten general circulation models (Salathé and others 2015), suggesting future episodic wind events will statistically become no more or less frequent than in the past. With increased winter precipitation and associated soil saturation, it is plausible for windthrow events to become more common or larger with no change in wind frequency or intensity. But this line of reasoning is speculative given the lack of literature supporting the idea.

Broad trends related to forest diseases and climate are difficult to project because the current understanding of climate-pathogen relationships is limited, and climate-pathogen interactions are likely to be species and host-tree specific (Kliejunas 2011, Littell and others 2013, Wilhelmi et al. 2017, Agne et al. 2018). For example, while Swiss needle cast (*Phaeocrytopus gaeumannii)* could become more severe with warmer and wetter winters, the net effect of climate change on Swiss needle cast is unknown because of uncertainty in how warmer and drier summers will influence the disease (Agne and others 2018). However, several studies have projected that the overall area suitable for beetle outbreaks is projected to decline in western Washington (Hicke and others 2006, Littell and others 2010, Littell and others 2013). These projections indicated that beetle outbreaks will increase in frequency at higher elevations but decrease in frequency at lower elevations due to changes in year-round suitable temperatures for beetles and disruptions of life cycle events.

EARTH

As further discussed later in this section, winter flood risk is likely to increase with higher projected winter stream flows (Hamlet and others 2013) and more frequent and more intense heavy rain events (Mote and others 2013). These same mechanisms, among other factors such as a decline in snowpack, will increase the conditions that trigger landslides (Salathé and others 2014, Mauger and others 2015).

[9] Historical fire return intervals for forests in western Washington range from 200 to over 1000 years depending on vegetation type.

AQUATIC RESOURCES

More precipitation falling as rain rather than snow, reductions in snowpack, earlier snowmelt, and reduced spring snowpack have all occurred over the last 50 years with increasing temperatures (Barnett and others 2008, Hamlet and others 2005, Hamlet and others 2007, Mote and others 2003, Mote and others 2005). Such trends are likely to continue with increasing temperatures in the 21st century.

The consequences of these trends will vary by watershed type. Hamlet and others (2013) classified most western Washington watersheds as either currently rain dominant or mixed rain and snow dominant. Rain-dominant watersheds produce peak flows throughout the winter months with little precipitation resulting from snow. Mixed rain- and snow-dominant watersheds typically have two peak streamflow periods: one occurring during the fall and winter months, largely reflecting the precipitation falling as rain; and one in late spring or early summer, mostly reflecting snowmelt.

With projected increases in winter precipitation, there will be little change in winter peak flows in rain-dominant watersheds (Hamlet and others 2013). Those watersheds Hamlet and others (2013) classified as historically mixed rain-snow watersheds in western Washington, primarily found on the west slope of the Cascade Range and northeast portion of the Olympic Peninsula, are projected to become rain dominant by the 2080s under moderate warming.[10] Mixed rain and snow watersheds are more likely to display changes in timing of peak flow with increasing temperatures (Elsner and others 2010) because of projected declines in snowpack, possibly resulting in a single, earlier peak streamflow period, similar to rain-dominant basins. In addition to timing changes, flooding magnitude and frequency also are projected to increase with time (Mauger and others 2015), with notable increases occurring in watersheds currently classified as mixed rain and snow (Mantua and others 2010).

Wetlands are expected to be sensitive to changes in climate given the relationship of wetland hydrology, structure, and function to temperature and precipitation (Carpenter and others 1992, Parry and others 2007). Changes in the timing and form of precipitation, increases in temperature, and increasing frequency of summer drought, among other factors, may cause changes to wetland habitat (Lawler and others 2014).

Stream and wetland habitat for cold-water adapted species, such as salmon, steelhead trout, and bull trout, are likely to be impacted by changes in streamflow regime and increases in stream temperatures. Warmer stream temperatures and lower summer flows will increase the thermal stress experienced by salmon and possibly decrease the ability of migrating salmon to pass physical and thermal barriers (Beechie and others 2006, Independent Science Advisory Board 2007, Mantua and others 2010). An increase in winter flooding could have negative impacts on salmon eggs through scouring of the stream channel (Mantua and others 2011) and possibly change the timing of life history events (Crozier and others 2011).

[10] Hamlet and others 2013 used an emissions scenario called A1B1, which is older than the RCP emissions scenario used throughout this analysis. A1B1 results in more warming than RCP 4.5 but less than RCP 8.5.

WILDLIFE

Similar to vegetation, wildlife species will respond individually to a changing climate with some species responding positively and other species negatively. Climate change will affect the physiology, distribution, and phenology (timing of life cycle events) of species, resulting in direct effects on individual wildlife species as well as indirect effects through changes in wildlife habitat (Parmesan 2006, Parmesan and Yohe 2003). Across the Northwest, amphibians and reptiles generally are considered more sensitive to climate change relative to birds, mammals, and plants based on a combination of both expert opinion and available literature (Case and others 2015). However, individual species response will vary based on species sensitivity to habitat, disturbance regimes, and dispersal ability, among other factors (Case and others 2015). For example, some species that are generalists are considered less sensitive because they can easily disperse, use a variety of habitats and structures, and have a wide phenotypic plasticity (ability to adapt to a wide range of conditions), among other reasons (Lawler and others 2014).

Recent work by Case and others 2015 combined opinions from approximately 300 experts to assess the sensitivities of 195 plant and animal species to a changing climate across the northwest. According to a database created from the assessment, the marbled murrelet, northern spotted owl, and Taylor's checkerspot butterfly all received overall sensitivity scores of "high" based on a weighted average of sensitivity to eight individual factors (refer to Case and others 2015 for a list of factors). Overall expert confidence in their sensitivity assessment ranged from fair for the marbled murrelet and northern spotted owl to good for the Taylor's checkerspot butterfly. While the work examined species sensitivity, it did not address individual species vulnerability or risk to a changing climate. However, one of the eight sensitivities assessed by Case and others (2015) was habitat. All three species had the highest sensitivity score for habitat, indicating experts felt all three species are habitat specialists and therefore have narrow habitat niches. Expert confidence in habitat sensitivity assignment ranged from very good (the highest confidence ranking) for the butterfly to good (the second most confident ranking) for the murrelet and owl. Using data from Case and others (2015), as well as other data sources and expert opinion, Washington's State Wildlife Action Plan (WDFW 2015) examined individual species' vulnerability, defined as the sensitivity and exposure of a species to climatic factors. Marbled murrelet and northern spotted owl respectively received moderate and moderate-high vulnerability scores, which in part reflect the habitat-specialist nature of both species.

Effects of DNR Management on a Changing Climate

While DNR's contribution to global carbon emissions may be small, DNR's possible contribution to a changing climate is considered in this RDEIS because global impacts are the result of the sum of individual emissions. Carbon is the leading type of greenhouse gas emitted.[11] A primary source of carbon emissions from DNR-managed lands occurs following tree harvest, during the process of creating wood products such as lumber and paper. Additional carbon emissions occur from nursery operations, and vehicle and equipment emissions related to all timber activities. Primary sources of carbon sequestration (capture and storage) on DNR-managed lands are tree growth, harvest deferrals, and carbon storage in long-term wood products such as timber rather than paper products. Carbon sequestration in soils and

[11] Refer to https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data.

release of carbon from soils via decomposition will vary depending on management intensity. Whether DNR-managed lands sequester and store more carbon than is emitted is analyzed in Chapter 4, “Environmental Consequences.”

■ Existing Policies and Regulations

The Council on Environmental Quality maintains greenhouse gas tools that agencies can use in their NEPA review, such as implementing the Forest Vegetation Simulator to estimate changes in carbon stocks over time due to succession and both anthropogenic (human caused) and natural disturbances.[8] DNR used a complementary approach in the analysis of environmental consequences in Chapter 4 (refer to Chapter 4 for more information). Although DNR does have climate and carbon principles, DNR does not currently have a policy that specifically addresses climate change. Nonetheless, existing language in the *Policy for Sustainable Forests* (DNR 2006) provides silvicultural flexibility and both forest health and natural disturbance-response guidance that should facilitate an adaptive agency response to a changing climate.

3.3 Vegetation

This section of the RDEIS describes the current conditions of vegetation in the analysis area, including both general forest conditions as well as vegetation in special management or conservation status. Forest conditions directly related to climate change, riparian areas, and wildlife habitat are described in other sections of this chapter.

Forest in the OESF. Photo: Richard Bigley

Why Is Vegetation Important?

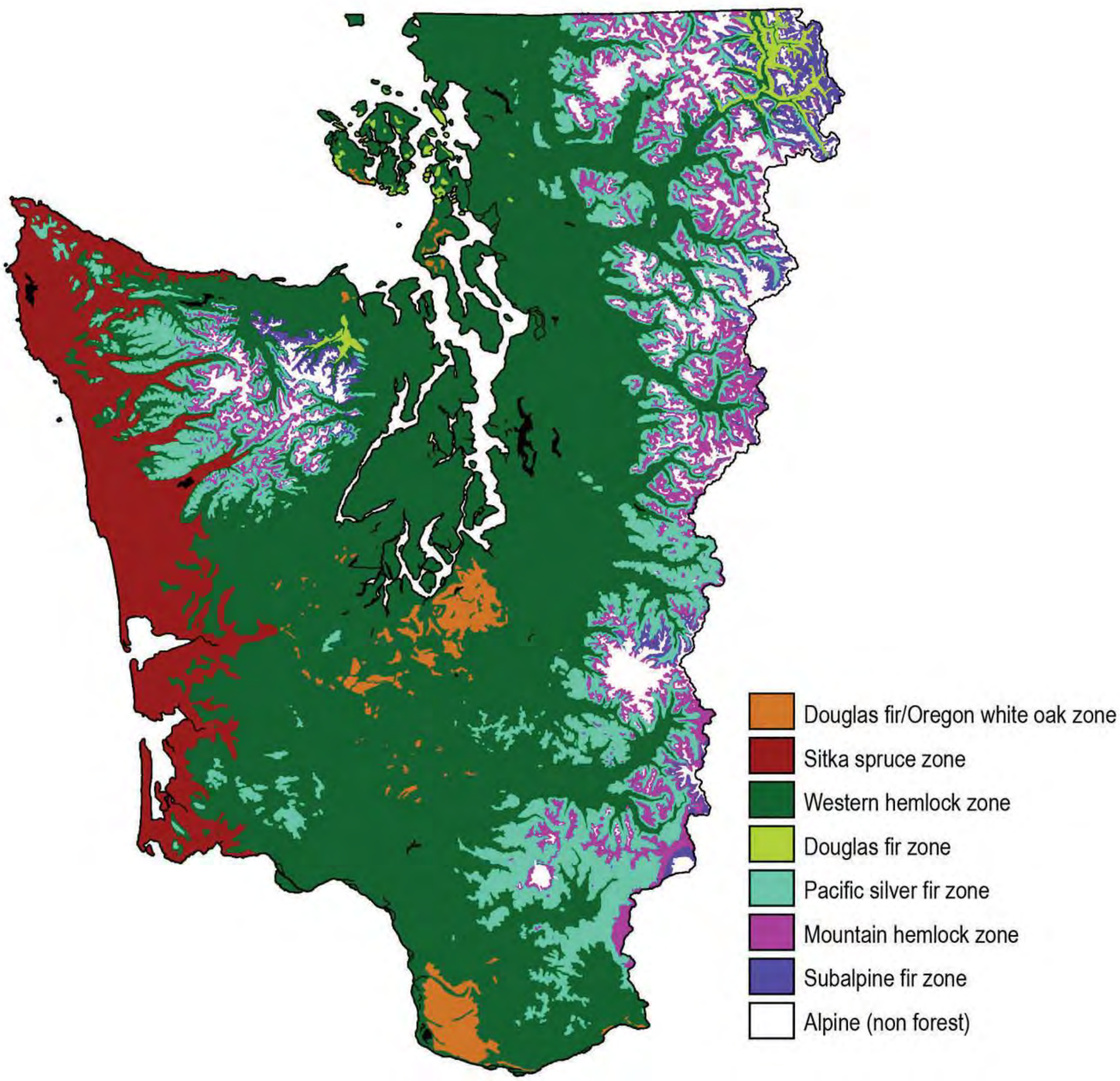
Areas of structurally complex, long-term forest cover provide potential nesting opportunities for the marbled murrelet. The proposed alternatives change the management of vegetation on a small percentage of forestlands in the analysis area to support the development and maintenance of this type of forest.

Current Conditions

DNR maintains data from various sources on forest conditions in the analysis area. The following section summarizes the existing conditions of forestlands in the analysis area in order to understand potential impacts from the alternatives.

The analysis area contains a great diversity of forested habitats. The steep, mountainous topography of western Washington has dramatic effects on precipitation and temperature. Accordingly, tree species have become stratified by their tolerance and competitive abilities. In *The Natural Vegetation of Oregon and Washington,* Franklin and Dyrness (1973) separate the region into vegetation zones based on the dominant tree species. In the simplest terms, western Washington can be divided into seven vegetation zones (Figure 3.3.1).

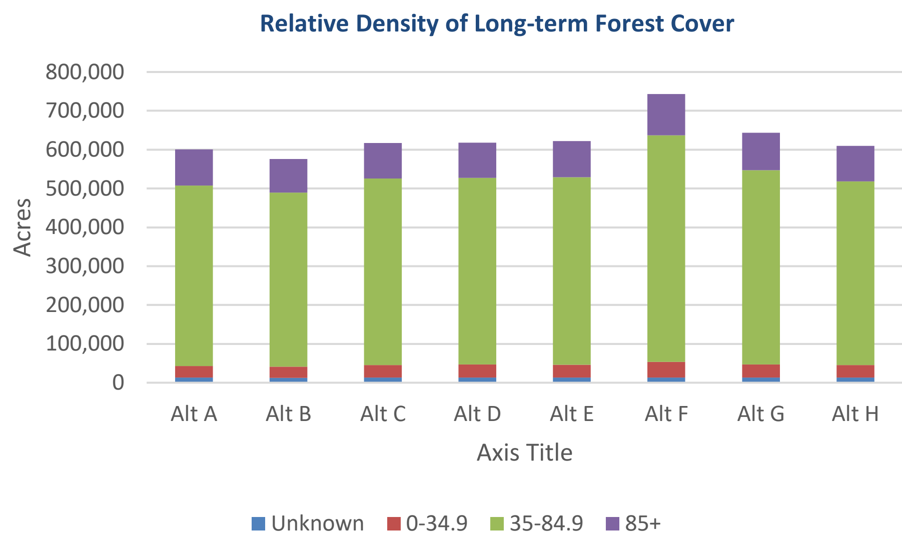
Figure 3.3.1. Potential Natural Vegetation Zones of Western Washington (Van Pelt 2007)



General Forest Conditions

Forests on DNR-managed lands in western Washington generally reflect a history of active timber harvest; however, there are some stands that have never been harvested. Over 80 percent of DNR-managed forests in the analysis area are dominated by Douglas fir or western hemlock. Areas of long-term forest cover also are dominated by these species, although with a higher proportion of forests dominated by western hemlock than by Douglas fir. Most forest stands within long-term forest cover have a relative density below 85 (Curtis 1982), while between 14 and 15 percent of stands have relative densities over 85 depending on the alternative (Figure 3.3.2). High stand density can be related to increased risks from weather and disease in the presence of other risk factors, such as landscape position, soil, and climate (Powell 1999, Mitchell 2000).

Figure 3.3.2. Current Proportional Distribution of Acres in Long-term Forest Cover by Stand Density Class (Curtis' Relative Density), by Alternative



Forest Health Issues

DNR, in conjunction with USFS, conducts annual aerial forest health surveys (Betzen and others 2017). The 2017 survey detected several sources of damage to forests in the analysis area, mostly from insects and bears (refer to Table 3.3.1). Several root diseases are common in western Washington and are likely present in long-term forest cover (refer to Table 3.3.2). In order to address forest health issues, DNR manages its forest consistent with its policy on forest health in the *Policy for Sustainable Forests* (DNR 2006, p. 32). Forest health strategies include adjusting stand composition to favor species best adapted to the site, incorporating other cost-effective forest health practices into the management of forested state trust lands, and working closely with the scientific community, other agencies, and other landowners to effectively address forest health issues (DNR 2006, p. 32).

Table 3.3.1. Forest Damage in the Analysis Area, Measured in 2017 and 2015 (Betzen and Others 2017, Dozic and Others 2015)

Source of Forest Damage Detected	Damaged Area
Douglas-fir beetle (*Dendroctonus pseudotsugae*)	938 acres
Damage from black bears (*Ursus americanus*)	~2 trees per acre over 11,800 acres
Swiss needle cast (*Phaeocryptopus gaeumannii*)	1,400 acres severe, 48,000 acres moderate
Douglas-fir engraver (*Scolytus unispinosus*)	25 acres
Fir engraver (*Scolytus ventralis*)	406 acres
Silver fir beetles (*Pseudohylesinus sericeus*)	6 acres

Table 3.3.2. Common Root Diseases in Western Washington (Dozic and Others 2015)

Disease name	Host species
Black stain root disease (*Leptographium wageneri*)	Douglas fir
***Armillaria* sp.**	All conifers
Laminated root rot (*Phellinus sulphurascens*)	Douglas fir
Annosus root disease (*Heterobasidion irregulare* and *Heterobasidion occidentale*)	All conifers

As described in Sections 3.2 and 4.2, a changing climate may bring increased disturbance events such as fire or disease, although trends are difficult to predict and may not necessarily increase during the planning period. Many of these disturbances are outside of DNR's control, although DNR does conduct forest health treatments in some stands to increase wind firmness and resilience to wildfire. Such activities are consistent with DNR policy. Section 4.2 discusses the potential for climate-related loss of forest structure in long-term forest cover.

Vegetation in Special Management or Conservation Status

DNR-managed forestlands within the analysis area includes vegetation that is managed for conservation purposes pursuant to the 1997 HCP, the *Policy for Sustainable Forests*, or state law. These lands are managed primarily to maintain habitat for protected species, biodiversity, or unique natural features of regional or statewide significance.

OLD GROWTH

DNR policy generally defers from harvest old-growth stands (stands 5 acres and larger that originated naturally before the year 1850), as well as very large-diameter, structurally unique trees. Old growth within the analysis area is included as long-term forest cover under every alternative. According to DNR inventory information, there are approximately 88,000 acres of potential old growth in western Washington, with 60 percent of those acres demonstrating a high potential to be old growth (DNR 2005).

GENETIC RESOURCES

DNR protects the genetic resources of its native tree populations by deferring from harvest a system of gene pool reserves, which are naturally regenerated, Douglas-fir stands well adapted to local conditions. Gene pool reserves generally are located in forestlands that are protected for other reasons (as potentially unstable slopes, old growth, or riparian areas). There are approximately 2,400 acres of gene pool reserves in long-term forest cover under each alternative.

NATURAL AREAS

As described in Chapter 1, DNR manages two types of natural areas defined by state law: natural area preserves and natural resources conservation areas. These areas protect native ecosystems, rare plant and animal species, or unique natural features. Both types of natural areas are covered under the HCP and are included in long-term forest cover for this RDEIS. Natural area preserves are managed under the State of Washington *Natural Heritage Plan,*[12] and some natural area preserves also have site-based management plans. The natural resources conservation areas are managed under the *State of Washington Natural Resources Conservation Areas Statewide Management Plan*[13] or individual management plans.

Natural areas are managed primarily for the protection of important biological or ecological resources, including plant communities that are in good to excellent ecological condition and some examples of mature forest. Research, environmental education, and low-impact recreation activities also occur on these lands. Natural areas are protected under state law from conversion to non-conservation uses. A summary of the status and management of these lands can be found in the 2014 *State Trust Lands HCP Annual Report* (DNR 2015).[14]

There are approximately 85,000 acres of forested natural areas within long-term forest cover. Some of these natural areas maintain marbled murrelet habitat by protecting late-seral forests with potential nesting platforms. Natural areas managers work with DNR biologists and consult with USFWS as necessary to avoid, minimize, and mitigate potential impacts from activities or projects in marbled murrelet habitat. Such activities can include new recreational facilities in natural resources conservation areas or forest restoration.

RARE PLANTS AND HIGH-QUALITY ECOSYSTEMS (SPECIAL ECOLOGICAL FEATURES)

The *Policy for Sustainable Forests* specifies that DNR will identify forested state trust lands with "special ecological features" of regional or statewide significance. This task is informed by the *Natural Heritage Plan*, which identifies and prioritizes plant species and ecosystems for conservation. Rare plants and high-quality ecosystems are priorities for inclusion as natural areas. DNR's Natural Heritage Program maintains a comprehensive database on rare plant species, communities, and their locations. The database of known locations is consulted by DNR's regional foresters when planning timber sales activities, with the intent of avoiding impacts to special ecological features. Thirty four species of rare plants are currently known to occur within long-term forest cover under any alternative (refer to Appendix K for a list of species).

Federally listed, threatened plants within the analysis area include water howellia and golden paintbrush. The habitat of these plants is covered under the 1997 HCP, but they are not known to occur in forested habitat on DNR-managed lands.

PLANTS ASSOCIATED WITH UNCOMMON HABITATS

DNR's conservation strategies in the 1997 HCP provide measures to protect wildlife species that rely on uncommon habitats or uncommon habitat elements (DNR 1997, p. IV.151). These measures specifically protect features such as talus, caves, cliffs, oak woodlands, large snags, and large, structurally unique

[12] Available at https://www.dnr.wa.gov/publications/amp_nh_plan_2018.pdf?x4do1.
[13] Available at http://www.dnr.wa.gov/Publications/amp_nrca_statewide_mgt_plan_9_1992_2.pdf.
[14] Available at http://www.dnr.wa.gov/publications/lm_trust_lands_hcp_annual_rprt_2014.pdf.

trees. These uncommon wildlife habitats are included as long-term forest cover and provide conditions for different types of vegetation, and in some cases, unique vegetation. Oak woodlands, composed of the only native oak in Washington, the Oregon white oak, have been designated a priority habitat by the Washington Department of Fish and Wildlife (WDFW). Talus and cliffs can provide conditions for pioneering vegetation, while cliffs provide conditions for shade tolerant vegetation. DNR’s regional foresters consult with staff biologists when planning timber sales activities with the intent of conserving these features.

3.4 Aquatic Resources

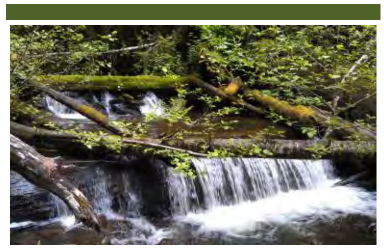
This section describes the existing conditions of riparian habitat, wetlands, water quality and quantity, and fish populations and habitat within the analysis area, which this RDEIS refers to collectively as aquatic resources.

The Joint Agencies often consider these elements of the environment individually when reviewing proposed actions. However, for this RDEIS, the Joint Agencies are considering these elements collectively because all of them would be affected by the alternatives in similar ways, by similar means, and to similar degrees.

Why Are Aquatic Resources Important?

Aquatic resources provide a valuable suite of functions and ecosystem services, such as improving water quality and providing fish and wildlife habitat. DNR's management philosophies are based largely on the underlying assumption that maintaining the hydrologic functions of wetlands and riparian areas is essential to maintaining the health and function of forest ecosystems on state trust lands (DNR 2006, p. 36). All forested aquatic resources in the analysis area are considered part of long-term forest cover.

Text Box 3.4.1. What Is Riparian Habitat?



Riparian habitat is located where land and water meet along the edges of streams and lakes.

Riparian areas include stream banks, adjacent floodplains, wetlands, and associated riparian plant communities.

Water quality and quantity are directly related to riparian function, as are fish populations and habitats.

Current Conditions

Riparian and Wetland Habitat

Approximately one-third of all DNR-managed lands within the analysis area is forested riparian or wetland habitat. This habitat was modeled by applying the 1997 HCP riparian management buffers to current DNR stream and wetland data. Forested areas within these modeled buffers were designated as long-term forest cover under each alternative.

Waters

RIVERS AND STREAMS

The *Policy for Sustainable Forests* and 1997 HCP include protection for Type 1 through 5 streams.[15] The level of protection for these streams is based on the specific nature of the stream channel and its position relative to fish-bearing stream habitat.

WATER QUALITY

Washington State Department of Ecology's *Water Quality Assessment* lists the water quality conditions for water bodies in the state, as required under Section 303(d) of the Clean Water Act (Ecology 2016). Not all streams have been assessed for this list, and forest streams generally are not a priority for 303(d) listing due to the regulatory framework in place to protect water quality in working forests. Only localized areas of non-compliance (or inconsistent compliance) with water quality standards are listed for state trust lands. For example, in the OESF HCP Planning Unit, out of nearly 3,000 miles of streams on state trust lands, only 10 miles are on the 303(d) list for failure to consistently meet the criteria for stream temperature, dissolved oxygen, turbidity, or fecal coliform bacteria (DNR 2013).

WATER QUANTITY

Timber harvest and associated roads can increase stormwater runoff that is delivered to rivers, streams, and wetlands. Peak flows and discharges are of the greatest concern; these flows and discharges occur within the analysis areas primarily during fall and winter, when Pacific storms deliver large amounts of precipitation to the region. DNR minimizes the effects of peak flows through watershed-level planning and operating procedures. DNR ensures that sufficient amounts of hydrologically mature forest is maintained in each watershed to prevent detectable increases in peak flows that could impact water quality.

Fish

At least nine native species of resident and anadromous salmonids occur in rivers and streams crossing state trust lands in the analysis area (NMFS and USFWS 2006, Table 3-21). In addition, several salmonid species in the analysis area are currently listed under the Endangered Species Act. Numerous other native fish species, including minnows, suckers, sculpins, and three species of lamprey, also are distributed in water bodies throughout the analysis area. Appendix J contains a list of these species and their general distribution within the analysis area.

[15] DNR stream types are based on *Washington Forest Practices Board Emergency Rules* (stream typing) from November 1996.

Existing Policies and Regulations

Forest Practices Rules

Text Box 3.4.2. How Are Aquatic Resources Managed?

Aquatic resources on DNR-managed lands are protected by an extensive framework of regulations, policies and plans.

This RDEIS considers these existing protections when evaluating potential adverse effects of the alternatives on aquatic resources.

All forest management activities on non-federal lands in Washington are regulated under the state forest practices rules (WAC 222). The rules establish standards for forest practices such as timber harvest; pre-commercial thinning; road construction, maintenance and abandonment; hydraulic projects (water crossing structures); fertilization and forest chemical application; and specific wildlife species protections. Many of these standards serve to protect aquatic resources.

The rules allow landowners with an HCP to be exempt from certain sections of the forest practices rules if they apply protections that will achieve at least the same level of protection as the rules. DNR applies its 1997 HCP riparian conservation strategies, described in the following section, for several activities, including delineating riparian management zones.

Riparian Conservation Strategies

For state trust lands, riparian conservation is implemented through two riparian conservation strategies in the 1997 HCP. One strategy applies specifically to the OESF HCP Planning Unit and another applies to the remaining westside HCP planning units. (The latter is implemented through the *Riparian Forest Restoration Strategy* [RFRS].)

Both strategies establish riparian management zones to protect salmonid-bearing streams and some non-fish-bearing streams. The OESF riparian conservation strategy uses a watershed analysis approach to achieve riparian restoration objectives set by the 1997 HCP. A limited amount of harvest, including thinning, can be permitted in riparian zones, depending on this watershed analysis. The RFRS provides direction on how to develop site-specific riparian forest prescriptions to achieve desired future conditions on stream reaches.

The 1997 HCP does not allow variable retention harvest[16] of forested wetlands. Thinning is permitted in the wetland management zone.

[16] Refer to Chapter 7 for definition.

3.5 Wildlife and Biodiversity

This section describes wildlife species and overall wildlife diversity in the analysis area.

Black Bear. Photo: WDFW

Why Is Wildlife Important?

Many of the species associated with the habitat provided in long-term forest cover, while not particularly rare, are nevertheless important for recreational, economic, cultural, and ecological values. Long-term forest cover also includes the habitat of some species listed under the Endangered Species Act, which are covered by the 1997 HCP.

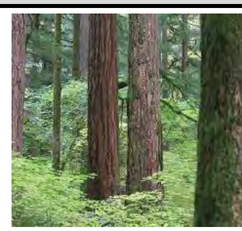
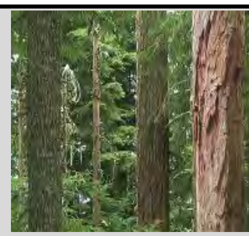
The analysis area has a variety of forested habitats that support these species, with some variability in the amount and distribution of this habitat depending on the alternative. This section describes the current species and overall wildlife biodiversity within the analysis area. Special emphasis is given to a discussion of northern spotted owls (*Strix occidentalis caurina*), whose habitat overlaps significantly with marbled murrelet habitat.

Current Conditions

Wildlife Habitat

DNR classifies forested stands into "stand development stages" that represent the general progression of growth and structural development of forests over time. Table 3.5.1 summarizes these stages and the number of wildlife species closely associated with them. The greatest diversity and abundance of wildlife occurs in the early ecosystem initiation stage and in the later structurally complex stages (Johnson and O'Neil 2001, Carey 2003).

Table 3.5.1. Stand Development Stages and Associated Wildlife Species Diversity

Stand development stage[a]		Approximate acres within the analysis area	Number of species closely associated with stage[b]
Ecosystem Initiation Begins soon after most overstory trees have been removed by harvest or natural events. This stage is known to support a high number of wildlife species, particularly as foraging habitat.		123,000	70
Competitive Exclusion Trees fully occupy the site, competing for light, water, nutrients, and space. Dense overstory means there are few or no shrubs or groundcovers and relatively little wildlife use.		1,093,000	6
Understory Development Overstory trees die, fall down, or are harvested, creating gaps in the canopy. An understory of trees, ferns, and shrubs develops. This process can be accelerated through active management.		55,000	6
Biomass Accumulation Numerous large, overstory trees rapidly grow larger in diameter, producing woody biomass. Forest stands lack large snags or downed woody debris in this stage.		25,000	11
Structurally Complex Approaching conditions of natural older forests with multiple tree and shrub canopy layers, dead and downed logs, and a well-developed understory. Multiple tree canopies are present, supporting diverse vertebrate and invertebrate species.		83,000	70

[a] Adapted from OESF FEIS, p. 3-28.

[b] Habitat associations are based on Brown 1985 and Johnson and O'Neil 2001.

Thinning is a silvicultural strategy that DNR uses to move dense stands (stands in the competitive exclusion stage) into a more structurally complex stage. Thinning dense stands of relatively low value wildlife habitat can expedite the transition over time into more variable stands containing physical elements important to forest wildlife, including snags, large trees, and diverse shrub and ground covers.

Wildlife Species

This RDEIS uses wildlife "guilds" to describe species that will be most affected by various forest conditions expected to be created or altered by the alternatives. A guild is a group of species utilizing the same class of resources in a similar way. It is hypothesized that these groups of species could be affected in similar ways by the alternatives. In addition, this section describes wildlife species that are especially important to consider because of their sensitivity to disturbance, low population levels, or recreational, commercial, cultural, and ecological values.

The guilds, which are based on habitat associations described by Brown 1985 and Johnson and O'Neil 2001, are as follows:

- The **early successional guild** is composed of the many species that are associated primarily with very young forest stands (ecosystem initiation stage), including deer, elk, small mammals, migratory songbirds, and several species of bats.
- The **late successional guild** is composed of species that are primarily associated with the structurally complex forest stage. Representative species include the northern goshawk, northern pygmy owl, brown creeper, Vaux's swift, Townsend's warbler, northern flying squirrel, and black bear (for denning).
- The **edge guild** is composed of species that use the edges between early stages, such as competitive exclusion, and later stages. Representative species include the red-tailed hawk, great horned owl, Cascades fox, and mountain lion.
- The **interior guild** is composed of species that avoid edges or otherwise require large blocks of interior forest. Representative species include the pygmy owl and several species of migratory songbirds.
- The **riparian guild** is composed of species closely associated with streams and nearby upland habitat. Representative species include several species of amphibians and migratory songbirds, as well as aquatic mammals such as minks and beavers.

STATE-LISTED, CANDIDATE, SENSITIVE AND REGIONALLY IMPORTANT SPECIES

Appendix L provides a list of state-listed, candidate, and sensitive species present within the analysis area and their primary forest habitat associations. Appendix L also provides a table of species of regional importance, including those species that are important for recreational, commercial, cultural, or ecological values. This RDEIS focuses on those species of state and regional importance that are highly dependent on specific forest conditions that may vary among the alternatives.

FEDERALLY LISTED SPECIES IN THE ANALYSIS AREA

Several federally listed terrestrial species are found in forested habitats or openings within forested areas in the analysis area. The species in Table 3.5.2 occur, or may occur, on HCP-covered lands within the analysis area. (Fish species are discussed in Section 3.4, "Aquatic Resources.") The 1997 HCP provides conservation for these species. These species are currently covered or are likely to be covered under the 1997 HCP in the near future. The HCP implementation agreement (IA 25.1(b)) describes the process for adding coverage when species are listed.

Table 3.5.2. Terrestrial Wildlife in the Analysis Area Listed as Threatened or Endangered Under the Endangered Species Act

	Species	Listing status
Mammals	Columbian white-tailed deer (*Odocoileus virginianus leucurus*)	Endangered
	Gray wolf (*Canis lupus*)	Endangered
	Grizzly bear (*Ursus arctos horribilis*)	Threatened
	Mazama pocket gopher (*Thomomys mazama subspecies*)	Threatened
Birds	Streaked horned lark (*Eremophila alpestris strigata*)	Threatened
	Northern spotted owl (*Strix occidentalis caurina*)	Threatened
	Marbled murrelet (*Brachyramphus marmoratus*)	Threatened
	Snowy plover (*Charadrius alexandrinus nivosus*)	Threatened
	Western yellow-billed cuckoo (*Coccyzus americanus*)	Threatened
Amphibians	Oregon spotted frog (*Rana pretiosa*)	Threatened
Invertebrates	Oregon silverspot butterfly (*Speyeria zerene hippolyta*)	Threatened
	Taylor's checkerspot butterfly (*Euphydryas editha taylori*)	Endangered

The 1997 HCP, which covers DNR-managed forestlands within the range of the northern spotted owl, is a multispecies conservation strategy. DNR's current incidental take permit covers several listed species. Within the six westside HCP planning units, species that are newly listed under the Endangered Species Act can be added to DNR's incidental take permit (DNR 1997, p. B.12).

Northern Spotted Owl

The northern spotted owl was listed as threatened under the Endangered Species Act in 1990 (55 FR 26114) because of widespread loss of habitat across the owl's range. More recently, and based on the best available scientific information, competition from the barred owl (*Strix varia*) poses a significant and complex threat to the northern spotted owl (*Revised Recovery Plan for the Northern Spotted Owl*, USFWS 2011).

The 1997 HCP has a comprehensive approach to conserving the northern spotted owl on DNR-managed forestlands. The conservation objective is to provide habitat that makes a significant contribution to demographic support, maintains species distribution, and facilitates dispersal (DNR 1997, p. IV.1). In the five westside planning units (not including OESF), these objectives are accomplished primarily through the designation of dispersal areas and nesting, roosting, and foraging areas. In areas designated to provide nesting, roosting, and foraging habitat, 50 percent must be in a nesting, roosting, and foraging habitat condition (DNR 1997, p. IV.4). In areas designated to provide dispersal support, 50 percent must be in a dispersal habitat condition (DNR 1997, p. IV.9). A detailed accounting of the status of habitat within nesting, roosting, and foraging areas and dispersal areas is available in the 2015 *State Trust Lands HCP Annual Report* (DNR 2016).[17]

In the OESF HCP planning unit, the conservation strategy for the northern spotted owl identifies landscapes for maintenance and restoration of northern spotted owl habitat (DNR 1997, p. IV.88). A detailed accounting of the current amount of habitat within landscapes is available in the 2017 *State Trust Lands HCP Annual Report* (DNR 2018a).[18] The HCP directs that each landscape have at least 20 percent Old Forest Habitat and 40 percent Young Forest Habitat and better.

Existing Policies and Regulations

The 1997 HCP

Conservation strategies described in the 1997 HCP are designed to conserve currently threatened and endangered species, and to help avoid future listing of other wildlife species (DNR 1997). Specific conservation strategies are included for 1) northern spotted owls (DNR 1997, p. IV.1; for the OESF refer to p. IV.86); 2) riparian conservation that conserves salmonid freshwater habitat and other aquatic and riparian obligate species (DNR 1997, p. IV.55; for the OESF refer to p. IV.106); 3) marbled murrelets (DNR 1997, p. IV.39); and unlisted species (DNR 1997, p. IV.145; for OESF refer to p. IV.134). These various conservation strategies are intended to work together to accomplish a long-term, multispecies conservation program.

Text Box 3.5.1. What Are Biodiversity Pathways?

DNR policy is to use "biodiversity pathways" techniques—such as retaining trees and creating snags—to increase forest structure and associated wildlife habitat values in actively managed stands across the analysis area.

Policy for Sustainable Forests

The *Policy for Sustainable Forests* identifies biodiversity as one of the primary goals for landscape-level management of state trust lands (DNR 2006, p. 6).

The *Policy for Sustainable Forests* also defines DNR's general silvicultural strategy (DNR 2006, p. 46), which is to use "biodiversity pathways" (refer to Text Box 3.5.1) to increase wildlife habitat values through active forest management, including the following:

- Retaining trees and snags (biological legacies) at harvest.
- Thinning to variable densities to encourage development of an understory.
- Improving habitat by creating snags and felling trees to create structure (DNR 2004)

[17] Available at http://www.dnr.wa.gov/publications/lm_trust_lands_hcp_annual_rprt_2015.pdf.
[18] Available at https://www.dnr.wa.gov/publications/lm_trust_lands_hcp_annual_rprt_2017.pdf.

3.6 Marbled Murrelet

This section briefly describes the biology and ecology of the federally listed marbled murrelet and the current habitat conditions, population, and regulatory status of the species.

Marbled Murrelet at Sea. Photo: DNR

Why Is the Marbled Murrelet Important?

The marbled murrelet was federally listed under the Endangered Species Act as threatened in Washington, Oregon, and California in 1992. The purpose of the Endangered Species Act is to protect and recover imperiled species and the ecosystems upon which they depend. USFWS has responsibility for implementing the Endangered Species Act, with the intent of recovering the marbled murrelet so it no longer needs to be listed as a threatened species.

Marbled murrelets spend most of their lives on coastal marine waters from southern Alaska to central California. They are unique among seabirds because they nest inland from these waters in mature forests. Marbled murrelets do not build a typical nest; rather, they lay a single egg on a branch in the live crowns of coniferous trees. They use a variety of tree species, but in Washington, Douglas fir and western hemlock are the primary species associated with marbled murrelet nesting. Marbled murrelets have a tendency to return to the same nesting areas. Population declines are greater in Washington than in other parts of the species' range.

Current Population Trends and Habitat Conditions

This subsection presents information on the status and trends of marbled murrelet populations, as well as their inland[19] and marine habitat and a brief summary of recent findings on their population ecology and habitat relationships. These summaries are based largely on several recently published reviews (McShane and others 2004, Huff and others 2006, Piatt and others 2007, USFWS 2009, Raphael and others 2011, COSEWIC 2012, Falxa and others 2016). Information on marbled murrelets and inland habitat in Washington includes findings from DNR-sponsored surveys and estimates of the distribution, quantity, and quality of marbled murrelet habitat on DNR-managed lands.

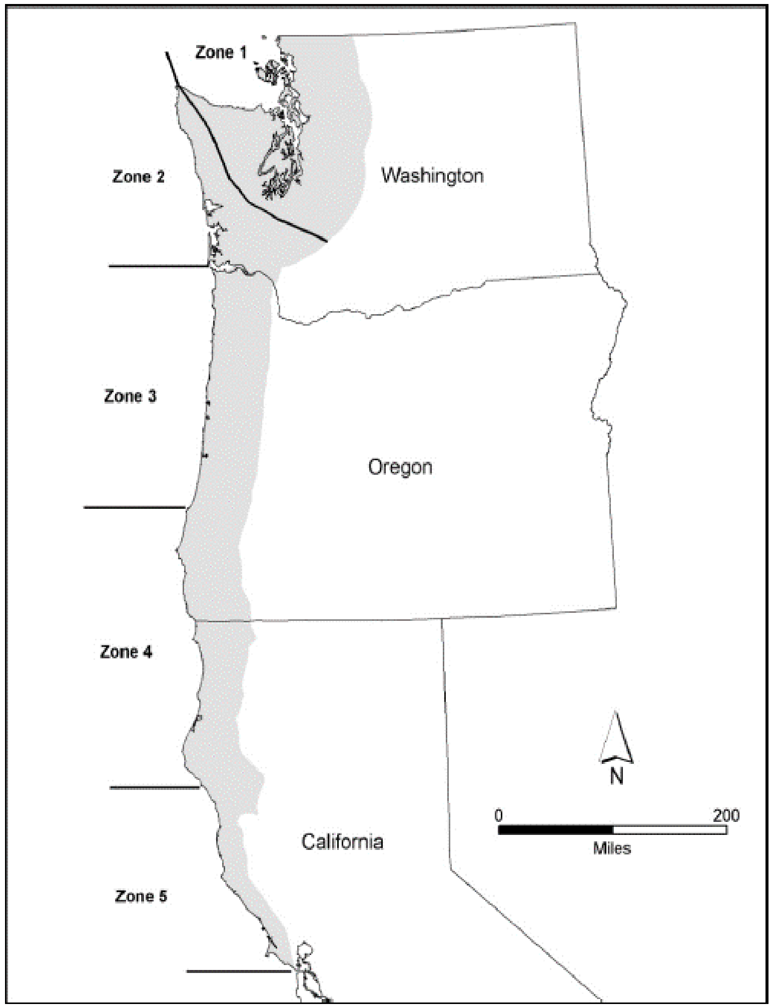
[19] Inland habitat means marbled murrelet habitat on land, in other words nesting habitat. The term "inland habitat" is used in this section and in Section 4.6 of this RDEIS to distinguish inland habitat from marine habitat.

Population Decline

The federally listed murrelet population in Washington, Oregon, and California is classified by the USFWS as a distinct population segment (75 FR 3424). Since 2000, this population has been monitored through the effectiveness monitoring program of the federal *Northwest Forest Plan*. Researchers conduct annual at-sea murrelet surveys (Madsen and others 1999, Huff and others 2006, Raphael and others 2011, Falxa and others 2016) to estimate population size and trend across the plan area, which encompasses five of the conservation zones in the *Recovery Plan for the Threatened Marbled Murrelet (Brachyramphus marmoratus) in Washington, Oregon and California* (USFWS 1997) (refer to Figure 3.6.1).

Figure 3.6.1. Five of the Marbled Murrelet Conservation Zones (USFWS 1997) That Are Monitored by the Northwest Forest Plan Effectiveness Monitoring Program

Shaded area is overlap between *Northwest Forest Plan* area and breeding distribution area of the marbled murrelet. Copied from Falxa and others 2015 (p. 44).



The marbled murrelet population is declining in Washington. Examination of population trends by conservation zone suggest a decline in Washington (Pearson and others 2018). The overall Washington murrelet population declined 3.9 percent per year between 2001 and 2016 (Pearson and others 2018).[20]

The most recent population estimate for the entire *Northwest Forest Plan* area in 2016 was 22,600 murrelets (Pearson and others 2018). The long-term trend derived from 2001 to 2016 marine surveys indicates that the marbled murrelet population across the *Northwest Forest Plan* area has increased at a rate of 0.15 percent per year. While the overall trend estimate across this time period is slightly positive, the evidence for this positive trend is not conclusive because the confidence interval for the estimated trend ranges from -1.2 to 1.5 percent (Pearson and others 2018).

[20] This population trend is different than that used in the population viability analysis (a decline of 4.4 percent). The population viability analysis is described in Chapter 4 and Appendix C.

While the direct causes for ongoing marbled murrelet population declines are not completely known, the USFWS Recovery Implementation Team concluded that sustained low recruitment (in other words, too few juvenile marbled murrelets to offset adult mortality) is the overarching cause of the continued population decline (USFWS 2012). The Recovery Implementation Team identified five mechanisms that contribute to sustained low recruitment, and therefore continued declines: ongoing and historic loss of inland habitat, predation on murrelet eggs and chicks at nest sites, changes in marine forage conditions that affect prey availability, post-fledgling mortality, and cumulative and interactive effects (USFWS 2012). Miller and others (2012) also note that loss of inland habitat over the past 20 years (an individual murrelet's potential lifespan) may be resulting in additive effects hindering populations. They also identified a reduction in the availability or quality of prey, increased densities of predators, and emigration as factors affecting survival and reproduction. More recent analysis indicates that the amount and distribution of inland habitat are the primary factors influencing the abundance and trends of murrelet populations (Falxa and others 2016). Inland habitat loss has occurred throughout the listed range of the murrelet, with the greatest losses documented in Washington, where the steepest declines of murrelet populations occurred (Raphael and others 2016).

MARINE CONDITIONS

Marbled murrelets face a variety of challenges finding food, avoiding predators, and surviving in their marine environment. Changes in prey abundance and availability are due largely to ocean conditions, harmful algal blooms, and degradation of prey resources from pollution, shoreline development, and fishing. Other human-caused risks to murrelets at sea include direct mortality from pollution, especially oil spills, and entanglement in fishing gear, as well as disturbance from vessel traffic and potential negative influences from anthropogenic global warming on marine ecosystems (Piatt and others 2007, USFWS 2009).

After inland habitat loss, within the Puget Sound and the Strait of Juan de Fuca in Washington, marine habitat degradation due to anthropogenic activities (for example, shipping lanes, boat traffic, shoreline development) is the second most important factor influencing the distribution and abundance of murrelets in the nearshore marine waters of Puget Sound and the Strait of Juan de Fuca (Raphael and others 2016). Murrelets in Washington fly long distances over marine waters to reach marine foraging habitat, in addition to the long distances they fly from inland habitat to reach marine waters (Lorenz and others 2017).

Although challenges in the marine environment are expected to contribute to marbled murrelet population declines, there is not yet a body of science to clearly identify marine conditions as the primary cause of marbled murrelet population decline. From studies of marine populations of marbled murrelets and studies of inland habitat conditions, scientists have inferred that the marine distribution of marbled murrelets during the breeding season appears to be substantially related to the abundance and proximity of large, contiguous patches of inland habitat (Miller and others 2002, Piatt and others 2007, Raphael and others 2016). For that reason, there is a conservation need to protect and develop inland habitat in close proximity to places where marine prey is abundant (Lorenz and others 2017, USFWS 2012).

AVAILABILITY OF INLAND HABITAT


Marbled Murrelet Egg in Nest. Photo: Nicholas Hatch

Habitat characteristics important to the marbled murrelet include large nesting platforms on mature trees, adequate canopy cover, and sufficient interior forest habitat (habitat away from edges) to provide security. The loss of inland habitat was a major cause of the murrelet's decline over the past century and may still be contributing as inland habitat continues to be lost to fires, logging, and windstorms (Raphael and others 2016).

Causes of Habitat Loss Within the Listed Range

Monitoring of inland habitat within the *Northwest Forest Plan* area indicates inland habitat declined from an estimated 2.53 million acres in 1993 to an estimated 2.23 million acres in 2012, a decline of about 12.1 percent (Raphael and others 2016). Habitat loss was greatest on non-federal lands, with a net loss of 27 percent over twenty years, almost entirely due to timber harvest, while fire was the major cause of inland habitat loss on federal lands (Raphael and others 2016). While most (60 percent) of the potential inland habitat is located on federal lands, a substantial amount of inland habitat occurs on non-federal lands (34 percent) (Raphael and others 2016).

Habitat models developed for the *Northwest Forest Plan* indicate approximately 1.3 million acres of potential inland habitat in Washington. Most habitat occurs on federal lands managed under the *Northwest Forest Plan* while approximately 14 percent (187,000 acres) of the potential habitat occurs on DNR-managed land. Cumulative habitat losses since 1993 have been greatest in Washington, with a 13.3 percent decline over the *Northwest Forest Plan's* monitoring period, with most habitat loss occurring on non-federal lands due to timber harvest (Raphael and others 2016). Currently, only about 12 percent of habitat-capable lands[21] in Washington contain potential inland habitat for the marbled murrelet.

As described briefly in Chapter 2 and with more detail in Appendix E DNR developed a habitat classification model (the P-stage model) to identify potential inland habitat on Washington state trust lands. The P-stage model was applied to all DNR-managed land within the analysis area using DNR forest inventory data from 2018. The P-stage model identified approximately 212,000 acres of habitat, 9 percent more than had been previously identified under the *Northwest Forest Plan*).[22]

As Table 3.6.1 illustrates, inland murrelet habitat makes up approximately 15.3 percent of total DNR-managed land within the analysis area. This habitat is distributed throughout the analysis area. In the OESF and Straits west of the Elwha River strategic location, some DNR-managed lands are adjacent to

[21] Habitat-capable land refers to areas within the *Northwest Forest Plan* boundaries capable of developing into forest.
[22] A discussion of how the P-stage model compares with other available habitat models is provided in Appendix E.

federal lands while others are not, for example the Clallam Block. The North Puget strategic location includes some DNR-managed lands that are west of federal lands and others that are adjacent to federal lands. In the Southwest Washington strategic location, DNR-managed lands are embedded in extensive industrial forests with relatively scarce and fragmented murrelet habitat, and an absence of federal lands. Southwest Washington is a priority area for murrelet habitat conservation (DNR 1997, USFWS 1997). In the marginal landscape (portions of Straits, South Puget, and Columbia planning units; refer to Appendix H) in the Puget Trough lowlands, the probability of marbled murrelet occupancy in DNR-managed forests is low. Strategic locations are described in greater detail in Chapter 2 of this RDEIS.

Table 3.6.1. Distribution of Marbled Murrelet Habitat on DNR-Managed Land, by P-Stage Class and Landscape

	P-stage (acres)								
Landscape	**0**	**0.25**	**0.36**	**0.47**	**0.62**	**0.89**	**1**	**Total Habitat**	**Total Land**
Southwest Washington	140,219	13,449	3,853	400	159	2	8,905	26,768	166,987
OESF and Straits west of the Elwha River	229,563	13,801	9,359	5,594	3,790	814	42,171	75,529	305,091
North Puget	302,945	27,958	4,715	2,615	3,572	19,137	3,834	61,831	364,775
Other high value landscape	278,842	26,543	4,589	2,722	2,332	2,486	4,420	43,092	321,934
Marginal landscape	219,960	3,498	482	223	227	0	0	4,430	224,390
Total	1,171,529	85,249	22,998	11,554	10,080	22,439	59,330	211,650	1,383,177

FACTORS INFLUENCING NEST SUCCESS

The ability of a marbled murrelet to successfully produce an egg and raise a chick is influenced by where the nest is located within the forest, predator density, and other factors. Radio-telemetry studies tracking nesting murrelets in Washington indicate that nesting success may be very low. A 5-year radio-telemetry study of marbled murrelet breeding ecology in Washington found that only 4 of 20 nests were successful in a sample of 152 murrelets tagged near the Olympic Peninsula during the 2004 through 2008 breeding seasons (Bloxton and Raphael 2009, Lorenz and others 2017). That success rate is consistent with other studies throughout the murrelet's range (for example, refer to Peery and others 2007, Barbaree and others 2014).

One factor that contributes to failed nests is predation (USFWS 1997, USFWS 2012, McShane and others 2004, USFWS 2009). Although there is uncertainty about how key elements affecting nest predation interact, predator abundance, patterns of land use and cover, proximity and type of forest edge, and proximity to human-enriched food sources all appear to play a role in nest predation risk (USFWS 2009). Corvids (jays, crows, and ravens) are known predators of murrelet eggs and nestlings, and are more abundant in patchy, fragmented landscapes and/or in landscapes with higher levels of human use (Luginbuhl and others 2001, Raphael and others 2002, Neatherlin and Marzluff and others 2004, Malt and Lank 2009). Studies of simulated marbled murrelet nests have shown that proximity to early-seral forest edge, campgrounds, and small settlements are associated with higher levels of corvid use and predation (Marzluff and others 2004, Marzluff and Neatherlin 2004, Malt and Lank 2007). In addition to predation impacts, other human activities and land uses can disturb nesting marbled murrelets, which can affect their nesting success. These activities are summarized *in Appendix H* and are quantified in Section 4.6.

Edge Conditions

A forest edge is an abrupt transition between two habitat types (refer to Section 2.4 in Chapter 2 and Appendix H for more information). Some edges are naturally occurring, created by wetlands, streams, or avalanche chutes, and others are created through human activity. Timber harvesting can create a high contrast edge along the boundary between the harvested area and the adjacent forested stands. Some types of forest edges increase the risk of disturbance to habitat and nest sites. Interior forest habitat (a forested area [patch] at least 328 feet [100 meters] from any type of edge) is better protected from the effects of predation and from many of the other disturbances that have been found to affect marbled murrelet habitat or nests. Also, changes to microclimate and the effects of windthrow are greater near forest edges than within the forest interior. Edge categories are defined as follows:

- The **inner edge** of the interior forest patch is located 167 to 328 feet (51 to 100 meters) from the edge of an actively managed forest.
- The **outer edge** of the interior forest patch is located 0 to 164 feet (0 to 50 meters) from the edge of an actively managed forest.
- A **stringer** is a long, relatively narrow (less than 656 feet [200 meters] wide) corridor of long-term forest cover that is primarily associated with riparian areas.

The adverse impacts of edges are expected to decline with distance from edge and as edge-creating stands mature (refer to Appendix H). Table 3.6.2 summarizes the current edge conditions of potential marbled murrelet habitat on all DNR-managed land in the analysis area at the beginning of the planning period (referred to as “Decade 0” throughout this analysis). How these edge conditions affect habitat quality is analyzed in Section 4.6.

Table 3.6.2. Edge Condition of Existing Murrelet Habitat on DNR-Managed Land, Decade 0

Interior	Inner edge	Outer edge	Stringer	Total
84,536 (40%)	41,368 (20%)	47,766 (23%)	37,979 (18%)	211,649

Habitat Distribution

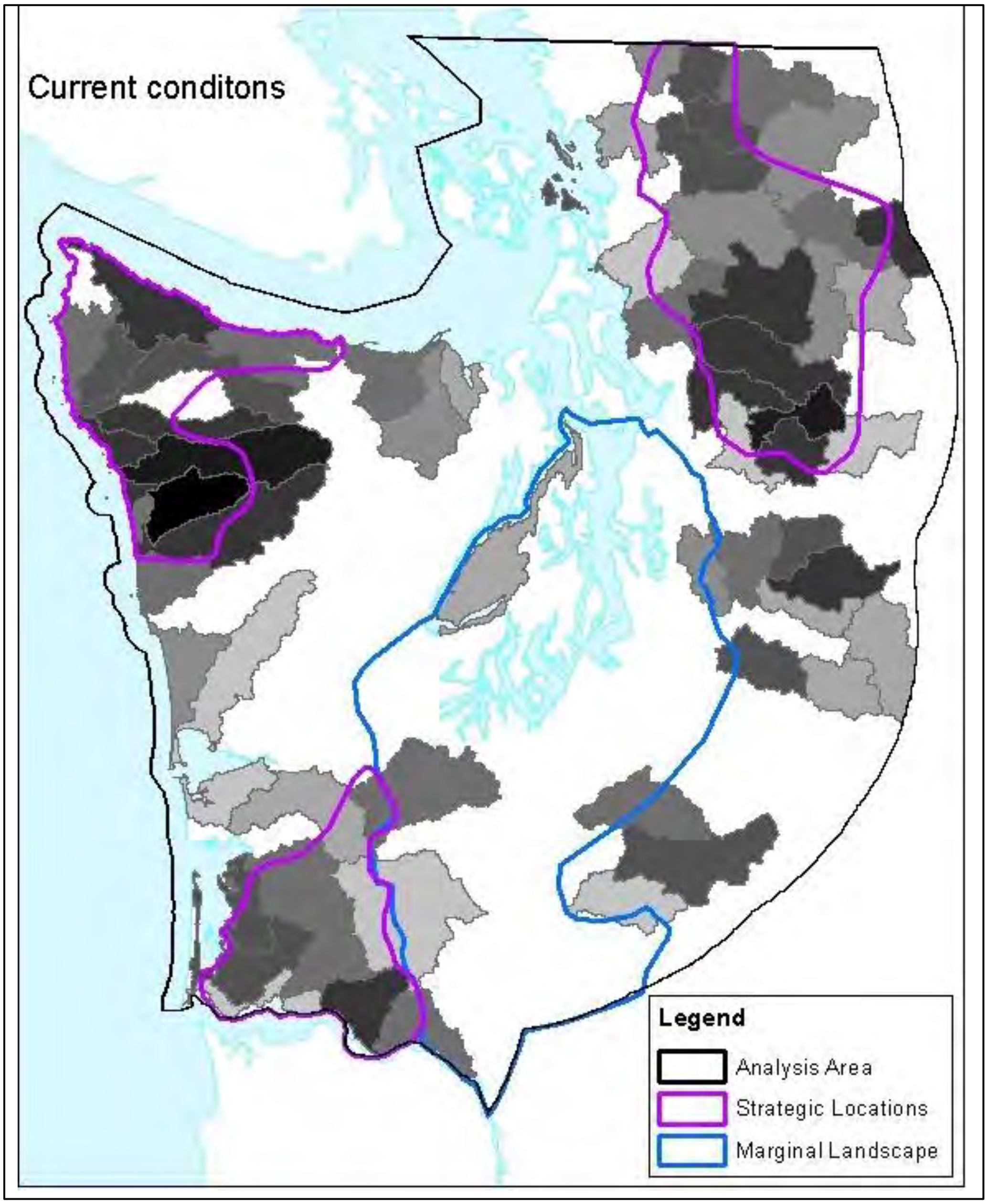
During development of the RDEIS, the Joint Agencies identified the importance of adequate distribution of inland habitat for marbled murrelets. Inland habitat that is well distributed will contribute to stable and increasing populations, increase geographic distribution, and promote a population that is resilient to disturbances (Raphael and others 2008). For the RDEIS, three new components have been added to the marbled murrelet analysis to evaluate habitat distribution: habitat location, habitat proximity to occupied sites, and habitat patch size.

- **Habitat Location:** Inland habitat is not evenly distributed across DNR-managed lands within the range of the murrelet in Washington. Instead, the majority of inland habitat is concentrated in three strategic locations: the OESF and Straits (west of the Elwha River), Southwest Washington, and North Puget, and a few watersheds[23] in the Cascade Mountains. Figure 3.6.2 shows the strategic locations and marginal landscape identified in Chapter 2.

  Currently, 62 watersheds contain at least 50 adjusted acres of inland habitat on DNR-managed lands. Fifty adjusted acres was the minimum amount considered for including a watershed in the analysis DNR conducted to assess how habitat is distributed across the landscape by watershed (refer to Section 4.6, "Habitat Distribution") because DNR management of less than 50 adjusted acres would have little influence in a watershed. Few watersheds in the marginal landscape contain more than 50 adjusted acres of habitat. Refer to Figure 3.6.2 for a map showing current conditions. In Figure 3.6.2, darker colors indicate a larger amount of habitat in a watershed.

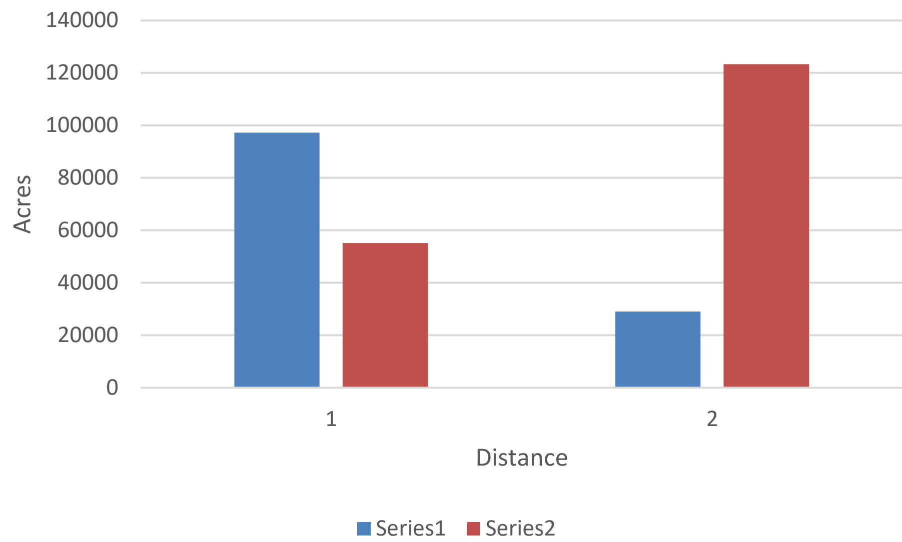
[23] For this analysis, watersheds are defined as hydrologic unit code fifth-level basins (also known as a 10 digit-HUC). Fifth-level bases are typically about 100,000 to 150,000 acres in size.

Figure 3.6.2. Current Distribution of Marbled Murrelet Habitat by Watershed (Only Watersheds With at Least 50 Adjusted Acres Included) Darker coloring indicate a larger amount of habitat within the watersheds.



- **Proximity to Occupied Sites:** Meyers and others (2002) found that murrelets are less likely to occupy habitat if it is isolated (greater than three miles [five kilometers]) from other occupied sites. For the RDEIS, the Joint Agencies analyzed the amount of habitat within 3.1 miles (five kilometers) or within 0.5 mile (0.8 kilometers) of an occupied site to understand the amount of habitat that is most likely to be occupied currently and in the future. Currently, most habitat (64 percent) is within 3.1 miles (5 kilometers) of an occupied site, while about 20 percent is within 0.5 mile (0.8 kilometer) (Figure 3.6.3). DNR's current interim strategy (as represented by Alternative A) maintains habitat within 0.5 mile (0.8 kilometer) of an occupied site for consideration in long-term conservation strategy development.

Figure 3.6.3. Acres of P-stage Within and Beyond 3.1 miles (5 kilometers) or 0.5 miles (0.8 kilometer) From an Occupied Site

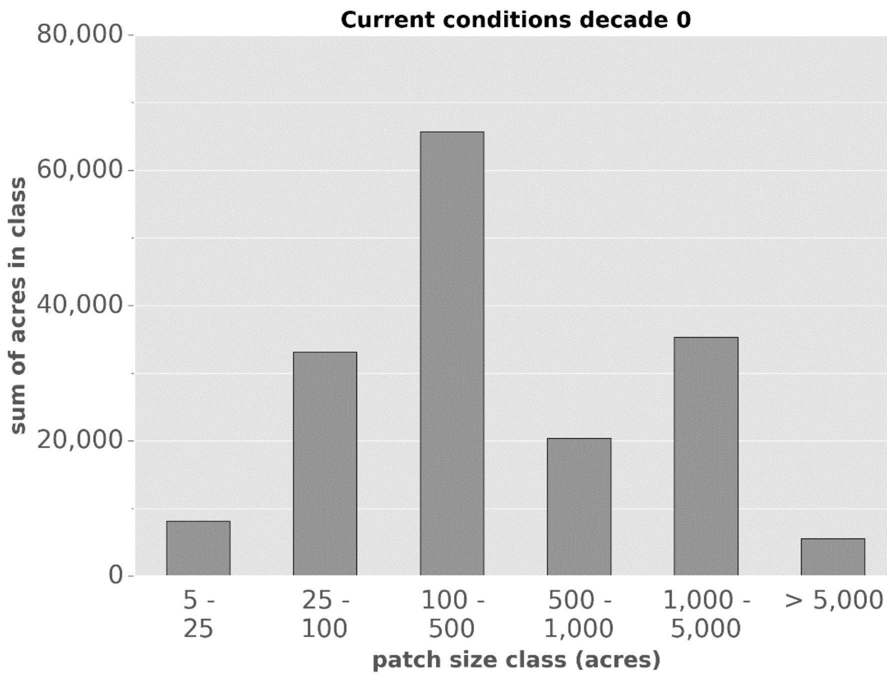


- **Habitat Patch Size:** As described under edge conditions, interior forest provides higher quality habitat than forest near an edge. In general, larger patches of habitat contain more interior forest and less edge, although this is not always true depending on patch configuration. For the RDEIS, the Joint Agencies analyzed habitat patch size. This analysis focuses on patches that are five acres or larger. The 1997 HCP marbled murrelet habitat definition identifies five acres as the minimum patch size for marbled murrelet habitat (DNR 1997). Currently, there are 174,000 acres of inland habitat in patches greater than or equal to five acres (Table 3.6.3). By area, most habitat patches are between 100 and 500 acres in size (Figure 3.6.4).

Table 3.6.3. Current Size Distribution of Habitat Patches

	Number of patches greater than or equal to 5 acres	Sum of area in patches greater than or equal to 5 acres	Number of large patches (greater than or equal to 1000 acres)	Sum of area in large patches (greater than or equal to 1000 acres)
Current	1,538	174,000	20	46,000

Figure 3.6.4. Current Size Distribution of Habitat Patches



Existing Policies and Regulations

Federal Designation of Critical Habitat

Critical habitat for the marbled murrelet is designated on over 3.69 million acres in Washington, Oregon, and California (76 Federal Register 61599, Oct. 5, 2011). In Washington, the critical habitat designation includes over 1.2 million acres, located primarily on lands managed by USFS. In August 2016, USFWS published a determination confirming its previous critical habitat designations.[24]

In 1997, USFWS completed a recovery plan for the marbled murrelet. The primary objectives of the recovery plan are to stabilize and increase murrelet populations, changing the downward population trend to an upward trend throughout the listed range; provide conditions in the future that allow for a reasonable likelihood of continued existence of viable populations; and gather the necessary information to develop specific delisting criteria. The *Northwest Forest Plan* (which includes critical habitat designated on federal lands) has been largely effective at conserving habitat on federal lands in Washington (Raphael and others 2016). Implementation of the *Northwest Forest Plan*, in conjunction with designation of critical habitat, has substantially decreased the rate of net habitat loss on federal lands, such that the net change in the amount of habitat on federal lands from all causes has been limited to just 6 percent of all net loss among all ownerships for Washington (Raphael and others 2016). However, the federal recovery plan (USFWS 1997) goal of stabilizing marbled murrelet populations in Washington has not been met.

[24] 81 Federal Register 51348 (Aug. 4, 2016)

HCPs

Seven HCPs and two safe harbor agreements in Washington include the marbled murrelet as a covered species. HCPs that cover the marbled murrelet in Washington vary considerably in scale and scope of habitat protection for murrelets based on ownership objectives, forestry operations, capabilities, and geographic location. DNR's 1997 HCP is the largest covering marbled murrelets in the state.

State Forest Practices Rules

The Washington forest practices rules (WAC 222) regulate timber harvest on private, state, county, and municipal lands. The rules require forest landowners to identify potential marbled murrelet inland habitat (as defined in the rules) where it exists and conduct protocol surveys to detect murrelets before any modification or alteration of habitat takes place. If surveys determine there is a high likelihood that nesting is occurring in a stand, the contiguous habitat is designated as "occupied" and requires additional SEPA review to assess any further, likely adverse effects from management (in other words, Class IV Special review; DNR 1997a). Landowners that have Endangered Species Act Section 10 permits for listed species receive "take coverage" that allows different management prescriptions than in the forest practices rules. DNR completes SEPA review on all of its timber sales.

Washington State Listing and Periodic Status Review

In February 2017, the Washington State Fish and Wildlife Commission listed the marbled murrelet as endangered (it had previously been listed as threatened in 1993). The *Periodic Status Review for the Marbled Murrelet* (Desimone 2016) details the status of the species in Washington.[25]

Interim Strategy (No Action Alternative)

As described in Chapter 1, DNR implements an interim strategy under the 1997 HCP to protect inland habitat on state trust lands. There are 592 occupied sites identified through audio-visual surveys on DNR-managed lands, but due to the difficulty of finding nest locations, only 13 nest sites have been confirmed (refer to Appendix D). DNR designates and protects HCP-surveyed occupied sites and additional habitat areas identified under the HCP interim strategy from harvest (DNR 1997, p. IV.39).

The no action alternative, Alternative A, is described in Chapter 2, and includes ongoing protection of HCP-surveyed occupied sites and buffers in addition to areas already in conservation status, plus additional habitat areas in all HCP planning units. A variety of forest management activities are addressed in the 1997 HCP, including transportation system management, harvest and thinning, and other silvicultural practices. The 1997 HCP calls for development of a long-term strategy that will bring greater certainty to how and where habitat will be protected.

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[25] WAC 220-610-010

3.7 Recreation

This section describes how DNR recreation lands are used and managed within the analysis area.

Why Is Recreation Important?

Every year, there are an estimated 11 million visits to DNR-managed lands by people seeking a variety of recreational opportunities. There are numerous recreation lands located within areas designated as long-term forest cover. Recreation and public access are therefore important considerations when evaluating impacts to DNR-managed lands from the alternatives.

Current Conditions

DNR's primary recreation focus is to provide a primitive experience in a natural setting through trails, water access, trailhead facilities, and rustic camping facilities. The department broadly categorizes recreation as either "developed" or "dispersed." Developed recreation occurs at DNR-managed recreation facilities and on DNR-managed trails. Dispersed recreation occurs outside of designated facilities and trails.

Text Box 3.7.1. What Is the Difference Between Developed and Dispersed Recreation?

Developed recreation occurs at DNR-managed recreation facilities and managed trails. Dispersed recreation occurs outside of these designated areas throughout DNR-managed lands.

Recreational use of DNR-managed lands, both designated and non-designated, is influenced by many factors. These include, but are not limited to, historic use of the area; topography of the landscape; presence of landscape features that are attractive to the recreating public; publicly accessible roads; the presence, density, and use intensity of facilities and trails (both designated and non-designated); proximity to population centers; forest management activities; enforcement presence; and adjacent landowners and land uses.

Types of Facilities and Trails

Statewide, DNR manages over 160 designated recreation facilities and over 1,100 miles of designated trails for both motorized and non-motorized uses. Designated facilities include trailheads, campgrounds, and day-use sites. Day-use sites are visited for a variety of activities including picnicking, environmental education and interpretation, paragliding and hang gliding, water access, and other activities where recreationists do not stay overnight.

Picnic Facility in a DNR-Managed Forest. Photo: DNR

Trail Through DNR-Managed Forest. Photo: DNR

Trailheads provide access to DNR-managed trails and trail systems. Day use sites and trailheads often provide informational kiosks and toilet facilities. Campgrounds provide recreationists the opportunity to stay overnight in an area managed for camping and may also provide access to nearby trail systems. Many campgrounds contain fire rings, picnic tables, cleared areas for tents, campers, automobiles, and some recreational vehicles. Many of DNR's campgrounds also have informational kiosks and toilet facilities.

Trail-based recreational use includes both motorized and non-motorized activities. Non-motorized uses include hiking and walking, trail running, horseback riding, hiking, riding with pack stock and/or pets, and mountain bicycle riding. Motorized uses include motorcycle riding, ATV riding, and 4x4 driving. DNR manages designated trails for specific recreational uses or combinations of uses. Trails can be exclusively non-motorized, primarily motorized, or mixed motorized and non-motorized. In addition to trails, forest roads provide considerable access for both developed and dispersed recreation activities. Many people recreate directly on forest roads or use these roads to access developed or dispersed recreation areas.

Dispersed recreational activities include, but are not limited to, hunting, fishing, target shooting, rock climbing, dispersed camping, water activities, hiking, forest product gathering, and geocaching. DNR encourages responsible public use of roads, trails, land, and water, consistent with its obligations as a trust and land manager. In some areas, dispersed use can become concentrated enough that non-designated trails and informal recreation areas are created. Recreational users sometime also venture off designated trails and roads and create trails without authorization from DNR. It is estimated there are hundreds of miles of non-designated trails on DNR-managed lands, and the department may not be aware of all the locations. Non-designated trails are not managed by DNR and can cause conflicts with land management and environmental responsibilities.

Recreation Planning

Text Box 3.7.2. Is Marbled Murrelet Habitat a Current Consideration in Recreation Planning?

Yes. Marbled murrelet habitat is part of the recreation suitability analysis done at the beginning of a recreation planning process.

DNR uses a recreation planning process when assessing a landscape (a defined block of DNR-managed land) for recreational use and public access. Formal recreation planning is an in-depth, multi-year process that considers many factors including, but not limited to, land management responsibilities, public and stakeholder input, adjacent landowners and land uses, and environmental responsibilities.

A critical step in formal recreation planning is the recreation suitability assessment for the landscape. This assessment is a process in which scientists, lands managers, planners, and GIS analysts identify criteria, gather data, and map areas that have long-term limiting factors for recreational use. Criteria are grouped into three categories: biological, geological/soils, and management. Maps are created to reflect areas with moderate to no suitability for recreational development. For recreation landscapes in the analysis area, marbled murrelet habitat has been identified as an important biological criterion in the recreation suitability maps. Three landscapes in the analysis area have undergone formal recreation planning: Reiter Foothills Forest, Snoqualmie Corridor, and Green Mountain and Tahuya State Forests.

Current Projects and Planning

BAKER TO BELLINGHAM RECREATION PLANNING

In autumn 2015, DNR launched a formal recreation planning process for approximately 86,000 acres of DNR-managed lands in Whatcom County. This planning process, which is nearly complete, includes a full recreation suitability analysis, including marbled murrelet conservation strategies identified in the eight alternatives. Land covered by the conservation strategies in any of the alternatives is generally removed from consideration for placement of recreation, although some land is identified as conditional use with the potential for recreation if the area is not included in a final adopted marbled murrelet long-term conservation strategy.

DARRINGTON TO NORTH MOUNTAIN TRAIL DEVELOPMENT

Beginning in 2016, DNR started developing a new landscape for non-motorized recreation in the North Puget HCP planning unit. To ensure compliance with the interim marbled murrelet strategy, a trained biologist conducted a field assessment of the area to identify suitable habitat and evaluate impacts and restrictions prior to the development of the trails. Three locations were found where trails could not reasonably be routed to avoid entering identified habitat and in those cases, DNR biologists worked with recreation staff to identify acceptable routing and restrictions to minimize potential impacts.

■ Existing Policies and Regulations

Recreation on DNR-managed lands is guided by a variety of statutes, regulations, rules, county ordinances, and internal policies. RCW 79.10 directs DNR to apply a "multiple use concept" to public lands "where such a concept is in the best interests of the state and the general welfare of the citizens thereof, and is consistent with the applicable provisions of the various lands involved."[26] Public access and recreation on DNR-managed lands are regulated under WAC Chapter 332-52. Trails built without department permission and that are not recognized by DNR as part of a formal recreational trail system are referred to in this analysis as non-designated trails, consistent with DNR's Recreational Trails Policy. Several other DNR policies and plans guide recreation and public access on DNR-managed lands. These plans and policies include, but are not limited to, the *Policy for Sustainable Forests (*including DNR's

[26] RCW 79.10.100

policy on public access and recreation), the *South Puget HCP Planning Unit Forest Land Plan*, and formally adopted recreation plans.

Development and maintenance of recreational facilities, trails, and trail bridges are also subject to applicable county ordinance and permit requirements, which vary from county to county. Recreational development and maintenance actions may also be subject to review under SEPA, RCW Chapter 43.21C, and WAC Chapter 197-11, depending on the scope of the project.

Recreation Under the Interim Strategy

Under the interim marbled murrelet strategy, DNR follows specific practices related to recreational development to achieve marbled murrelet conservation objectives.

STRAITS, COLUMBIA, SOUTH COAST PLANNING UNITS

No new recreational development is permitted within occupied sites and buffers. Some additional areas also are deferred from harvest but are not known to contain occupied sites. Within these areas, recreation planning is done on a site-specific basis, depending on potential environmental impacts.

OESF, NORTH PUGET, AND SOUTH PUGET HCP PLANNING UNITS

Marbled murrelet audio/visual surveys are incomplete in these areas. For known occupied sites, buffers, and unsurveyed old forest in the OESF HCP Planning Unit, no new recreational development is permitted. For all other forested areas, a site-specific assessment is conducted for new recreation development proposals. The assessment looks for suitable habitat in the area where recreational development is being proposed. The type of recreation and any tree harvest would be evaluated against a quality rating of the area, and decisions made on a site-specific basis.

3.8 Forest Roads

This section describes the use and management of DNR forest roads within the analysis area and how environmental impacts from forest roads are addressed by current regulations and policies.

Forest Road on DNR-managed Land. Photo: DNR

Why Are Forest Roads Important?

Timber harvest operations, land management, and recreation all have a high dependency on the forest road system maintained by DNR. Construction and management of forest roads affect many natural resources, including wildlife, soils, and water. While the proposed alternatives do not amend the regulations and procedures already in place to minimize these impacts, they do propose some changes to the location and management of forest roads. Understanding the current rules related to road management is important to determine whether proposed changes might exacerbate environmental impacts or affect activities dependent upon forest roads.

Current Conditions

The risk of impact to natural resources from roads varies but is related to the location, quality of construction, density of roads, the number of stream crossings, and noise disturbance from road use, construction, and maintenance activities. DNR implements rules, policies, and procedures (described in the next section) to minimize these impacts.

Road Miles in the Analysis Area

DNR currently has 8,488 miles of active roads in the six westside HCP planning units. In the analysis area, 63 percent (251 of 401) of the marbled murrelet occupied sites identified under the interim strategy (Alternative A) contain roads within the occupied site and/or the buffer. These roads include 793 miles of active, drivable road; 20 miles of active, decommissioned roads; 10 miles of orphaned roads; and 26 miles of road with unknown status but most likely active. [27] (Abandoned roads are not included in this count.) These road locations vary from the edge of the occupied site buffer to bisecting the occupied site.

[27] DNR designates forest roads as active, abandoned, or orphaned roads. *Active roads* are currently used for timber management or are *decommissioned*, meaning that they are closed for current use but are needed for long-term management so they can be re-opened in the future. *Abandoned roads* are physically closed to all current and future uses, and natural resources have been restored within the road prism. *Orphaned roads* are roads or railroad grades that have not been used for forest practices activities since 1974 and have not been abandoned (WAC 222-24-052 (4)). Orphaned roads are available for use and can become active roads when used again for forest practices.

DNR conducts a variety of roadwork (construction, reconstruction, and maintenance activities) throughout the analysis area. “Construction” involves building new roads as well as performing a major upgrade or widening of an existing road to accommodate a new use or standard. “Reconstruction” means reopening a decommissioned road, rebuilding failed road segments, or significantly reshaping the surface of the road. Typically, reconstruction takes place within the existing road prism. “Maintenance” involves new surfacing, grading, brushing, replacing existing culverts, and similar activities.

Text Box 3.8.1. How Many Roads Are Currently Located in Occupied Sites?

In the analysis area, 63 percent of occupied sites identified under the interim strategy contain roads within the occupied site and/or the buffer.

From 2003 to 2017, the miles of active road increased from 7,628 miles to 8,488 miles; however, the majority of this increase is due to a better road inventory and the acquisition of new property. Over the same 15-year period, DNR constructed 104 miles and abandoned 97 miles of road per year (on average), keeping the actual growth of the forest roads system due to new construction to a minimum (refer to Table 3.8.1).

Example of Recently Abandoned DNR Forest Road. Photo: DNR

Since 2013, new road construction mileage has dropped to an average of 84 miles per year, while road abandonment has decreased to 70 miles per year (refer to Table 3.8.2). Future road management numbers are expected to match these current mileages, with abandonment matching or being slightly lower than the new construction numbers. The decrease in planned abandonment is due to the upcoming completion of the road maintenance and abandonment plans required under WAC 222-24-050. However, abandonment will still be an important management option under the action alternatives.

Table 3.8.1. Average Miles of Annual Road Work from 2003 to 2017, by HCP Planning Unit

Type of road work (miles)	Columbia	North Puget	OESF	South Coast	South Puget	Straits	All Units
New construction	21	40	4	19	9	10	104
Reconstruction	15	85	3	9	3	4	120
Decommissioning	2	2	6	3	1	3	17
Abandonment	16	60	1	7	8	3	97

Table 3.8.2. Average Miles of Annual Road Work from 2013 to 2017, by HCP Planning Unit

Type of road work (miles)	Columbia	North Puget	OESF	South Coast	South Puget	Straits	All Units
New construction	20	29	4	16	8	8	84
Reconstruction	12	61	5	6	3	3	90
Decommissioning	2	6	5	2	1	1	11
Abandonment	14	41	1	5	1	2	70

ROCK PITS

Rock pits are closely associated with roads. Aggregate is an important, non-renewable resource within the landscape. Forest roads continually lose rock from the road surface from many causes such as log truck haul, recreational traffic, and revegetation. More rock sources will need to be developed to meet the future road construction and maintenance needs of the forest road system. As older rock sources are depleted, they are reclaimed (abandoned) similarly to roads. There are currently six rock pits located within the occupied sites designated under Alternative A, with another 27 located within 0.25 miles of an occupied site. Frequency of use of these rock pits varies widely depending on road work needs. Some are used annually or multiple times per year, while others may only be used once every 1 to 5 years. Refer to the conservation measures in Chapter 2 of this RDEIS for restrictions on blasting within occupied sites and within 0.25 miles of an occupied site.

How Roads Impact the Environment

Roads provide access to forest resources for timber harvest and management, collection of non-timber forest products, research, and a variety of recreational uses. Forest roads also are a source of environmental impacts, including habitat disturbance, disruption of natural water flow paths, potential for landslides, and erosion affecting water quality.

HABITAT IMPACTS

Roads can impact wildlife by removing habitat and by creating edges that fragment blocks of continuous forested habitat needed by many wildlife species (refer to Section 3.5 and Appendix H). Roads also create corridors for predators such as jays and ravens to forage along edges and become established in adjacent habitat, thereby increasing the risk of predation of murrelet nests. Recreational use of forest roads also can lead to increased amounts of garbage that attracts predators of marbled murrelets.

NOISE

Road construction and maintenance activities include blasting and use of heavy equipment that have noise-disturbing impacts on marbled murrelets. Blasting is used for road construction, rock production, and expansion and development of new rock pits. Use of roads by heavy hauling trucks, as well as by off-road vehicles, trucks, and other vehicles, also can cause noise-related disturbance impacts (refer to Section 4.6).

Road work is largely conducted during the summer construction season, which aligns with the marbled murrelet nesting season. Under the interim strategy, noise-producing activities such as blasting, pile-driving, rock crushing, and using heavy equipment in or within one-quarter mile of occupied sites must follow daily timing restrictions to avoid coinciding with marbled murrelets visiting their nests. Timing restrictions also are applied to activities in other types of habitat.

STREAM CROSSINGS

Stream crossings (predominately culverts) can create barriers to fish passage by increasing water velocities, creating large vertical drops, and containing inadequate water depths. There are currently 212 culverts and 39 bridges located within occupied sites and buffers designated under Alternative A. All of these stream crossings require maintenance during their lifespan and require replacement when found to be functionally or structurally deficient (undersized or failing). Culvert lifespan varies by material, location, exposure to saltwater or acidic soils, and abrasion rates. Previous galvanized metal culverts have can last 20 to 40 years before needing replacement. Newer aluminized coated culverts are expected to last 40 to 60 years.

Historically, DNR averages 81 fish barrier replacements or removals each year. Removals of fish barriers have decreased in the analysis area since 2016, except in OESF where the decrease is expected after 2021. Decreases are due to completion of road maintenance and abandonment plans required under WAC 222-24-050. The number of replacements of non-fish stream crossings is not known at this time but is expected to be slightly higher than the fish barrier replacement numbers. New stream crossings will be needed with new road construction and during reconstruction of decommissioned roads. The number of new stream crossings is unknown because it is determined on a case-by-case basis along with road location.

DISRUPTION OF WATER FLOW PATHS

Road construction can cause the disruption of the natural flow patterns of groundwater and surface water. A road cut into a hillside can intercept subsurface water, bringing it to the surface and causing it to flow down a ditch or road surface. Inadequate drainage can interrupt the hydrologic connectivity of surface water and cause concentration of flows or move water from one drainage to another (pirating).

Concentrating flows increases the energy carried by the water and can cause erosion, puddles, or ground saturation that can lead to sediment delivery, maintenance problems, or landslides. Pirating water moves water from one basin to another, changing the natural amount of water each drainage is prepared to carry. This can cause changes in the size and shape of the channel, decreased water availability for fish, and changes in vegetation type. Managing drainage structures so the road does not carry water for long distances eliminates pirating water and reduces the amount of water (energy) carried by ditches to erodible soils, surface water, or other protected infrastructure.

Inadequately sized culverts in non-fish bearing streams cause an imbalance in the channel, creating deposits of sediment upstream and scouring streambed material downstream. They also increase the chance of culvert blockages and flooding across the road. Flooding at culverts can lead to a distinct failure of the road at the culvert site or a long failure along the road or ditch line. Replacing undersized culverts with larger structures vastly reduces the risk of these types of failures.

LANDSLIDES

Poor location, quality of construction, and management of water can lead to road-caused landslides events (such as small slumps or large landslides). Roads built on unstable slopes or landforms can increase the potential for landslides, threatening natural resources and/or public safety. Road-caused landslide events are typically shallow but can still produce large quantities of sediment and damage to the road system as well. Well-planned road locations and active management of water can reduce the risk of road-caused landslides.

EROSION AND WATER QUALITY

Fine sediments from native surface or aggregate surface roads can enter surface waters, increasing turbidity and lowering water quality. Erosion caused by traffic creates sediment particles that are washed from the roads by rain and captured by ground or surface water or are lifted into the air by passing vehicles. Sediments also are created during construction and maintenance activities. These activities remove vegetation, exposing bare soil, and loosen compacted earth, making the particles easier to transport. Adequate and well-placed drainage structures, good vegetation cover, lower traffic rates, and quality aggregate surfaces all help to reduce erosion and delivery of sediment to water.

■ Existing Policies and Regulations

The Forest Practices Act (RCW 76.09 and WAC 222-24 concerning road construction and maintenance) and the 1997 HCP road management strategies are the primary regulations that govern road work. In addition, internal policies and guidance on road work include the *Policy for Sustainable Forests*, watershed analysis plans, and the DNR *Forest Roads Guidebook*. Typical road construction and hydraulic projects are considered Class I through III forest practice and are exempted from SEPA by RCW 43.21C.037(1). SEPA review is required for road work in conjunction with a timber sale or other non-exempt project to eliminate the segmentation of environmental effects and may be used for stand-alone projects depending on the scope of work. For individual projects, SEPA review may be needed if the project has the potential to affect public resources or use. SEPA review is used to determine if there are environmental impacts, if specific impacts can be mitigated, or if significant environmental impacts are likely to occur, requiring more analysis or a change of plans.

1997 HCP Road Management Under the Interim Strategy (No Action Alternative)

The 1997 HCP road management strategies guide DNR to reduce the number of new roads; control the overall size of the road network; and design, plan, construct, and abandon roads to protect riparian areas and avoid impacts to habitat areas of federally listed and certain unlisted species.

Road management is similar across the analysis area, but because the process for identifying marbled murrelet habitat currently differs among the planning units, different management approaches apply in different types of marbled murrelet habitat under the no action alternative (refer to Table 3.8.3).

Table 3.8.3. Summary of Road Management in Marbled Murrelet Habitat Under the No Action Alternative (Alternative A, Interim Strategy)

Habitat type	Road construction	Reconstruction, abandonment, and maintenance	Noise-creating activities related to road work
Occupied sites	Prohibited	OESF: Subject to review if felling trees over 6” in diameter[a]	Timing restrictions evaluated or required within one-quarter mile of occupied sites
Old forest northern spotted owl habitat (OESF)	Subject to review	Subject to review if felling trees over 6” in diameter	Timing restrictions evaluated within a one-quarter mile of unsurveyed old forest habitat
Reclassified habitat (murrelet)	Subject to review	OESF: Subject to review if felling trees over 6” in diameter	n/a
North and South Puget field-delineated, newly-identified murrelet habitat[b]	Operational access is prohibited in higher-quality habitat; some access may be allowed in low-quality habitat if surveys determine no occupancy, unless within a one-quarter mile of occupied site	Operational activities must minimize the loss of platform trees, especially those containing four or more platforms. Consultation with USFWS is required.	Timing restrictions on the use of heavy equipment

[a] OESF interim strategies letter dated March 7, 2013.
[b] 2007 and 2009 concurrence letters.

To avoid impacts or potential impacts to marbled murrelet habitat, longer roads are sometimes built and in areas that may be less desirable for road construction. For example, DNR may build mid-slope roads, locate roads with more stream crossings, or choose more restrictive hauling routes. Avoiding occupied sites, buffers, and reclassified habitat can put pressure on other lands by causing higher road use (more hauling) and haul-related maintenance on existing roads in those areas.

The interim strategy is challenging to implement for road activities in the North and South Puget HCP planning units. Survey work to identify occupied sites and buffers are incomplete in these areas; therefore, site-specific assessments of habitat are needed to build roads. These assessments sometimes lead to delay in road management or road-building decisions and delay the timing of timber harvest or timber sales.

3.9 Public Services and Utilities

This section describes the current location and management of public services and utilities within the analysis area.

■ Why Are Public Services and Utilities Important?

A Technician Repairs Microwave Dishes on a Communication Tower Located on State Trust Lands (Grass Mountain, South Puget HCP Planning Unit). Photo: Steve Diamond/NorthWest Tower Engineering, Inc.

Non-timber revenue sources, such as selling rights-of-way and leases for communications and energy-related uses, are a critical component of DNR's business strategy (DNR 2006, p 26). In addition to providing revenues for state trust beneficiaries, these uses are important to the communications and energy infrastructure of the entire Puget Sound region.

The following sections describe existing rights-of-way and leases for communications and energy-related uses that may be affected by the alternatives. For this assessment, these uses include the following:

- Utility rights-of-way for transmission lines
- Communications sites (for example, cell and radio towers)
- Oil and gas production

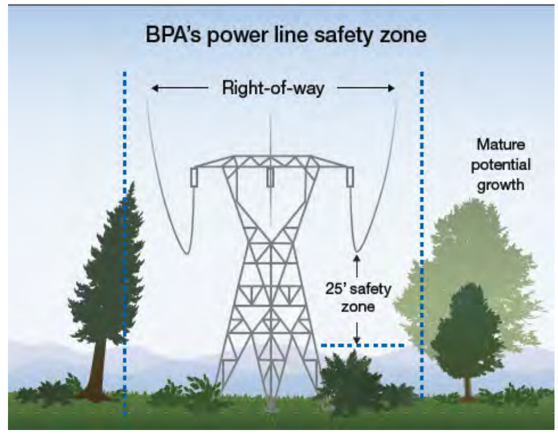
■ Current Conditions

Utility Rights-of-Way

Dozens of telephone companies, public utilities districts, and power providers, including Puget Sound Power and Light, Pacific Power, Seattle City Light, and Tacoma Public Utilities, and the federal Bonneville Power Administration, maintain utility rights-of-way through DNR-managed lands in the analysis area. Rights-of-way for major utility corridors may be up to 300-feet wide for areas where multiple lines share a single corridor.

Maintenance of telephone and electric transmission lines requires access roads, many of which occur outside the transmission line rights-of-way. A typical access road right-of-way is 50 feet wide. Inspection, maintenance, and repairs of utility lines may involve occasional use of helicopters. Maintenance crews also may remove trees outside of the right-of-way to prevent trees from falling onto transmission lines or structures. All transmission lines also eventually require replacement, tower upgrades, or expansion.

Text Box 3.9.1. How Are Transmission Lines Managed?



Graphic: BPA 2008

Bonneville Power Administration (BPA) typically maintains a 150-foot-wide cleared right-of-way easement for 500-kV transmission lines under its Vegetation Management Program (BPA 2000 and 2015).

Leases for Communications and Energy-Related Facilities

Communication facilities include antennas and associated small buildings or sheds for commercial television and radio, 2-way VHF radio, cellular, and wireless broadband. DNR manages more than 100 communication sites across Washington, including several key sites in the analysis area. Communication sites are typically located on non-forested hilltops and mountaintops within range of populated areas and highway corridors.

Table 3.9.1 contains descriptions of these uses as well as known and potential future locations trends within the analysis area.

Table 3.9.1. Communication and Energy-Related Infrastructure on Lands Managed Under the 1997 HCP

Leases/contracts	General locations within analysis area	Description	Trends
Communication sites	Found in multiple locations, primarily on high peaks, including the following: • Devil's Mountain (North Puget HCP planning unit) • Grass and Tiger Mountains (South Puget HCP planning unit) • Radar Ridge and Capitol Peak (South Coast HCP planning unit)	Typically high-elevation sites with multiple towers, antennas, and other structures and outbuildings. Usually less than an acre. Include DNR-provided or lessee-constructed access roads.	Based on recent DNR annual reports, demand for and placement of communication sites on state trust lands is increasing.

Leases/contracts	General locations within analysis area	Description	Trends
Oil and gas leases	No oil or gas is currently produced on state trust lands, though potential oil and gas resources are located in the North and South Puget HCP planning units. Pipeline corridors run through some state trust lands.	DNR may sell rights to explore for, drill, extract, or remove underground deposits of oil and gas (in other words, petroleum and natural gas). Site size varies, but most are a few acres.	DNR anticipates new leases may be granted in the next decade. [a]

[a] *State Trust Lands HCP 2014 Annual Report* (DNR 2015b)

Existing Policies and Regulations

Policy for Sustainable Forests

The *Policy for Sustainable Forests* clearly identifies that selling rights-of-way and leases for communications and energy-related uses are a critical component of DNR's business strategy (DNR 2006, p. 26). It also recognizes that public or private utilities may need to cross state trust lands and directs DNR to cooperate with requests by granting permanent and temporary rights-of-way consistent with applicable policies and regulations, including SEPA, *Forest Practice Rules*, the 1997 HCP (including the riparian conservation strategies), the sustainable harvest calculation, and other state and federal laws (refer to Chapter 1).

The 1997 HCP

Leases, contracts, permits, and easements granted by DNR for communications and energy-related facilities are subject to the conditions of their contracts and the 1997 HCP. DNR reviews proposed uses to ensure compliance with the commitments of the 1997 HCP. These commitments are included in the 1997 HCP such that activities will not increase the level of take beyond a *de minimis* level. The 1997 HCP defines what levels of activity are *de minimis* and how the activity is otherwise covered by the 1997 HCP (DNR 1997, p. IV.193).[28]

ESA compliance for any additional take of marbled murrelets (or take of any other listed species) beyond a *de minimis* level for non-timber resources would need to be addressed as a separate action, with formal consultation between DNR and USFWS. This could potentially initiate further NEPA and SEPA review.

Federal agencies consult with DNR on projects that may cross state trust lands. For example, as part of project review under NEPA, the Bonneville Power Administration may identify and mitigate potential conflicts with DNR land use plans, including the 1997 HCP.

[28] The level of impact from these activities is reviewed during the annual meetings described in the Implementation Agreement §16.2b; also refer to §17.0 for easements that are accomplished through a land transfer, sale, or exchange (DNR 1997, p. B.4 through 6).

3.10 Environmental Justice

This section describes where minority and low-income populations are located within the analysis area and the degree to which those populations use and depend upon DNR-managed forestlands.

Text Box 3.10.1. Who Relies on the Forest?

Photo: University of Washington

Many Hispanic communities within the analysis area are economically tied to private, state, and federal forests. Hispanic forest workers now make up a large proportion of the workforce when it comes to some of the most difficult (and often lowest-paying) forest-related jobs, including tree planting, thinning, and harvesting and collection of both timber and non-timber products such as western floral greens. Shown in photo: Cedar block cutting.

Why Is Environmental Justice Important?

The term "environmental justice" addresses Executive Order 12898, which directs federal agencies to identify and address any "disproportionately high and adverse effects" of their actions, programs, or policies on low-income and minority populations (Council on Environmental Quality 1997).

Environmental justice concerns considered in this RDEIS are focused on whether any of the alternatives may cause disproportionately high adverse economic effects on minority or low-income populations due to reduced timber harvest and other forest management activities, particularly in places where these populations are dependent on timber revenues and forest-related jobs.

Potential economic effects on American Indians also are considered.[29] Issues related to traditional tribal access and cultural uses of state trust lands are addressed separately under Sections 3.12 and 4.12, "Cultural Resources."

Current Conditions

Minority Forest Workforce

The forest workforce, like the forest industry itself, has changed and will likely continue to do so. Shifting from the primarily local, white workforce that harvested trees during the high harvest years of the second half of the last century, the workforce is now made up to a large degree by immigrant workers, primarily

[29] The term American Indian is used in this section based on U.S. Census Bureau race classifications.

Hispanic. This trend of increasing populations of minority forestry workers in rural communities began as early as the 1970s and continues today.

Hispanic forest workers now make up a large proportion of the workforce when it comes to some of the most difficult (and often lowest-paying) forest-related jobs, including tree planting, thinning, and harvesting of both timber and non-timber forest products including mushrooms, salal, bear grass, and other western greens (Ballard 2004, Campe and others 2008).

Due to this trend in forest workers, many Hispanic communities within the analysis area are economically tied to private, state, and federal forests. Other work crews are part of a seasonal workforce that travels around the western U.S. following seasonal peaks in labor markets.

Minority and Low-income Populations

For this assessment, minorities are considered within the following U.S. census tracking data racial and ethnicity categories:

- Black or African American
- American Indian and Alaska native
- Asian
- Native Hawaiian and other Pacific Islander
- Hispanic
- Two or more races

Minority and low-income populations are listed in Table 3.10.1 by county. [30] Acres of DNR-managed land within the county are provided for context.

Table 3.10.1. Minority and Low-Income Populations, by County, With Acres of DNR-Managed Land

County	Minority population (% of county population)	Low-income population (% of county population)	Acres of DNR-managed lands
Clallam	18.3	16.2	162,041
Cowlitz	17	20.6	28,270
Grays Harbor	22.5	19.6	90,603
Island	21.5	10.3	340
Jefferson	12.4	14.1	203,774
King	40.2	11.3	116,880

[30] Environmental justice guidelines developed by the Council on Environmental Quality (1997) and the U.S. Environmental Protection Agency (1998) indicate that low-income populations should be identified based on the annual statistical poverty thresholds established by the U.S. Census Bureau. The U.S. Census Bureau defines a poverty area as a census tract or other area in which at least 20 percent of residents are below the poverty level. Median household income and per capita income are other measures that can be used to identify low-income environmental justice populations.

County	Minority population (% of county population)	Low-income population (% of county population)	Acres of DNR-managed lands
Kitsap	24.4	11.2	14,235
Kittitas	17.1	18.6	2,591
Lewis	17.4	17.1	96,317
Mason	21	15.6	58,925
Pacific	19.5	17.8	86,898
Pierce	34.7	13.1	24,959
San Juan	11.8	12.7	1,193
Skagit	27.3	15.7	139,540
Snohomish	30.2	9.9	157,225
Thurston	26.2	11.9	64,588
Wahkiakum	10.9	13.9	40,195
Whatcom	22.1	15.7	88,903
Total (Average)	32.1	13.2	1,377,477

Source: U.S. Census 2015

Existing Policies and Regulations

Executive Order 12898 requires federal agencies to take appropriate steps to identify and avoid disproportionately high and adverse effects of federal actions on the health and surrounding environment of minority and low-income persons and populations. All federal programs, policies, and activities that substantially affect human health or the environment shall be conducted to ensure that the action does not exclude persons or populations from participation in, deny persons or populations the benefits of, or subject persons or populations to discrimination under such actions because of their race, color, income level, or national origin. Executive Order 12898 also was intended to provide minority and low-income communities with access to public information and public participation in matters relating to human health and the environment.

3.11 Socioeconomics

This section describes the economic conditions that may result from current management practices on state trust lands. Impacts of the alternatives on these conditions will be discussed in Section 4.11.

Why Are Socioeconomics Important?

DNR-managed forestland plays an important role in the local economies of 18 counties in the analysis area. Changes to how much land is available to harvest or use for other ecosystem services can impact these local economies. Maintaining funding to state trusts is an important piece of the need, purpose, and objectives for the long-term conservation strategy.

The affected environment for this section is all trusts and counties with state trust lands inside the marbled murrelet analysis area (Table 3.11.1). Counties that do not contain state trust lands within the analysis area are not part of the affected environment. State trust lands are defined in Chapter 1.

Table 3.11.1. Acres of DNR-Managed Lands by Management Category in Counties within the Analysis Area (Counties Containing State Trust Lands Only)

County	DNR-managed lands in analysis area Acres	No harvest allowed Acres (%)	Harvest is constrained Acres (%	Available for harvest Acres (%)	DNR-managed lands outside the analysis area Acres (%)
Clallam	162,000	48,000 (29%)	73,000 (45%)	41,000 (26%)	0
Cowlitz	28,000	1,900 (7%)	14,000 (49%)	13,000 (44%)	58,000
Grays Harbor	91,000	23,000 (25%)	20,000 (22%)	48,000 (53%)	0
Island	340	340 (100%)	0 (0%)	0 (0%)	0
Jefferson	208,000	88,000 (42%)	103,000 (50%)	17,000 (8%)	0
King	117,000	56,000 (48%)	39,000 (33%)	22,005 (19%)	0
Kitsap	14,000	6,100 (43%)	2,800 (20%)	5,300 (37%)	0
Kittitas[a]	3,000	2,500 (97%)	82 (3%)	3 (0%)	206,000
Lewis	96,000	19,000 (19%)	44,000 (45%)	35,000 (36%)	0
Mason	59,000	19,000 (33%)	14,000 (8%)	35,000(60%)	0
Pacific	87,000	25,000 (29%)	24,000 (27%)	38,000 (44%)	0
Pierce	25,000	6,800 (27%)	16,000 (65%)	1,800 (7%)	0
San Juan	1,200	1,200 (100%)	0 (0%)	0 (0%)	0
Skagit	140,000	41,000 (29%)	59,000 (42%)	41,000 (29%)	0

County	DNR-managed lands in analysis area Acres	No harvest allowed Acres (%)	Harvest is constrained Acres (%	Available for harvest Acres (%)	DNR-managed lands outside the analysis area Acres (%)
Snohomish	157,000	65,000 (41%)	40,000 (26%)	52,000 (33%)	0
Thurston	65,000	12,000 (18%)	14,000 (21%)	39,000 (61%)	0
Wahkiakum	40,000	13,000 (32%)	10,000 (24%)	17,000 (43%)	0
Whatcom	89,000	32,000 (37%)	29,000 (33%)	28,000 (31%)	0
Total	1,383,000	460,000 (33%)	492,000 (38%)	433,000 (30%)	

[a]DNR-managed lands in Kittitas County are not subject to the interim strategy for marbled murrelet in the 1997 HCP. A small portion of this county is included within the inland range of the marbled murrelet and is listed here for context. No impacts from the strategy are expected due to the small amount of operable area within the analysis area in this county.

Current Conditions

Population

The total human population in affected counties in the marbled murrelet analysis area as of 2017 is about 5 million (Office of Financial Management (OFM) 2018a; Table 3.11.2).

Text Box 3.11.1. How Resilient Are Local Economies to Changes in DNR Forest Management?

While most counties in the analysis area have medium to high socioeconomic resiliency, Pacific and Wahkiakum counties are highly dependent on DNR-managed lands and "may experience difficulty adapting to changes in forest management strategies." (Daniels 2004)

Economic Diversification and Timber Dependency

Daniels (2004) assessed the economic diversity[31] and socioeconomic resiliency[32] of Washington counties. Most counties in the analysis area were found to have medium or high socioeconomic resiliency and be among the counties with greater economic diversity in the state. There were notable exceptions, however. Wahkiakum County is one of the least socioeconomically resilient and least economically diverse county in the state (refer to Table 3.11.2). Pacific County also has low socioeconomic resiliency and below-median economic diversity. All counties in the analysis area are classed as having medium or high forest dependence.[33] Daniels (2004) identified Pacific and Wahkiakum counties as "DNR counties of concern" due to the relatively large role DNR-managed lands have in the

[31] Economic diversity is measured by Daniels 2004 using an index of regional specialization.
[32] Socioeconomic resiliency is defined by Daniels 2004 as the ability to adapt to change. Daniels assumes that communities with high social and economic diversity are more resilient.
[33] Forest dependence is determined by Daniels 2004 based on the forest area in each county.

socioeconomic well-being of these counties. Daniels states that these counties "may experience difficulty adapting to changes in DNR forest management strategies."

Since the Daniels study was done in 2004, the economies of Pacific and Wahkiakum counties have not changed markedly. The Washington Employment Security Department (2017a) shows that employment fell in Pacific County from 2007 to 2011 and has since recovered slowly. The primarily industries in the county were natural resource-based including shellfish farming, forest-products, and other farming. The only sectors with an increase in employment were the information and finance sectors, but these sectors were relatively small in Pacific County. For Wahkiakum County, the Washington Employment Security Department (2017b) and OFM (2018b) show that logging is the main industry in the county, and local government is the main source of jobs and wages. Total employment in the county has declined since the 1990s. Most of this decline has been from the loss of service jobs, including a nursing home that was Wahkiakum County's second largest private employer (Washington Employment Security Department 2017b, St. John 2012). However, logging employment had declined from 140 in the mid-2000s to 50 in 2016 (Washington Employment Security Department 2017b).

Table 3.11.2. Socioeconomic Resiliency and Economic Diversity Rating (Modified From Daniels 2004)

County	Socioeconomic resiliency	Economic diversity 4 = high diversity	Population, 2017 (OFM 2018a)	Employment, 2015 (Washington Employment Security Department 2018a)
Clallam	Medium	3	74,240	22,714
Cowlitz	High	4	105,900	37,975
Grays Harbor	Medium	3	72,970	22,220
Island	High	3	82,790	15,793
Jefferson	Medium	3	31,360	8,372
King	High	4	2,153,700	1,315,412
Kitsap	High	4	264,300	86,197
Kittitas	Medium	2	44,730	14,400
Lewis	Medium	3	77,440	24,679
Mason	Medium	2	63,190	14,032
Pacific	Low	2	21,250	6,417
Pierce	High	4	859,400	295,384
San Juan	Medium	2	16,510	5,690
Skagit	High	4	124,100	49,574
Snohomish	High	4	789,400	283,151
Thurston	High	4	276,900	110,206
Wahkiakum	Low	1	4,030	700
Whatcom	High	4	216,300	88,100
Total	N/A	N/A	5,278,510	2,924,740

Demographics

Since 2001, the period for which DNR has county-specific forest products sector employment data, overall employment, income and population growth in counties in the marbled murrelet analysis area have followed different trajectories.

POPULATION TRENDS

Total

Since 2001, all counties in the analysis area have experienced an increase in population. In most counties, the increase was at least 11 percent. Thurston County had the largest rate of increase at 32 percent. Three southwest Washington counties, Grays Harbor, Pacific, and Wahkiakum counties, were the only counties with single digit increases, at 6 percent, 1 percent, and 5 percent, respectively (Table 3.11.3; OFM 2018a).

Table 3.11.3. Change in Employment in Marbled Murrelet Analysis Area Counties (OFM 2018a; Washington Employment Security Department 2018)

County	Change in population (2001-2017)	Change in working age population (15–64 years old, 2001- 2017)	Change in number of jobs (2001-2016)	Change in median household real income (2001-2015, 2017 dollars)	Median household real income in 2015, rounded to the nearest '000 (2017 dollars)
Clallam	15%	6%	11%	5%	46,000
Cowlitz	13%	8%	0%	0%	50,000
Grays Harbor	6%	3%	-4%	-12%	44,000
Island	15%	3%	10%	1%	60,000
Jefferson	18%	0%	1%	12%	53,000
King	23%	21%	15%	10%	81,000
Kitsap	13%	5%	18%	-4%	65,000
Lewis	12%	8%	0%	2%	47,000
Mason	26%	19%	17%	-10%	54,000
Pacific	1%	-7%	6%	-13%	41,000
Pierce	21%	18%	24%	-1%	60,000
San Juan	15%	0%	13%	-2%	59,000
Skagit	19%	14%	13%	-7%	56,000
Snohomish	28%	26%	35%	6%	75,000
Thurston	32%	25%	30%	-9%	62,000
Wahkiakum	5%	-11%	-12%	-13%	50,000
Whatcom	27%	21%	28%	4%	55,000
Total	16% (analysis area counties)	12% (analysis area counties)	19% (analysis area counties)	4% (Washington State)	$63,000 (Washington State)

WORKING AGE

The working age population, defined as ages 15–64[34], increased in all counties except Pacific and Wahkiakum. In these counties, the working age population fell by 7 percent and 11 percent, respectively, between 2001 and 2017. Wahkiakum and Jefferson counties had the largest difference in population and working age population change. In these counties, the rate of change in population exceeded the rate of change in working age population by 17 and 18 percent, respectively.

Employment Trends

Total employment in counties in the marbled murrelet analysis area increased by 19 percent between 2001 and 2016.[35] Employment in most counties increased in that time, but decreased in Grays Harbor and Wahkaikum counties, both located in southwest Washington (Table 3.11.3). Employment numbers were stagnant in two other southwest Washington counties, Cowlitz and Lewis. The largest increases in employment occurred in urban counties surrounding Seattle including Snohomish, Pierce, and Thurston counties. Whatcom County also experienced employment growth well above the average for marbled murrelet analysis area counties.

Real Income

Changes in median real incomes between 2001 and 2014[36] ranged from a 12 percent increase in Jefferson County to a 13 percent decrease in Pacific and Wahkiakum counties. The median real income decreased in eight counties, increased in nine counties, and remained unchanged in one county. Along with Pacific and Wahkiakum counties, Grays Harbor, Mason, Pierce counties experienced a decrease in real income of at least 10 percent, with decreases of 12 percent, and 10 percent, respectively. Median real incomes in southwest Washington are low compared to the rest of the analysis area. Five of the six lowest median real incomes are in southwest Washington, Cowlitz, Lewis, Grays Harbor, Pacific, and Wahkiakum counties. Median real incomes decreased in three of these counties over the 2001 to 2015 period. King, Snohomish, and surrounding counties had the highest median incomes in 2014.

Trust Revenue

State trust lands provide revenue for trust beneficiaries (refer to Chapter 1). Timber sales are the single largest source of revenue. However, other revenue sources exist, including leasing of lands for communication sites and special forest products,[37, 38] interest income, permits, fees, and miscellaneous sales and other revenue.

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[34]This definition comes from the Organization for Economic Cooperation and is used by the Federal Reserve Bank (Organization for Economic Cooperation 2018, Federal Reserve Bank of St. Louis 2018)

[35] Most current finalized data available from the Washington Employment Security Department

[36] 2015 real income data was not included because only preliminary estimates were available.

[37] Such as brush and boughs.

[38] Other lease categories include agriculture, mineral and hydrocarbon, special use, real estate, and right-of-way.

From 2011 to 2017, an annual average of about $172 million (2017 dollars) was distributed to trust beneficiaries that receive revenue from state trust lands within the analysis area (Tables 3.11.4 and 3.11.5). Some of these beneficiaries also received revenue from lands outside of the analysis area. Total distributions vary due to fluctuations in timber and agricultural markets. The Common School and Escheat Trust received distributions from land transactions under the Trust Land Transfer Program[39] while Pacific and Wahkiakum counties received distributions from land transactions under the State Forest Trust Land Replacement Program (DNR 2013b). Funding for these programs varies from year to year.

Distributions from most major sources have been relatively stable over the 2011 to 2017 period. The exception is funds for the Trust Land Transfer Program, which have decreased over the period. Timber sales generated an average of $114.5 million per year. Other important sources of trust revenue are agricultural and commercial leases and fund transfers through the Trust Land Transfer Program. From 2011 to 2017, the Trust Land Transfer Program provided an average of $25.5 million (2017 dollars) per year, all to the Common School Trust. Leases allowing harvest of non-timber forest products from state trust lands generated about $500,000 or less per year in revenue. Refer to DNR annual reports[40] for more detail on trust revenues and distributions. The revenue generated from sales and leases varied based on market conditions and qualities sold.

Table 3.11.4. Average Annual Fund Distribution to Beneficiaries of the Federally Granted Trusts[41] for Fiscal Years 2011–2017 in 2017 Real Dollars (Revenue From State Trust Lands Statewide)

Trust(s)	Distributions from timber sales and timber sale related activities	Distributions from all other revenue sources	Total distributions
Agricultural School Grant	$4,457,076	$518,953	$4,976,030
Capitol Building Grant	$7,101,043	$152,213	$7,253,256
CEP&RI and CEP&RI transferred[a]	$3,986,344	$1,032,389	$5,018,734
Common School and Escheat	$35,576,513	$50,266,399	$85,842,911
Normal School	$2,493,594	$181,106	$2,674,700
Scientific School Grant	$6,029,248	$1,193,949	$7,223,196
University Grant (original and transferred)	$1,895,838	$280,495	$2,176,333
Total	$61,539,656	$53,625,504	$115,165,160

[a] CEP&RI refers to charitable, educational, penal, and reformatory institutions as defined by the state.

[39] More information available at https://www.dnr.wa.gov/managed-lands/land-transactions

[40] Available at https://www.dnr.wa.gov/about/fiscal-reports/dnr-annual-reports

[41] Trusts supported by State Lands, which are lands granted to the state by the Federal government at statehood through the Omnibus Enabling Act of 1889.

Table 3.11.5. Average Annual Distribution of Funds to Beneficiaries of State Forest Trust Lands (State Forest Transfer and State Forest Purchase Trusts) for Fiscal Years 2011–2017, in 2017 Dollars[42]

Beneficiary county[a]	Distributions from timber sales and timber sale related activities	Distributions from all other revenue sources	Total distributions
Clallam	$5,956,953	$351,647	$6,308,600
Cowlitz	$2,011,851	$27,729	$2,039,580
Grays Harbor	$1,874,525	$3,140	$1,877,666
Jefferson	$1,682,566	$26,218	$1,708,784
King	$1,781,053	$76,093	$1,857,146
Kitsap	$529,047	$67,427	$596,474
Lewis	$6,673,487	$8,623	$6,682,110
Mason	$3,529,674	$166,931	$3,696,605
Pacific	$1,952,524	$11,350	$1,963,874
Pierce	$372,293	$1,318	$373,611
Skagit	$9,734,264	$62,702	$9,796,966
Snohomish	$9,802,379	$162,119	$9,964,498
Thurston	$4,431,154	$147,536	$4,578,690
Wahkiakum	$1,606,065	$3,049	$1,609,114
Whatcom	$3,303,822	$69,717	$3,373,539
Total	$55,241,658	$1,185,599	$56,427,257

State Trust Lands Acreage and Management Options

State trust lands are distributed throughout the state. State Lands (lands granted to the state by the Federal government at statehood) are located both inside and outside the marbled murrelet analysis area. State Forest Lands (lands acquired from counties) are present in 15 of the counties that fall within the analysis area (Table 3.11.6). For all counties in the analysis area except Cowlitz County, State Forest Transfer Lands and State Forest Purchase Lands (which are types of State Forest Lands) are entirely within the analysis area (Table 3.11.7). (Refer to Chapter 1 for a discussion on the types of state trust lands).

[42] Includes only counties that benefit from lands within then analysis area. Several counties in the analysis area do not contain State Forest Trust lands and several counties contain State Forest Trust lands outside the analysis area. Does not include of interest distributed to state forestland beneficiaries.

State trust lands are organized into land classes that define areas with different management constraints. State trust lands may be deferred or constrained from harvest to meet objectives defined by the 1997 HCP, *Policy for Sustainable Forests*, or state or federal laws. Examples of these constraints include northern spotted owl habitat, unique habitats, riparian and wetland management zones, and associated potentially unstable slopes. In most cases, only thinning can occur on lands in riparian management zones, although very limited regeneration harvest is allowed in riparian management zones in the OESF HCP Planning Unit.

Table 3.11.6. Statewide Management Options by Trust or Trust Group Under the No Action Alternative

Acres Where Harvest is Limited Includes Both the Uplands with Specific Objectives and the Riparian Land Classes; Rounded

	Trust(s)	No harvest allowed Acres (%)	Harvest is constrained Acres (%)	Available for harvest (includes non-forested lands) Acres (%)	Total trust area Acres (% of acres in the analysis area)
State Lands	**Agricultural School Trust**	11,000 (15%)	17,000 (24%)	44,000 (61%)	71,000 (35%)
	Capitol Building Trust	29,000 (27%)	43,000 (39%)	37,000 (34%)	110,000 (73%)
	CEP&RI (including CEP&RI transferred) Trust	7,700 (11%)	11,000 (16%)	51,000 (73%)	70,000 (38%)
	Common School and Escheat Trust	266,000 (15%)	393,000 (22%)	1,137,000 (63%)	1,795,000 (28%)
	Normal School Trust	13,000 (19%)	25,000 (37%)	29,000 (44%)	67,000 (39%)
	Scientific School Trust	16,000 (19%)	31,000 (37%)	37,000 (45%)	84,000 (51%)
	University Trust (original and transferred)	15,000 (17%)	27,000 (30%)	47,000 (53%)	89,000 (50%)
Other lands	**Community College Forest Reserve**	72 (2%)	790 (22%)	2,700 (75%)	3,500 (100%)
	Community Forest Trust	52,000 (100%)	0	0 (0%)	52,000 (3%)
	Land Bank	170 (100%)	0	0 (100%)	170 (1%)
	Water Pollution Control Division Trust	1,700 (28%)	650 (11%)	3,600 (61%)	6,000 (100%)
	Other	167,000 (99%)	30 (0%)	1,000 (1%)	168,000 (67%)

Table 3.11.7. Management Options on a) State Forest Transfer Trust and b) State Forest Purchase Trust Within the Analysis Area, by County, for Alternative A (Rounded)

A) State Forest Transfer Trust

County	No harvest allowed Acres (%)	Harvest is constrained Acres (%	Available for harvest Acres (%)	Total trust area Acres (% of acres in the analysis area)
Clallam	26,000 (28%)	36,000 (39%)	31,000 (33%)	93,000 (100%)
Cowlitz	550 (5%)	4,200 (38%)	6,300 (57%)	11,000 (47%)
Grays Harbor	410 (17%)	330 (14%)	1,600 (68%)	2,300 (100%)
Jefferson	2,100 (14%)	2,300 (16%)	10,000 (70%)	15,000 (100%)
King	9,100 (40%)	8,500 (37%)	5,300 (23%)	23,000 (100%)
Kitsap	1,900 (25%)	2,200 (29%)	3,500 (46%)	7,600 (100%)
Lewis	8,200 (20%)	15,000 (39%)	16,000 (41%)	40,000 (100%)
Mason	8,300 (29%)	2,300 (8%)	18,000 (62%)	28,000 (100%)
Pacific	4,400 (29%)	3,500 (23%)	7,200 (48%)	15,000 (100%)
Pierce	2,700 (30%)	6,200 (70%)	10 (0%)	8,900 (100%)
Skagit	21,000 (25%)	32,000 (38%)	31,000 (37%)	85,000 (100%)
Snohomish	14,000 (22%)	20,000 (31%)	29,000 (47%)	62,000 (100%)
Thurston	2,700 (14%)	4,600 (23%)	13,000 (63%)	20,000 (100%)
Wahkiakum	3,800 (30%)	3,200 (25%)	5,600 (45%)	12,600 (100%)
Whatcom	8,300 (28%)	8,900 (30%)	12,000 (41%)	29,000 (100%)
TOTAL	113,000 (25%)	150,000 (33%)	190,000 (42%)	453,000 (100%)

B) State Forest Purchase Trust

County	No harvest allowed Acres (%)	Harvest is constrained Acres (%	Available for harvest Acres (%)	Total trust area Acres (% of acres in the analysis area)
Clallam	100 (42%)	10 (2%)	130 (55%)	240 (100%)
Cowlitz	30 (11%)	80 (27%)	170 (62%)	280 (100%)
Grays Harbor	3,600 (12%)	6,600 (23%)	19,000 (65%)	29,000 (100%)
Jefferson	10 (31%)	0 (0%)	10 (69%)	16 (100%)
Kitsap	20 (24%)	30 (32%)	40 (44%)	79 (100%)
Kittitas	3 (100%)	0 (0%)	0 (0%)	3 (100%)
Lewis	200 (7%)	660 (21%)	2,200 (72%)	3,100 (100%)
Mason	300 (53%)	30 (4%)	240 (42%)	560 (100%)

County	No harvest allowed Acres (%)	Harvest is constrained Acres (%	Available for harvest Acres (%)	Total trust area Acres (% of acres in the analysis area)
Pacific	2,700 (33%)	2,400 (30%)	3,100 (37%)	8,200 (100%)
Pierce	610 (18%)	2,700 (82%)	0 (0%)	3,300 (100%)
Skagit	0 (0%)	1 (50%)	1 (50%)	2 (100%)
Snohomish	60 (3%)	330 (20%)	1,300 (77%)	1,700 (100%)
Thurston	3,400 (14%)	4,200 (18%)	16,000 (68%)	24,000 (100%)
Whatcom	250 (25%)	220 (22%)	520 (53%)	1,000 (100%)
TOTAL	11,000 (16%)	17,000 (24%)	42,000 (60%)	71,000 (100%)

Tax Revenue

Timber harvests generate direct revenue for county governments and the state general fund through the forest tax and create economic activity that results in other state and local tax revenue (Washington Department of Revenue 2018a). From 2011 to 2016, an average of $29.6 million per year (in 2017 dollars) was distributed to counties within the analysis area from forest tax revenue (Table 3.11.8 Washington Department of Revenue 2015, 2018b). Average sales tax distributions were $450 million in the same period. Sales tax distributions exceed forest tax distributions in all counties in the analysis area except Pacific and Wahkiakum counties.

Looking broadly at taxes generated by harvest of timber and manufacture of wood products, Mason and Lippke 2007 reported that the state and local taxes generated per million board feet of annual timber production equaled $210,000 (in 2004 dollars, which equals $270,000 in 2017 dollars), not including the forest tax. DNR harvested 5.038 billion board feet in western Washington in the 2005 through 2014 period. At this harvest volume, state and local taxes generated from state trust lands is about $136 million per year (2017 dollars).

Other activities, such as recreation and harvesting of non-timber forest products on state trust lands, also have the potential to generate tax revenue in counties within the analysis area. The extent to which they do is not known. A report by Briceno and Schundler (2015) looking at all ownerships estimated that outdoor recreation generates state and local tax contributions of about $2.1 billion per year (2017 dollars). They estimated that recreation expenditures, excluding equipment, related to trust lands was $477 million per year (2017 dollars), while expenditures, excluding equipment, on all lands was $13.4 billion (2017 dollars). If the state and local tax contributions from state trust land recreation is proportional to the contribution of state trust land recreation to total expenditures, the state and local taxes generated by recreation on state trust lands is $76 million per year (2017 dollars).

Table 3.11.8. Average Sales Tax Distributed to Counties in the Analysis Area in 2011–2016, in 2017 Real Dollars
(Rounded; Washington Department of Revenue 2015, 2018b)

County	Average annual sales tax distribution by county	Average annual forest tax distribution by county	Ratio of forest tax distribution to sales tax distribution (>1.0 indicates timber tax distribution exceeds sales tax distribution)
Clallam	$8,500,000	$2,100,000	0.24
Cowlitz	$8,600,000	$3,100,000	0.36
Grays Harbor	$6,200,000	$3,800,000	0.61
Island	$7,800,000	$100,000	0.01
Jefferson	$4,500,000	$1,200,000	0.26
King	$155,600,000	$1,300,000	0.01
Kitsap	$30,800,000	$400,000	0.01
Kittitas	$6,600,000	$100,000	0.01
Lewis	$8,600,000	$5,300,000	0.61
Mason	$6,500,000	$1,500,000	0.23
Pacific*	$1,700,000	$3,300,000	1.92
Pierce	$69,700,000	$1,700,000	0.02
San Juan	$5,300,000	$<10,000	0.00
Skagit	$16,400,000	$1,400,000	0.09
Snohomish	$58,700,000	$1,500,000	0.03
Thurston	$28,600,000	$1,300,000	0.05
Wahkiakum*	$400,000	$900,000	2.40
Whatcom	$26,400,000	$800,000	0.03
Total	$450,900,000	$29,600,000	0.07

* Indicates counties in which the forest tax distribution exceeds sales tax distribution.

Forest Products Industry Employment

Activities on state trust lands directly support employment in counties in the analysis area. These jobs, in turn, indirectly support employment in these counties. Examples of direct employment include land management staff hired by DNR, timber harvest operators, and non-timber forest product harvesters. Examples of indirect employment includes equipment servicers and local shops.

Mason and Lippke (2007) found that direct employment resulting from both the harvesting and processing of 1 million board feet of timber in Washington State is equal to 8.67 full time jobs. These jobs were divided between logging jobs, mill jobs, and wood product manufacturers (Table 3.11.9). Since 2005, harvest activities have occurred on state trust lands in 15 of the 17 counties in the marbled murrelet analysis area. No harvest occurred in San Juan or Island counties. Mills that have purchased timber from DNR since 2005, the start of the last sustainable harvest planning decade, are located in 12 of the 17 counties (Table 3.11.10)[43].

Table 3.11.9. Jobs Created for Each Million Board Feet of Timber Harvested in Washington State (Reproduced From Mason and Lippke 2007)

	Logging	Sawn wood	Secondary wood products [a]	Primary Paper products [b]	Total
Direct employment	1.30	2.97	3.26	1.13	8.67
Indirect employment	0.53	1.14	0.83	0.12	2.62
Total	1.83	4.81	4.09	1.25	11.28

[a] Secondary wood products include manufactured wood products such as doors, molding, and furniture.
[b] Primary paper products are pulp and paper manufactured from pulp logs and wood chips.

Table 3.11.10. Counties With and Without Mills That Have Purchased Timber From DNR Since 2005[a]

Location of mills that have purchased timber directly from DNR*		Other counties
Clallam	Mason	Island
Clark	Pacific	King
Cowlitz	Pierce	San Juan
Grays Harbor	Skagit	Thurston
Jefferson	Snohomish	Wahkiakum
Lewis	Whatcom	

[a] Island, King, San Juan, Thurston, and Wahkiakum counties either do not have mills that purchased DNR timber or lack mills.

DNR used Bureau of Labor Statistics data for western Washington Counties to update the results in Mason and Lippke (2007) (Bureau of Labor Statistics 2017). These data showed similar direct employment rates as Mason and Lippke (2007) per million board feet harvested (Table 3.11.11). However, these data show a slight downward trend in employment per million board feet, indicating increasing productivity over time, with an abrupt drop during the recession in 2009 (Figure 3.11.1)[44].

[43] Sales from DNR to mills only. Some mills may have purchased DNR timber from other mills or brokers that purchased DNR timber.

[44] The Bureau of Labor Statistics does not disclose employment data if there are few businesses active in a county in a particular industry. Mill surveys by DNR show a continuous reduction in the number of sawmills since 2006 and a decline the total number in mills of all types since 2000 (DNR 2008, 2017). The reduction in operations results in an increase in counties where Bureau of Labor Statistics data are not disclosable. For example, the wood products manufacturing data for Pacific County show employment numbers though 2007, with 246 jobs in 2007. After that year, jobs numbers are reported as "not disclosable" and so not included in the summary graphs of jobs. The 2016 Washington Mill Survey reports that there are still two activity sawmills in Pacific County. A 2017 article from the Pacific County Economic Development Council report states that one of the mills employs between 145 and 160 workers. As a results, the magnitude of the drop in mill employment is appears greater in the Bureau of Labor Statistics data than actually occurred.

Table 3.11.11. Jobs per Million Board Feet Harvested in Counties in the Marbled Murrelet Analysis Area. Data From Bureau of Labor Statistics (2017)

	Forestry and logging	Wood products manufacturing	Paper manufacturing	Total
Direct jobs	1.5	4.5	2.1	8.1

Total jobs in the forest products sector declined during the recession and there was no subsequent recovery, even as the total harvest volume from all ownerships increased following the recession (Figure 3.11.2). Total employment in the sector shows no relation to harvest levels on DNR-managed lands in the marbled murrelet analysis area. The three job categories in the sector, forestry and logging, wood products manufacturing, and paper manufacturing, show slightly different patterns of job loss since 2001 (Figure 3.11.3). Forestry and logging jobs were in decline from 2001 to 2009 but have been stable since then. Paper manufacturing has been in near continuous decline since 2001; however, most of that decline occurred between 2004 and 2012. In the years since 2001, wood products manufacturing jobs experienced a peak in 2006, followed by a 38 percent decline to 2009. Since 2009, jobs in wood products manufacturing have been relative stable. Employment in these job categories do not show a strong link with harvest volumes from DNR-managed lands (Figure 3.11.4).[45] Since 2006, the timber volume exported out of Washington and Oregon ports has increased (DNR 2018b). These timber exports are mainly whole logs harvested on private timberlands in Washington and Oregon. Export of timber from DNR-managed and Federal lands is prohibited.[46] The effect of the increase in timber exports since 2006 on wood products and paper manufacturing is uncertain as the period with the greatest increase in exports corresponds to the period with the sharpest decline in timber harvest volume from all ownerships (Figure 3.11.5).

[45] DNR tracks both the volume sold and the volume harvest. Most timber sales have a two-year harvest contact. Purchasers can harvest timber anytime within that two-year period.

[46] WAC 240-15 and 36 C.F.R.§ 223.48

Figure 3.11.1. Forest Product Sector Jobs by Category in Counties in the Marbled Murrelet Analysis Area

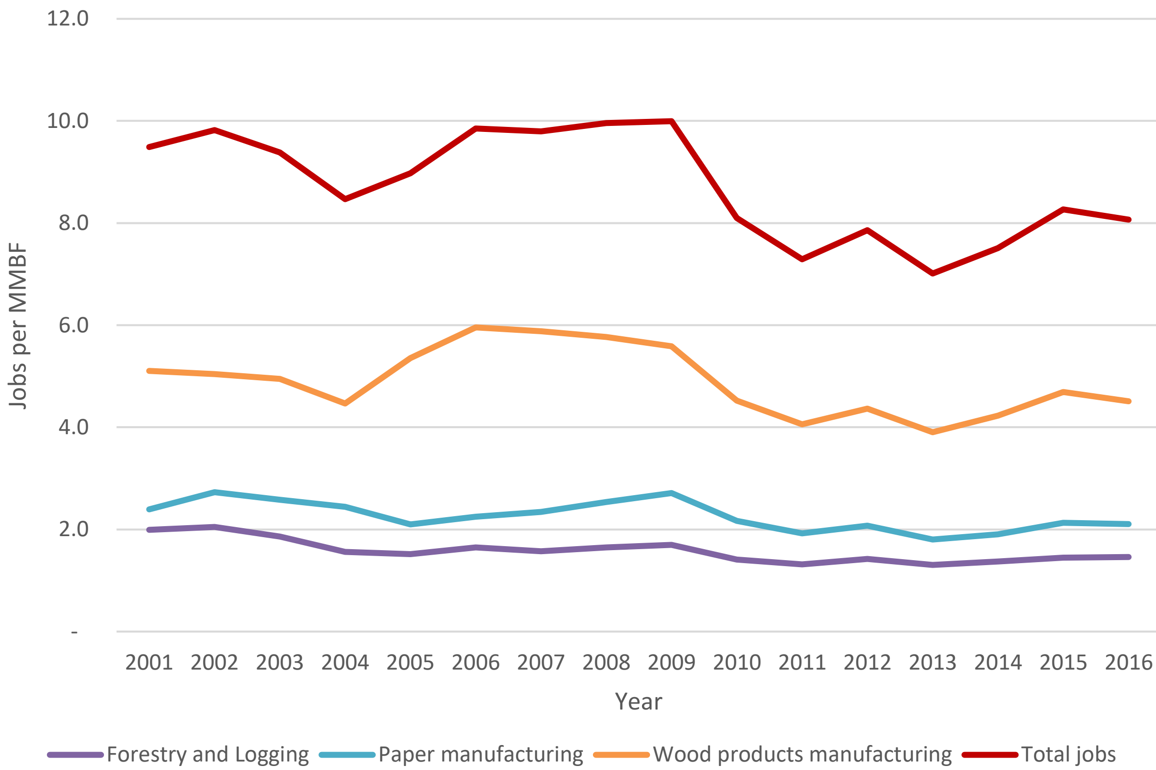


Figure 3.11.2. Forest Product Sector Jobs and Harvest Volumes from State Trust Lands and all Ownerships in Counties in the Marbled Murrelet Analysis Area

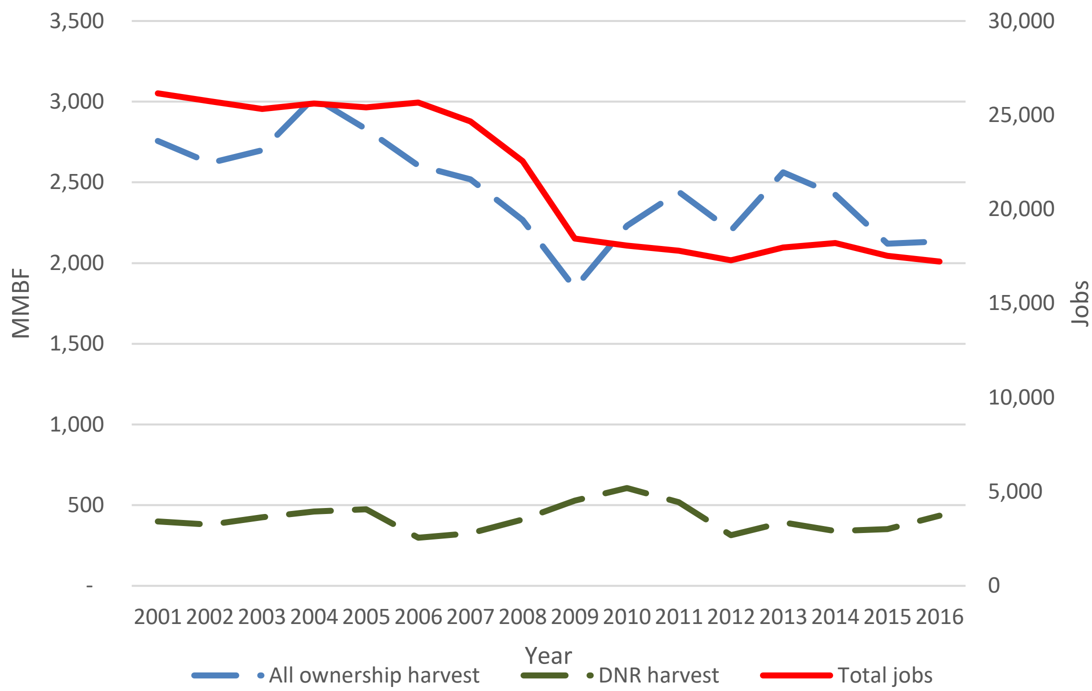


Figure 3.11.3. Forest Product Sector Jobs by Category and Harvest Volumes From All Ownerships in Counties in the Marbled Murrelet Analysis Area

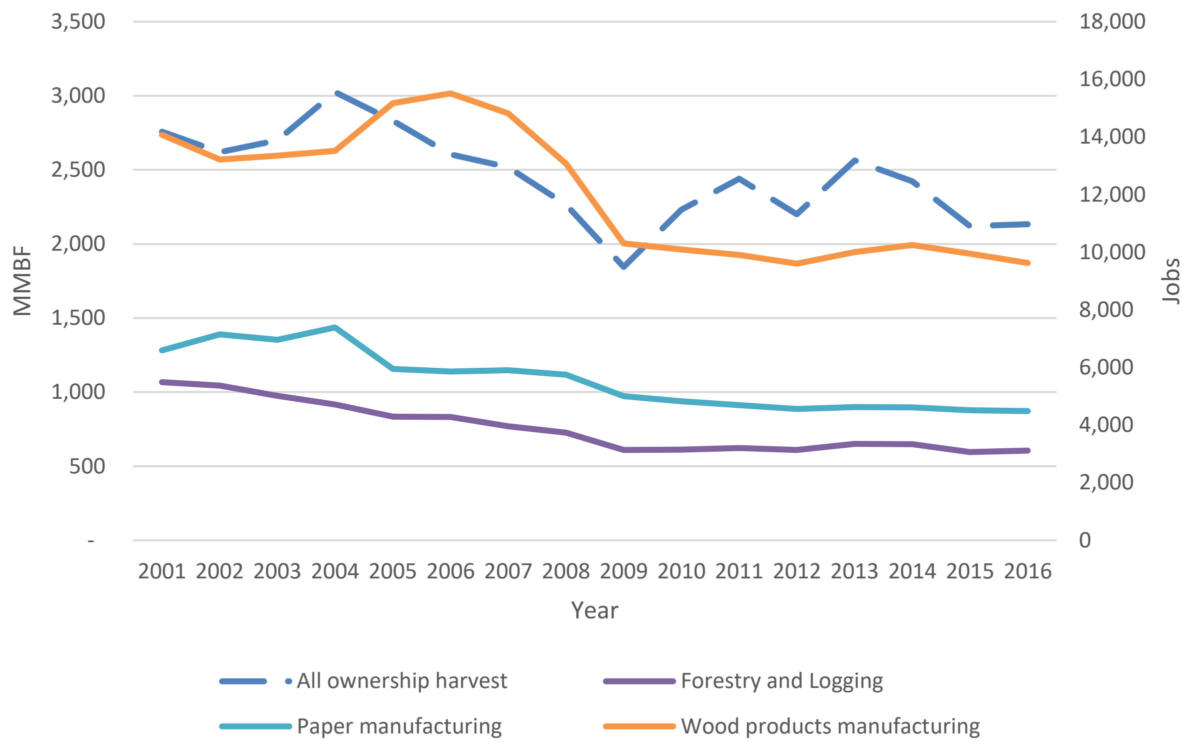


Figure 3.11.4. Forest Product Sector Jobs by Category and DNR Harvest Volumes From Washington and Oregon

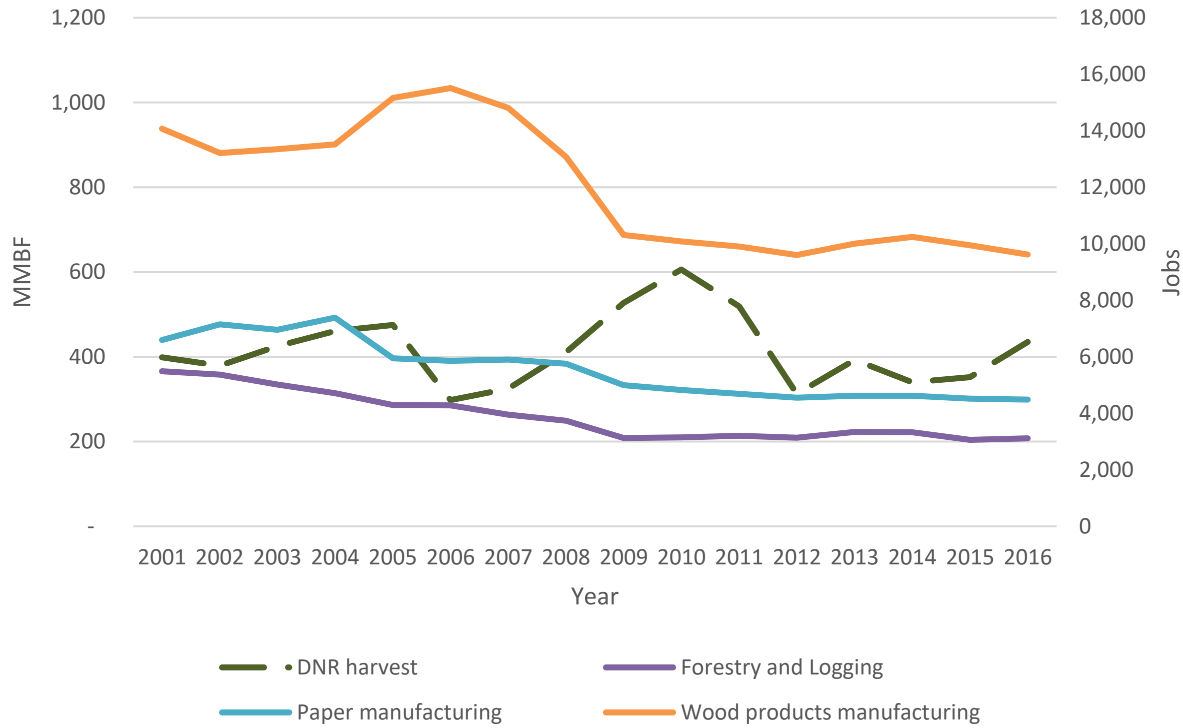
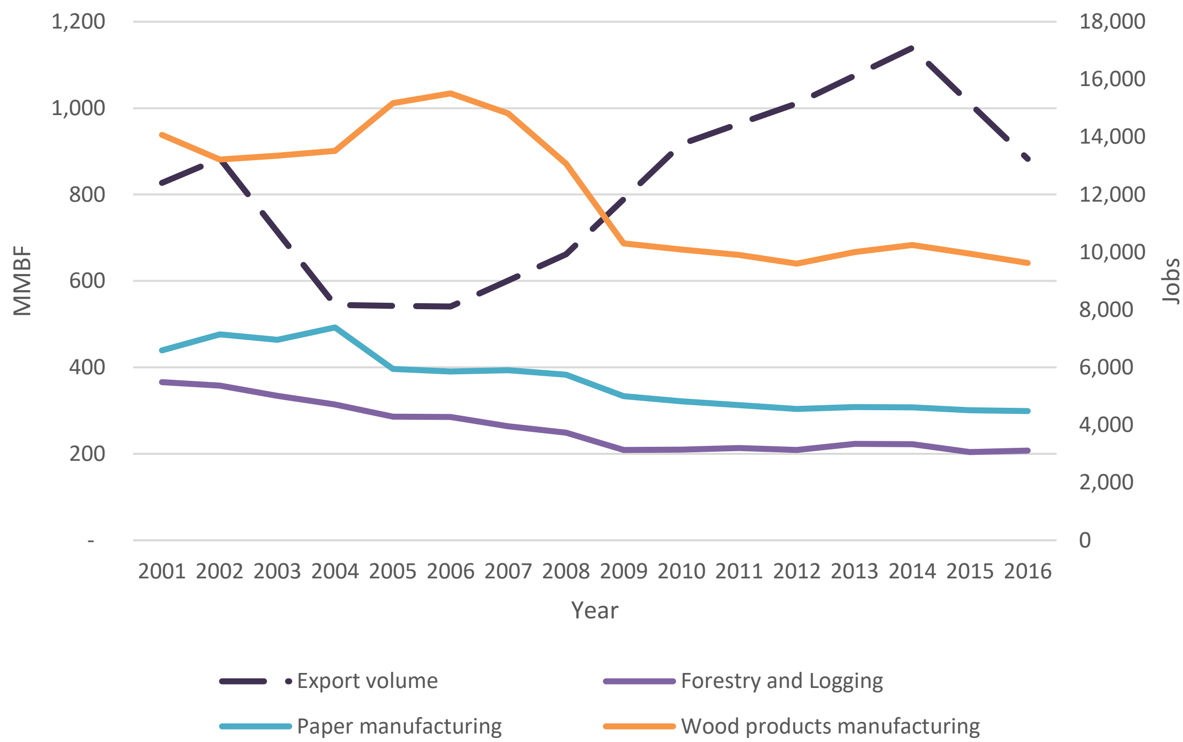


Figure 3.11.5. Forest Product Sector Jobs by Category and Export Volumes From State Trust Lands in Counties in the Marbled Murrelet Analysis Area



No data are available for the number of non-timber jobs supported by DNR-managed lands. These jobs include harvesting of forest greens, mushrooms, and other products, as well as jobs supported by recreation. The Washington Employment Security Department reports that between 46,100 to 49,100 jobs were in the "Arts, Entertainment and Recreation" category in 2014 and 2015 (Washington Employment Security Department 2016). The data do not show the wages associated with these jobs nor whether they are full or part-time. Others estimated higher numbers of jobs supported by recreation. Briceno and Schundler (2015) estimated that approximately 200,000 full- and part-time jobs are supported by outdoor recreation in Washington.

As illustrated in Table 3.11.12, most counties have a low percentage of total paid employees identified by the Bureau of Labor Statistics as working in the logging or wood product manufacturing sectors. Cowlitz and Wahkiakum counties had the highest percentage of their paid employees employed in the logging or wood product manufacturing sectors (Bureau of Labor Statistics 2017, OFM 2018b).

Statewide, the annual unemployment rate has fallen every year since 2010 from 9.9 percent (June 2010) to 4.5 percent (November 2017). The unemployment rate in Washington has closely tracked the nationwide rate since the 1990s, though with higher state-level unemployment in economic downturns (OFM 2016b).

Table 3.11.12. December 2015 Employment Information for Each County with State Trust Lands in the Analysis Area

County	% of total county paid employees forest products sectors[a]	Unemployment rate[b]	Socioeconomic resiliency	Economic diversity (4 = high diversity)	Population 2015
Clallam	3%	5.9 %	Medium	3	72,650
Cowlitz	10%	5.4 %	High	4	104,280
Grays Harbor	6%	6.1 %	Medium	3	73,110
Island	0%	4.8 %	High	3	80,600
Jefferson	0%	5.4 %	Medium	3	30,880
King	0%	3.9 %	High	4	2,052,800
Kitsap	0%	4.5 %	High	4	258,200
Kittitas	No data	4.5 %	Medium	2	42,670
Lewis	9%	5.9 %	Medium	3	76,660
Mason	5%	5.7 %	Medium	2	62,200
Pacific	3%	6.5 %	Low	2	21,210
Pierce	1%	4.7 %	High	4	830,120
San Juan	0%	3.7 %	Medium	2	16,180
Skagit	2%	4.8 %	High	4	120,620
Snohomish	0%	4.3 %	High	4	757,600
Thurston	0%	4.4 %	High	4	267,410
Wahkiakum	14%	6.0 %	Low	1	3,980
Whatcom	2%	4.3 %	High	4	209,790
Statewide rate	1%	4.5 %	N/A	N/A	

[a] Calculated from data from Bureau of Labor Statistics (2017) and OFM (2018b)
[b] Non-seasonally-adjusted unemployment rate, November 2017 (Washington Employment Security Department 2018b).

Carbon Sequestration

Currently, no state trust lands generate revenue though the sale of credit for carbon sequestration, and there is no program applicable to these lands.

Environmental Services and Other Non-Market Values

Estimating the value of DNR-managed timber lands beyond markets directly related to timber production requires looking at estimates of the value of environmental services and other land uses provided by forestlands.

ENVIRONMENTAL SERVICES AND CONSERVATION VALUES

Surveys have been developed to understand these non-market values and assess the value of different management options. For example, Garber-Yonts and others (2004) studied Oregon residents' willingness to pay for conservation in the Oregon Coast Range. They found that a hypothetical policy to increase the area of forests with old-growth characteristics resulted in a willingness to pay up to $380 per household per year. Willingness to pay for large (40 to 180 square miles) biodiversity reserves peaked at $45 per household per year. For all conservation polices, willingness to pay for additional conservation peaked at moderate levels of conservation and was negative for all policies at high levels of conservation.

Some people place value on the continued survival of species. Richardson and Loomis (2009) reviewed studies valuing preservation of threatened, endangered, and rare species. They found that willingness to pay for protection of these species ranged from $8 to $311 per year per household.

Cedar River Group and others (2002) studied the value of the property attributes of a 4,800-acre block of state trust land on Blanchard Mountain in Skagit County. These attributes included 18 different non-timber social, environmental, and economic resources. They found that the total value of these resources to Skagit and Whatcom county residents was $8.5 million. The study does not assess how this value may change with different levels of timber harvest.

Briceno and Schundler (2015) estimated that land and waters that provide recreation experiences also provide at least $143 billion to $264 billion (2017 dollars) in economic benefits from clean water, wildlife habitat, aesthetic attributes, and enhanced recreation experiences for the entire state.

Recreation

Across Washington State, recreation is an important contributor to the economy. Briceno and Schundler 2015, in a report for the Washington State Recreation and Conservation Office, estimated that recreation expenditures, excluding equipment, related to state trust lands was $477 million per year (2017 dollars).

State trust lands provide opportunities for recreation. The value of these opportunities has not been studied in detail for all state trust lands in the marbled murrelet analysis area. However, the value of one area, state trust lands on Blanchard Mountain in Skagit County, have been studied. There, the Cedar River Group and others (2002) estimated that between 30,000 and 50,000 people visited the 4,800-acre block of state trust lands. The economic impact of these visits to Skagit and Whatcom counties was $534,000 per year. They compared this value to the estimated value of harvest of 2 million board feet. This harvest level provided $1.6 million per year in economic impact to Skagit and Whatcom counties. The economic impact of these activities to the entire state is estimated as greater than $938,000 per year for recreation and $6.6 million per year for harvest of 2 million board feet.

Minerals and Hydrocarbons

The leases in this category include surface mining leases for rock, sand, and gravel, and prospecting leases for minerals or hydrocarbons. Nearly all of this revenue comes from the surface mining leases. The total revenue to the trusts in the analysis area from surface mining grew from fiscal year 2011 to 2015 from $594,000 to $1.1 million. This revenue comes from royalties from two surface mines. Revenue varies as extraction volume changes. No new surface mine leases are currently planned.

Harvest of Non-Timber Forest Products

Collection of non-timber forest products for non-tribal uses is allowed with a valid permit. Collection for tribal use does not require a permit. Permits are issued by the DNR region in which the harvesting occurs. The price varies; permits for small quantities of firewood are free, while other permits are priced in a bid process. Revenue from the collection of non-timber forest product on trust lands statewide is about $500,000 annually (2017 dollars), mostly from western Washington.

■ Existing Policies and Regulations

Trust Distribution Rate

Revenue generated for the trusts is split between the trust beneficiaries and DNR's management funds. The distribution rate of funds to the beneficiaries and DNR's management accounts[47] differs between the State Lands trusts, State Forest Transfer trust, and State Forest Purchase trust (Table 3.11.13). One State Lands trust, the Agriculture School trust, receives 100 percent of the revenue for activity on the lands in that trust (DNR 2015b). The Washington State Legislature sets the maximum allowable distribution to DNR's management funds.[48] The Board of Natural Resources sets the rate received by these funds within this limit. These rates have changed over time.

Revenue from State Forest Transfer and State Forest Purchase trusts is distributed within counties based on junior tax districts, which are tax districts created to fund particular services such as schools, emergency services, and libraries. Junior tax districts may receive a proportion of the revenue generated within the district. The proportion of the revenue they receive depends on factors such as the number of tax districts receiving revenue and the tax rate within the district as directed by RCW 76.64.110.

Table 3.11.13. General Distribution Rates, Upland Trust Revenue as of April 2018

Trust group	Beneficiaries	State general fund	DNR management accounts
Federally granted trusts	69%	0%	31%
State Forest Transfer	75%	0%	25%
State Forest Purchase	26.5%	23.5%	50%

[47] These accounts are the Resource Management Cost Account and the Forest Development Account. The Resource Management Cost Account receives money from State lands. The Forest Development Account receives money from the State Forest Transfer and State Forest Purchase lands.
[48] RCW 79.64.040

Tax Rates

The state timber tax is applied to harvests on private and state trust lands. The current rate is 5 percent of the stumpage value (Washington Department of Revenue 2018a). [49] Revenue from this tax is split between the state general fund and counties, with 20 percent going to the general fund and 80 percent to the county in which the harvest occurred. Sales tax varies by location due to local taxes, in addition to the 6.5 percent state sales tax. There are numerous other state and local taxes in counties in the marbled murrelet analysis area. Current state tax rates can be accessed at the Washington Department of Revenue.[50] Other tax rates are available from county governments.

[49] Stumpage is the price of standing timber or the right to harvest timber. Stumpage does not include costs of harvesting or transporting timber.
[50] https://dor.wa.gov

3.12 Cultural and Historic Resources

This section describes cultural and historic resources commonly found within the analysis area and how DNR manages those resources.

Text Box 3.12.1. How Are Cultural Resources Investigated in the Field?

Photo: Sara Palmer

DNR has its own archaeological staff and cultural resource technicians. DNR also works closely with tribal staff to locate and document cultural resources.

Why Are Cultural and Historic Resources Important?

DNR-managed lands within the analysis area contain many types of cultural and historic resources. DNR routinely surveys for these resources as part of its forest practices. DNR works with tribes to ensure protection of and access to traditional cultural materials and foods, as well as sites of cultural importance to tribal communities.

Current Conditions

Washington State law (WAC 222-16-010) defines cultural resources for forest practices as "archaeological and historic sites and artifacts and traditional religious, ceremonial, and social uses and activities of affected Indian Tribes." Cultural and historic resources on DNR-managed lands include archaeological and historic sites, resources, and objects.[51] Common examples on state trust lands include logging railroad grades, logging camps, mining camps, homesteads, and culturally modified trees. Logging railroad grades are the most common archaeological site type found on DNR-managed lands.

Traditional cultural properties, materials, and foods also are found on DNR-managed lands. These are places that have been identified as playing a significant role in a community's historically rooted beliefs, customs, and practices. Traditional cultural properties are eligible for listing in the National Register of Historic Places (refer to the following section). Traditional cultural materials and foods include many plants, fish, animals, and minerals traditionally used for food, medicine, and raw materials by Native peoples. There are 25 federally recognized tribes within the analysis area.[52] Maintaining tribal access to state trust lands for cultural practices, including the harvest of traditional plants, fish, roots, berries, wildlife, cedar bark, and boughs, is an important part of DNR's stewardship of state trust lands. Use of these resources is part of treaty rights for some tribes.

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[51] See WAC 25-48-020(9)-(11).

[52] For a list of federally recognized tribes in Washington, refer to www.goia.wa.gov/Tribal-Directory/TribalDirectory.pdf.

Existing Policies and Regulations

DNR Review and Consultation

DNR's practice is to avoid impacts to cultural resources when managing forestlands. Field staff routinely survey for cultural resources as part of forest practices. The *Policy for Sustainable Forests* directs DNR to identify and protect significant historic and archaeological sites, consistent with state and federal law, and to work with tribes and interested stakeholders to address culturally significant areas.[53] DNR consults with the Department of Archaeology and Historic Preservation (DAHP) and affected tribes to ensure avoidance and protection of cultural and historic resources. Tribes and DAHP regularly review and provide input for proposed forest management activities to ensure that areas of cultural significance are not disturbed.

Federal Review and Consultation

The issuance of an Endangered Species Act incidental take permit is considered a federal undertaking. The principal federal law addressing cultural resources is the National Historic Preservation Act of 1966 as amended (54 United States Code, Section 300101 et seq.) and its implementing regulations (36 CFR, Part 800), which address compliance with Section 106 of the National Historic Preservation Act. The regulations describe the process for identifying and evaluating historic properties, assessing the effects of federal actions on historic properties, and consulting with interested parties, including the State Historic Preservation Officer, to develop measures that would avoid, reduce, or minimize adverse effects. Federal consultation with federally recognized tribes also is mandatory, where applicable.[54]

Under the National Historic Preservation Act, the term "historic properties" refers to cultural resources that are listed on or meet specific criteria of eligibility for listing on the National Register of Historic Places. These criteria include the following: the resource is at least 50 years old (generally), demonstrates historical significance, and meets other criteria related to significant historical use or contribution. Section 106 of the National Historic Preservation Act describes the procedures for identifying and evaluating eligible properties, assessing the effects of federal actions on eligible properties, and consulting to avoid, reduce, or minimize adverse effects. Section 106 does not require preservation of historic properties but ensures that decisions of federal agencies include meaningful consideration of cultural and historic values and options to protect those properties.

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[53] Several state and federal laws address these resources, including Archaeological Sites and Resources (RCW 27.53), Forest Practices Application approval (WAC 222-16-010), SEPA (WAC 197-11-960), and Section 106 of the National Historic Preservation Act. Department policies and procedures addressing this topic include Executive Order 05-05, Commissioner's Order on Tribal Relations, Identifying and Protecting Cultural Resources (PR 14-004-030), Interim Direction on Special Ecological Features and Archaeological Resources (PO 14-012), and the Cultural Resources Inadvertent Discovery Guidelines.

[54] Also refer to Fish and Wildlife Native American Policy (2016); Department of Interior's Policy on Consultation with Indian Tribes and Alaska Native Corporations (512 DM 4).

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Chapter 4

ENVIRONMENTAL CONSEQUENCES

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Chapter 4

Environmental Consequences

This chapter identifies any potential impacts under each alternative on the affected environment described in Chapter 3. Potential mitigation is identified when necessary.

Identifying Impacts

Because the alternatives are limited to evaluating different approaches for marbled murrelet conservation, identifying adverse impacts to other natural resources can be challenging. By design, the alternatives do not propose changing any management approaches other than the marbled murrelet conservation strategy. Considerable adverse impacts to other resources therefore are not expected. Nevertheless, subtle, indirect, and/or cumulative impacts can occur to natural resources due to the varying degrees of conservation proposed for marbled murrelets under the alternatives. This chapter will assess the impacts that might occur to the natural and built environment from the different alternatives.

Asking the Right Questions

Each section of this chapter begins with questions that provide a framework for the analysis of environmental consequences. These "analysis questions" are designed to focus specifically on aspects of the environment likely to be impacted by the alternatives.

Evaluation Criteria and Measures

Determining whether there is an impact from the alternatives requires a methodology to evaluate whether and how an action alternative changes or affects current conditions under the no action alternative. For some elements of the environment (such as climate and marbled murrelet populations), environmental conditions will change even under the no action alternative. These changes also are evaluated.

Evaluation criteria rely on the existing conservation or management objectives, policies, or rules that are currently implemented and would continue to be implemented under the no action alternative. *Measures* either qualitatively or quantitatively identify changes that the action alternatives create to elements of the environment relative to these criteria. Each section of this chapter identifies the evaluation criteria and measures used.

■ Determining the Level of Impact

This revised draft environmental impact statement (RDEIS) is designed to meet the requirements of both the State Environmental Policy Act (SEPA) and National Environmental Policy Act (NEPA). Both laws require the RDEIS to evaluate adverse impacts. NEPA requires the identification of impacts that can be either beneficial or adverse.

Considering Scale and Context

The analysis area covers approximately 1.38 million acres of lands managed by the Washington State Department of Natural Resources (DNR). The evaluation of impacts must consider whether identified potential impacts are significant relative to scale and context. The impact of an alternative on a single campground, for example, may not be significant in the context of available recreation facilities in the analysis area, but may be significant when considered locally. Most alternatives are evaluated at the scale of the analysis area (analysis area scale), although some impacts are evaluated at the planning unit or county scale when appropriate data is available to measure the potential impact.

Considering Intensity

The term "intensity" refers to the severity of the impact. Intensity is affected by the duration and/or level of the impact. Some impacts can be relatively short in duration, and others may have longer-term consequences for an element of the environment. Indirect and cumulative impacts also are considered when determining the overall intensity of an impact to an element of the environment.

4.1 Earth: Geology and Soils

This section describes the potential effects of the alternatives on landslide potential and soil resources in the analysis area.

Analysis Question

Would the action alternatives affect the potential for landslides or increase soil erosion or compaction within the analysis area?

Evaluation Criteria

This analysis considers the existing policies, regulations, and procedures in place to protect soil resources and soil productivity and address landslide hazards, including the *Washington State Forest Practices Board Manual*, *Policy for Sustainable Forests*, and the *State Trust Lands Habitat Conservation Plan* (1997 HCP).

Scale of Analysis

As described in Chapter 1, this RDEIS considers DNR activities at the strategic level of planning. The scale of analysis for negative impacts to soils and landslide hazards is the analysis area, with additional analysis conducted at smaller scales to understand how marbled murrelet-specific conservation would overlap with areas of potential slope instability.

How Impacts Are Measured

Impacts to soil resources or areas of landslide potential are measured qualitatively, based on whether the proposed action alternatives would affect consistency with forest practices rules and other best management practices to protect potentially unstable slopes, or whether the alternatives would increase potential for soil damage from forest management activities.

Summary of Direct, Indirect, and Cumulative Impacts

Effects on Soil Productivity, Risk of Compaction, and Erosion

Because timber harvest activities are limited in areas of long-term forest cover, the proposed action alternatives are not likely to increase levels of surface erosion or compaction or otherwise adversely impact soil productivity. All action alternatives except Alternative B add conservation acres to long-term forest cover. However, even with the reduction of approximately 24,000 acres of long-term forest cover under Alternative B (compared to the no action alternative), all existing policies and regulations governing forest practices for soil productivity would remain in place. These policies and regulations also would apply to any area that is currently protected as marbled murrelet habitat under the interim strategy but may become available for management depending on which alternative is selected.

Standard Best Management Practices to Minimize Erosion Include Placing Crushed Surface Rock on Roads. Photo: DNR

Risk of Landslides

In marbled murrelet conservation areas, restrictions on harvest, thinning, road building, and related activities mean that active management will be limited. Some of these conservation areas are mapped as potentially unstable. However, mapped potentially unstable areas are not definitely at risk of a landslide occurring during the planning period.

Figure 4.1.1. Example of Special Habitat Area With Potentially Unstable Areas

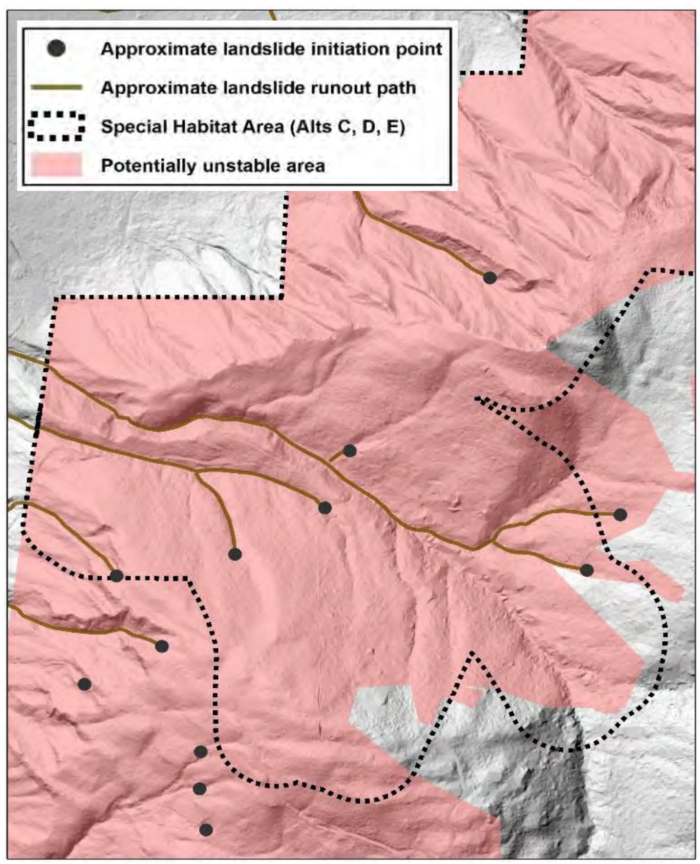


Figure 4.1.1 illustrates a proposed special habitat area that overlaps an area indicated as potentially unstable in DNR's

geographic information system (GIS). The area identified as potentially unstable in Figure 4.1.1 may be an overestimation of where the landslide risk specifically exists. Field verifications would be needed to more precisely analyze where the landslide risk is most likely. The figure shows areas (landslide initiation points and runout paths) where actual landslides occurred following an extreme storm event in 2009.

Lands identified as potentially unstable would continue to be managed under current regulations, policies, and procedures, which are designed to minimize landslide risks. For these reasons, landslide risk is not expected to increase compared to current conditions, even on the 24,000 additional acres made available for active management under Alternative B (as compared to the no action alternative).

Under any alternative, additional lands could be designated as a potentially unstable slope in the future, or land currently designated could be removed from that designation. No changes in the management of these areas are anticipated as a result of the proposed action.

Conclusions

Under all alternatives, including the 24,000 additional acres available for active management under Alternative B, DNR would continue to minimize the potential for landslides and damaging impacts to soils through the existing regulatory framework. Some areas of potential slope instability or high erosion potential would be included in marbled murrelet conservation areas, but active management would be restricted in these areas. Table 4.1.1 summarizes these conclusions.

Table 4.1.1. Summary of Potential Impacts to Geology and Soils

Key questions	Criteria	Measures	Potential impacts
Would the alternatives affect the potential for landslides or increase soil erosion or compaction within the analysis area?	Whether the alternatives would reduce DNR's ability to protect soils. Consistency with Washington State forest practices rules and other best management practices to protect potentially unstable slopes. Whether the alternatives would increase potential for soil damage from forest management activities.	Acres currently deferred that would no longer have restrictions for marbled murrelet. Net acreage of long-term forest cover under each alternative. Acres of potentially unstable slopes. Percentage of long-term forest cover that is potentially unstable. Percentage of potentially unstable slopes in interior forest.	None. No alternative would increase risks to soils or landslide potential. Compared to the no action alternative, Alternative B increases the acreage available for active management, including road building, by 24,000 acres, but the existing regulatory framework designed to minimize soil impacts from these activities would apply to these areas.

4.2 Climate

This section evaluates possible relationships between the marbled murrelet conservation strategy alternatives and climate change.

■ Analysis Questions

- *Do any alternatives cause more greenhouse gases to be emitted than sequestered?*
- *What effects will climate change have on the action alternatives or their expected environmental impacts?*

■ Evaluation Criteria

This analysis examines if the net amount of carbon sequestered in both forested stands and harvested wood is projected to be greater than the amount of carbon emitted from the burning or decay of harvested wood. For this analysis, DNR follows the methodology described in *Methods for Calculating Forest Ecosystem and Harvested Carbon with Standard Estimates for Forest Types of the United States* (Smith and others 2006), which is also described in the *Olympic Experimental State Forest HCP Planning Unit Forest Land Plan Final Environmental Impact Statement* (DNR 2016d). This carbon method estimates the amount of carbon sequestered in forested stands and soil and the amount of carbon sequestered and emitted from harvested wood over time. Region-specific estimates found in Smith and others 2006 were used in the analysis.

The analysis to determine whether the alternatives exacerbate the impacts of climate change on the environment uses two generalized categories of DNR-managed lands: those that are managed on a long-term basis to maintain forest cover for conservation, and those that are managed for revenue production, primarily through harvesting. In addition, when discussing vegetation, the analysis considers two key capabilities of natural systems, resistance and resilience. Resistance is defined as the ability to delay or prevent change. Resilience is defined as the capacity of a system to experience a stand-replacing disturbance without shifting to an alternative ecosystem state over the long term (adapted from Walker and others 2004). The analysis considers whether the action alternatives will result in a loss of resistance or resilience by elements of the environment as compared to the no action alternative.

Greenhouse Gas Emissions and Carbon Sequestration

Text Box 4.2.1. Do the Alternatives Influence Carbon Sequestration?

All alternatives are likely to increase the amount of carbon sequestered by DNR-managed forests.

For the 2016 draft EIS (DEIS), DNR did not have data on how much basal area[1] might be removed from each stand in the future, how much basal area would remain in each stand following a treatment, and how much carbon would be sequestered through time as each thinned or unharvested stand grows. Without such data, a quantitative analysis was difficult and would likely have produced questionable results. However, since the 2016 DEIS, DNR released the *Alternatives for Establishment of a Sustainable Harvest Level for Forested State Trust Lands in Western Washington Draft Environmental Impact Statement* (sustainable harvest DEIS [DNR 2016d]). The sustainable harvest DEIS integrated the effects of the marbled murrelet long-term conservation strategy alternatives with other policy decisions. The sustainable harvest DEIS analyzed carbon sequestered and emitted for each alternative based on modeled projections of both timber removal and tree growth.

While this RDEIS includes two new alternatives (Alternatives G and H), both new alternatives are within the range of alternatives evaluated in the sustainable harvest DEIS. Therefore, the carbon analysis conducted for the sustainable harvest DEIS include the ranges of carbon sequestered and emitted under all old and new alternatives examined in this RDEIS.

As described in detail below, this analysis concludes that all alternatives are likely to result in more carbon sequestered than emitted over a five-decade period.

Climate-Related Effects on Elements of the Environment

Potential impacts of climate change on elements of the natural environment within the analysis area are evaluated in the following section. The analysis focuses particularly on forest structure within long-term forest cover, evaluating whether potential climate-related declines in complex forest structure across the landscape would be ameliorated or exacerbated by the area conserved under each alternative. This analysis is focused on complex forest structure within long-term forest cover because complex forest structure is more likely to provide marbled murrelet habitat, and the intent of a long-term strategy is to conserve and promote habitat within long-term forest cover. Potential impacts of climate change on marbled murrelets are further discussed in Chapter 5.

Scale of Analysis

Carbon sequestration and emission is analyzed at the scale of the analysis area. This scale is appropriate because a determination of net carbon emissions for each alternative must consider both the carbon sequestered in the entire analysis area and the emissions from managing the same area.

[1] The cross-sectional area of all stems in a stand measured at breast height, expressed in square feet per acre.

The analysis to determine whether the alternatives exacerbate the impacts of climate change on the environment also is done at the scale of the analysis area. While climate will influence the future forests of Washington, including those on DNR-managed lands, climate projections and current understanding of individual tree species responses are not sufficiently robust to be applied at the stand level, although some research is trending in this direction (Lenior and others 2017) and broad adaptation strategies in forest types like those found in western Washington have been proposed (Halofsky and others 2018, Halofsky and others 2011).

How Impacts Are Measured: Carbon Sequestration

CARBON SEQUESTERED IN FORESTS

Many components of forests store carbon. In the scientific literature, elements of the environment that store carbon are called "pools." All forest-related carbon pools analyzed in this chapter are described in Table 4.2.1. Each pool was calculated separately based on the unharvested tree volume, which was estimated from DNR's sustainable harvest model and projected over time. All forest-related carbon pools were summed together.

Table 4.2.1. Pools of Carbon Stored in Forest Stands (Adapted From Smith and Others 2006)

Forest stand carbon pools	Description
Live trees	Live trees with a diameter at breast height of at least 1 inch; includes tree trunk, coarse roots, branches, and foliage.
Standing dead trees	Standing dead tree with a diameter at breast height of at least 1 inch; includes tree trunk, coarse roots, and branches.
Understory vegetation	Live vegetation; includes shrubs, bushes, tree trunks, roots, branches, and foliage of seedlings (trees less than 1-inch diameter at breast height).
Downed dead wood	Logging residue and other downed woody debris; includes woody material larger than 3 inches in diameter, stumps, and the coarse roots of stumps.
Forest floor	Organic material on forest floor; includes fine woody debris up to 3 inches in diameter, tree litter, humus, and fine roots in the organic layer of the forest floor above the mineral soil.
Soil organic carbon	Below-ground carbon without coarse roots; includes fine roots and all other organic carbon not included in other pools to a depth of 3 feet.

CARBON SEQUESTERED IN HARVESTED WOOD

When trees are harvested, some of the carbon they contain remains on site (for example, as slash or stumps, which decay over time) and some is removed as cut timber. Wood that is removed from the site is made into a variety of wood-based products, such as paper or lumber for homes and furniture.

Wood-based products sequester carbon for varying lengths of time. For example, paper may sequester carbon for only a short time if it is discarded after use or burned. However, paper can last longer if it is stored in books or magazines or recycled. Items made from wood, such as houses or furniture, also can sequester carbon for a long time (Smith and others 2006). Products made from wood are eventually discarded and placed in a landfill, where they are covered and decay slowly (Ryan and others 2010). In this analysis, harvested wood is calculated as two carbon pools to reflect different pathways by which carbon from harvest can be sequestered (Table 4.2.2). While calculated separately, both carbon pools are summed together in the figures and table found in the sustainable harvest DEIS.

Table 4.2.2. Pools of Carbon Stored in Harvested Wood (Adapted From Smith and Others 2006)

Harvested wood carbon pools	Description
Products in use	Wood that has not been discarded or destroyed, such as houses and other buildings, furniture, wooden containers, paper products, and lumber. Carbon stored in this pool is relatively stable but eventually is discarded to landfills.
Landfills	Wood that has been discarded and placed in landfills. Carbon is emitted to the atmosphere slowly because of slow decay rates.

CARBON EMITTED FROM HARVESTED WOOD

Carbon is emitted from harvested wood through burning or decay. If burned, the energy released may be captured to warm a home or generate electricity. In this analysis, carbon emissions arise from two distinct carbon pools, which are described in Table 4.2.3. Irrespective of carbon pool, it is assumed that carbon emissions from a tree begin the same year the tree is harvested. For example, Smith and others (2006) assumes that 26 percent of carbon in a saw log and 50 percent of carbon in pulpwood is emitted in the same year a softwood tree is harvested. This analysis uses the same assumption. Total carbon emitted from that harvested tree increases with time, but the rate of emissions will vary depending on factors such as the species harvested (hardwood or softwood) and whether the harvested tree is used as a saw log or pulpwood.

Table 4.2.3. Sources of Carbon Emissions From Harvested Wood (Adapted From Smith and Others 2006)

Harvested wood carbon source	Description
Emitted with energy capture	Wood products are burned and the energy is captured or used. For example, wood is burned in a fireplace, and the energy (heat) is captured in the home for a period of time (Ryan and others 2010). Another example of energy capture from wood products is if wood is burned to generate electricity, which is referred to as biomass energy. Biomass energy is used primarily by the forest products industry to run sawmills.
Emitted without energy capture	Wood products are burned intentionally or accidentally, and no effort is made to capture or use the energy, such as a house fire or burning trash. Another example is the natural decay of wood products. Wood products that are exposed to weather and decay fungi will eventually decompose, with rates of decomposition varying by type of wood product, size, and site conditions.

CARBON EMITTED FROM LAND-MANAGEMENT ACTIVITIES

Carbon is emitted due to direct and indirect use of fuel and energy when managing forests. For example, fuel is used by equipment during harvest operations and for electricity to power greenhouses where seedlings are grown prior to planting in the harvest units.

A carbon analysis by Sonne (2006) examined such sources for lands managed for rotation forestry in western Oregon and Washington. In the analysis, Sonne modeled greenhouse gas emissions from 107 different management scenarios that varied in assumptions around the seedling type grown, site preparation used, growth enhancement treatments implemented, and rotation age. Because no single scenario modeled was representative of DNR-managed lands, this analysis uses the average greenhouse gas emissions reported by Sonne 2006 across all modeled scenarios of 9.8 tonnes of CO_2 equivalent per hectare (or 1.08 tonnes of carbon per acre) over a 50-year rotation period. This emission value was applied to the total area harvested and thinned per decade.

■ Summary of Direct, Indirect, and Cumulative Impacts

Greenhouse Gas Emissions and Carbon Sequestration

Text Box 4.2.2. Will Climate Change be Affected by Changes in Carbon Sequestration Under the Alternatives?

Because all alternatives sequester more carbon than is emitted, no alternative results in a significant adverse impact.

In DNR's sustainable harvest DEIS, more carbon was sequestered than emitted over a five-decade period under each analyzed alternative. Compared to each other, differences in the net amount of carbon sequestered across all alternatives were small (DNR 2016d).

Alternative B, under which the least amount of long-term forest cover is conserved, is most similar to Alternative 2 in the sustainable harvest DEIS, which projects the greatest amount of harvest across all alternatives.[2] According to the sustainable harvest DEIS, Alternative 2 sequestered 1.4 percent less carbon than the no action alternative over 50 years. Alternative F, which conserves the most long-term forest cover, is most similar to Alternative 5 in the sustainable harvest DEIS. According to the sustainable harvest DEIS, Alternative 5 sequestered 1 percent more carbon than the no action alternative over 50 years. While this RDEIS includes two new alternatives (G and H), which were not modeled in the sustainable harvest DEIS, neither new alternative conserves as much long-term forest cover as Alternative F, nor do the alternatives release as much long-term forest cover as Alternative B. Because both alternatives fall within the range of alternatives modeled in the sustainable harvest DEIS, this analysis concludes that the two new alternatives will also sequester more carbon than emitted over a five-decade period. While the amount of carbon sequestered will increase with long-term forest cover area, this analysis also concludes that none of the alternatives is likely to result in a significant adverse impact to climate change from emissions because all alternatives sequester more carbon than is emitted.

[2] The sustainable harvest DEIS considers arrearage harvest levels and riparian harvest levels. Both of these policy considerations have little effect on carbon sequestration over the 50-year analysis period since they have only a small impact on the volume harvested over that period, compared to the effect of the marbled murrelet long-term conservation strategy alternatives.

Impacts of Climate Change on Elements of the Environment Critical to a Long-Term Conservation Strategy

VEGETATION

Growth and retention of structurally complex forest throughout the planning period is key to the success of a long-term conservation strategy. Forest growth (productivity) is affected by climate change. For reasons noted in Section 3.2, forest productivity will increase or decrease seasonally and annually depending on tree species and location (Littell and others 2008, Peterson and Peterson 2001, Stephenson 1990, 1998). However, broad generalizations about productivity can be made based on current energy and moisture limitations (Milne and others 2002, McKenzie and others 2003, Littell and Peterson 2005). For example, while low elevation lands in the Puget Trough and the northeast portion of the Olympic Peninsula are more likely to decline in productivity with increasing temperatures and moisture stress, this loss might be offset by increased forest productivity at higher elevations and other locations where warming temperatures extend the growing season. Yet even with increases in annual tree productivity, warmer and drier summers, combined with more intense droughts, will increase summer moisture stress and likely reduce summer productivity, even in some locations that are currently energy-limited. What is unclear is if such declines in summer productivity will more than offset increases in productivity during the rest of the year. With both increases and decreases in forest productivity likely, habitat goals could be reached sooner or later in different areas. Overall, it is not yet possible to conclude when climate-related influences to forest productivity on DNR-managed lands within long-term forest cover will be positive, negative, or neutral through the planning period. No significant productivity differences are anticipated within long-term forest cover between the no action alternative and the action alternatives, nor between action alternatives.

Text Box 4.2.3. Are Older Forests More Resilient to Climate Change?

Conserving older forest while allowing forests to grow with minimal human intervention is a reasonable strategy to promote westside forest resistance under a changing climate. Thinning to accelerate late-successional conditions in younger second-growth forests can help facilitate the goal of forest resilience.

Forest conditions can be changed through management. Thinning to accelerate late-successional conditions in younger second-growth forests could increase forest resilience by reducing drought-related stress in younger and more moisture-sensitive trees, and by fostering structural and compositional diversity at both the landscape scale (since most of the landscape is young to mid-seral and old forest, therefore provides some complement) and the stand scale (since older forests have the broadest range of tree sizes and species) (Halofsky and others 2018). Thinning will occur in long-term forest cover on a limited basis, consistent with conservation measures described in Table 2.2.5, to accelerate development of structurally complex forest.

DISTURBANCE

The forests of western Washington have evolved with largely stand-replacing disturbance events for millennia (Agee 1993). Episodic wind events have affected and continue to affect coastal Washington forests, but their influence in the rest of western Washington is more muted. Projections for western

Washington do not point conclusively to increases or decreases in the intensity of windstorms in the future (Warner and Mass 2017; Warner et al. 2015).While both wind and insects have helped shape the forests, fire has historically been the key driver of broad-scale stand initiation and related structural development across western Washington (Franklin and others 2002). For example, the Yacolt Burn of 1902 burned approximately 239,000 acres of forest in Clark, Cowlitz, and Skamania counties in less than a week. Importantly, the forests of western Washington are rarely fuel-limited; the maritime climate largely limits wildfires in these forests. As such, these forests are both adapted and resilient to stand-replacing disturbance regimes (Halofsky and others 2018). While these forests have been resilient to stand-replacing disturbances in the past, future resilience to such disturbances becomes less certain with time as the climate changes. Based on the long-term relationship between stand-replacing disturbances and western Washington forests, maintaining existing forest cover is a reasonable strategy to promote west-side forest resistance (for example, forestall change) and resilience under a changing climate (Halofsky and others 2018). Retaining older forested stands would help resist eventual change because older trees are better able to persist through unfavorable conditions created by disturbances than young trees and seedlings.

In addition, promoting well-distributed habitat patches rather than few, large patches will better increase the probability that some habitat will persist when a wildfire occurs (which will eventually happen). Therefore, alternatives that conserve older forest, such as murrelet habitat, across DNR-managed lands will provide greater resistance and resilience than those alternatives that concentrate conservation of older forest in one or a few areas. With projected increases in wildfire, some may argue for a more active management approach to reduce potential future wildfire severity. However, such a goal cannot be attained without fundamentally altering the structure of these systems and thus affecting the forest's value as murrelet habitat (Halofsky and others 2018).

EARTH

As described in Section 3.1, management of potentially unstable slopes and soils will be the same under each of the action alternatives as under the no action alternative. Management of potentially unstable slopes is designed to minimize the impacts of activities. These impacts will continue to be minimized. Any future changes in landslide timing, frequency, or severity due to climate change likely will be similar across all of the alternatives.

AQUATIC RESOURCES

As described in Section 3.2, changes in vegetation composition and disturbance are expected due to climate change. Timing, frequency, and severity of landslides are projected to change as well. These effects of climate change will impact aquatic resources. However, since the no action and action alternatives have similar amounts of activity in riparian areas and follow the same policies and procedures for management of riparian areas and watersheds (refer to Section 3.4), little difference in impacts to aquatic resources is expected between the action alternatives and the no action alternative. Likewise, there is little difference expected between action alternatives.

WILDLIFE

As described in Section 3.5, wildlife species can be organized into guilds. A guild is a group of species that utilizes the same class of resources in a similar way. The preceding analysis of impacts to vegetation shows that little difference in impacts due to climate change to vegetation is expected between the action alternatives and the no action alternative, and little difference is expected between action alternatives. Based on this conclusion, little difference in impacts on wildlife guilds is expected between the action alternatives and the no action alternative, nor between action alternatives.

Similarly, little difference in impact of climate change on marbled murrelets or other listed wildlife is expected between the action alternatives and the no action alternative, nor between action alternatives outside of Alternative F. Alternative F is likely to have the lowest climate change impact on the marbled murrelet and other older-forest associated species because of the substantial increase in total long-term forest cover acres (a 142,000 acre increase relative to the Alternative A). This increase in long-term forest cover area results in the most interior forest and largest habitat patches. Climate change impacts on the marbled murrelet are more specifically discussed in Chapter 5.

Conclusions

This analysis has determined that retaining more area in long-term forest cover sequesters more carbon, and well-distributed habitat increases the resilience and resistance of vegetation to a changing climate and disturbance regime.

The analysis also determined that all alternatives sequester more carbon than emitted over a five-decade period. Compared to each other, differences in the net amount of carbon sequestered across all alternatives was small.

All alternatives distribute long-term forest cover across the analysis area. Other than Alternative B, all alternatives increase long-term forest cover area relative to the No Action alternative, increasing likely long-term forest cover resilience, resistance, and persistence to a changing climate. Potential impacts from climate change on long-term forest cover are likely lowest for Alternative F, owing to its addition of 142,000 acres of long-term forest cover relative to the no action alternative. Alternatives C, D, E, G and H also all increase long-term forest cover area relative to Alternative A. Yet relative to Alternative A, Alternatives C, D, E, G and H will likely provide a similar benefit from a climate change perspective, with a maximum difference of approximately 43,000 acres of long-term forest cover across all six alternatives (including Alternative A). Any reduction in resilience to climate change impacts is probably slight under Alternative B, with a 24,000 acre decrease in long-term forest cover from the no action alternative (which is approximately 2 percent of DNR-managed lands in the analysis area)

This analysis concludes that none of the action alternatives likely will result in a net increase of greenhouse gas emissions or exacerbate impacts to elements of the environment from climate change.

Table 4.2.4. Summary of Potential Impacts Related to Climate Change

Key questions	Criteria	Measures	Potential impacts
Do any alternatives cause more greenhouse gases to be emitted than sequestered?	Greenhouse gas emissions do not exceed sequestration over a five-decade period.	Carbon sequestered and emitted.	Sequestration is greater than emissions across all alternatives.
What effects will climate change have on the action alternatives or their expected environmental impacts?	Whether conservation or management approaches in long-term forest cover exacerbate climate change impacts or reduce climate-related resilience.	Differences in amount of long-term forest cover. Changes in management of elements of the environment. Changes in complex forest structure.	Climate change will have impacts on elements of the environment. However, the action alternatives are not expected to exacerbate these impacts. Relative to Alternative A, Alternatives C through H are expected to increase resilience of long-term forest cover to climate change in similar ways. Alternative B would only slightly reduce resilience.

4.3 Vegetation

This section describes the potential effects of the alternatives on forest conditions, forest health, and vegetation in special management or conservation status.

Analysis Questions

- *Do any of the action alternatives result in changed forest conditions that predispose forest stands to a specific detrimental effect, or create the potential to spread insects, pathogens, or disturbance to other forest stands?*
- *Do any of the action alternatives affect the conservation status of old-growth forests, gene pool reserves,[3] or rare plants?*
- *Do any of the action alternatives affect the conservation objectives of natural areas?*

Evaluation Criteria

Scale of Analysis

This analysis looks at vegetation across the analysis area and focuses on potential changes to forest conditions within proposed marbled murrelet conservation areas. Some specific natural areas are considered in which vegetation management could be impacted by the alternatives.

How Impacts Are Measured

Data on forest conditions are used to qualitatively assess whether forests in long-term forest cover in the action alternatives are at any higher risk to forest health issues than forests in long-term forest cover under the no action alternative. The analysis also looks at whether the alternatives would require significant changes to how rare plants, old growth, genetic resources, or natural areas are managed or otherwise affect the conservation status of these resources.

[3] A gene pool reserve is a naturally regenerated, Douglas-fir stand that DNR has deferred from harvest to ensure that native genetic material, well-adapted to local conditions, will be available to DNR in the future.

Summary of Direct, Indirect, and Cumulative Impacts

Based on the following analysis, no significant adverse effects are expected to general forest conditions as a result of the action alternatives. Some positive impacts are expected to wildlife species that benefits from older forest conditions.

Stands With High Relative Density

There is little difference in the area of forest with high relative density[4] (RD >85) in long-term forest cover between Alternative A and the action alternatives, compared to the total acres of long-term forest cover (Table 4.3.1).

Where thinning can occur in stands with high relative density, a short-term risk of disturbance may develop (Mitchell 2000). Under the action alternatives, thinning in long-term forest cover would be limited in extent, as described in Chapter 2. The area of marbled murrelet habitat or security forest subject to thinning under the action alternatives is expected to be a small percentage of the total habitat area, so the short-term risk of disturbance to marbled murrelet habitat and security forest is expected to be low. In the long term, such treatments are expected to encourage the development of structurally complex forest and security forest.

Table 4.3.1. Change in Acres of Stands with High Relative Density (RD>85) in Long-Term Forest Cover from the No Action Alternative (Alternative A; Rounded to Nearest 1,000), Beginning of the Planning Period

	Total acres	Acres change from Alternative A						
	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
RD >85	92,000	-6,000	-1,000	-3,000	0	13,000	3,000	-2,000

For wildlife species benefitting from older forest conditions, a beneficial impact is expected in long-term forest cover due to more acres being in a protected status (refer to Section 3.5).

DNR-management and land use activities outside of long-term forest cover will be the same under each action alternative. Forests will be harvested, thinned, and replanted pursuant to the sustainable harvest calculation, *Policy for Sustainable Forests*, forest practices rules, 1997 HCP, and associated laws, policies, and procedures as described throughout this RDEIS. Therefore, forest conditions outside long-term forest cover are expected to be unaffected by the action alternatives.

[4] Relative density represents how the density (degree of crowding) of a given stand relates to the theoretical maximum density for a particular tree species.

Forest Health Risks

As described in Chapter 3, DNR, in conjunction with the US Forest Service, conducts annual aerial forest health surveys (Betzen and others 2017). The 2017 survey detected several sources of damage to forests in the analysis area, mostly from insects and bears. Forest damage occurs in both managed and unmanaged forests at approximately the same rates. Current rates of damage are small relative to the acres in the analysis area. Changes in management due to the action alternatives are not expected to change these overall rates of damage. Types of damage associated with smaller trees, such as bear damage, are expected to become less common as forests mature in long-term forest cover. Areas of root disease are present in both managed and unmanaged stands, including areas of marbled murrelet habitat. However, root disease spreads slowly and does not affect each tree species equally. Thus root disease is not expected to pose a specific risk to marbled murrelet habitat.

Vegetation in Special Management or Conservation Status

Long-term forest cover under every alternative includes forestlands managed for conservation purposes pursuant to the 1997 HCP, DNR's *Policy for Sustainable Forests*, and/or state law. These lands are managed primarily to maintain biodiversity or unique natural features of regional or statewide significance. Conservation measures under the action alternatives were evaluated to determine if those measures would conflict with these existing conservation commitments.

OLD GROWTH, GENETIC RESOURCES, RARE PLANTS, AND UNCOMMON HABITATS

DNR policies protecting old-growth forests and gene pool reserves would be unchanged by any alternative. Potential impacts to rare plants already are part of site-specific assessments conducted for forest management activities. However, because every location of every rare plant is not known, this vegetation can be at risk from forest management activities. Unknown occurrences of rare plants or plant communities likely would get an indirect conservation benefit if they were located within a marbled murrelet conservation area that is protected from active forest management (for example, within an occupied site or a special habitat area).

NATURAL AREAS

Under the no action alternative, management of natural areas would continue as provided in state law and DNR management plans for these areas, with consultation between DNR and U.S. Fish and Wildlife Service (USFWS) on any forest management or land use activities with potential to disturb marbled murrelet habitat.

The proposed conservation measures are not anticipated to impact the maintenance and development of marbled murrelet habitat on natural areas. Most conservation measures are compatible with management objectives for these lands. For example, no new roads are anticipated to be developed within natural areas. Existing roads are maintained for low-impact recreation or environmental education. No new leases or easements are issued in natural areas inconsistent with conservation goals; some existing property rights (for example, mineral exploration rights) may still exist if they were not acquired when DNR acquired the property.

Where special habitat areas overlap with natural area preserves and natural resources conservation areas, some minor impacts can be expected. Alternative D proposes 991 acres of special habitat areas that overlap natural area preserves and over 2,700 acres that overlap natural resources conservation areas. Because Alternative D proposes prohibiting facility and trail development in special habitat areas, development of future trails in some natural areas could be impacted (although there are no specific trail plans within these areas and within special habitat areas at this time). Alternative E includes 458 acres of natural area preserves within its designated special habitat areas and about 2,500 acres in natural resources conservation areas. Alternative H includes about 1,100 acres of natural area preserves and about 2,600 acres of natural resources conservation areas in special habitat areas. Both of these alternatives include a proposed conservation measure for trail development that is more flexible than under this Alternative D. Non-motorized trail development may occur on some natural resources conservation areas for environmental education or low-impact recreation purposes. Motorized trails or uses are not allowed in natural area preserves or natural resources conservation areas.

Forest restoration treatments are planned for several coastal natural areas (Bone River and Niawiakum River natural area preserves, Ellsworth Creek and Elk River natural resources conservation areas). Thinning or removal of larger trees may occur to accelerate older forest characteristics. Marbled murrelet habitat considerations will be part of developing treatment prescriptions; therefore, impacts from the action alternatives on proposed restoration activities are anticipated to be minor or negligible.

Table 4.3.2. Summary of Potential Impacts to Vegetation

Key questions	Criteria	Measures	Potential impacts
Do changed forest conditions predispose forest stands to a specific detrimental effect or create forest conditions with the potential to spread detrimental effects to other forest stands?	Acres of at-risk stands.	Acres of forest health concerns. Acres of stands with high relative density (RD >85).	No increase in area of forest health concerns expected. Minimal change in area of stands with high relative density under the action alternatives.
Do any alternatives affect the conservation status of rare plants, old-growth forests, or gene pool reserves?	Conservation policies in the *Policy for Sustainable Forests*, Olympic Experimental State Forest (*OESF) HCP Planning Unit Forest Land Plan.*	Acres of vegetation in conservation status.	The conservation status of rare plants, old-growth forest, or gene pool reserves would not be changed under any alternative. Rare plants whose locations are not currently known could receive an indirect benefit when they are included in marbled murrelet conservation areas and protected from active forest management.

Key questions	Criteria	Measures	Potential impacts
Do any of the alternatives affect the conservation objectives of natural areas?	RCW 79.70 and natural area preserve management plans; RCW 79.71 and natural resources conservation area management plans.	Planned projects on natural area preserves or natural resources conservation areas.	Alternatives D and E could limit the expansion or development of new low-impact trails for educational purposes in natural area preserves or natural resources conservation areas where special habitat areas overlap these lands. Forest restoration activities planned in natural area preserves or natural resources conservation areas might be affected by thinning limitations; however, mitigation for these planned activities could be to follow a marbled murrelet habitat-enhancement treatment prescription.

4.4 Aquatic Resources

This section describes the potential effects of the alternatives on aquatic resources in the analysis area, focusing on key aquatic functions and habitat.

■ Analysis Questions

- *How would the action alternatives affect riparian functions, including riparian habitat, wetlands, water quality and quantity, and fish populations and habitat?*
- *Would marbled murrelet conservation areas or measures restrict DNR's ability to conduct active management under the 1997 HCP riparian conservation strategies to restore functioning riparian habitat?*

■ Evaluation Criteria

This section considers how proposed changes in long-term forest cover configuration in and adjacent to aquatic resources could potentially alter key aquatic functions using the following criteria:

- Riparian habitat function is maintained. Key positive indicators of riparian function are large woody debris recruitment; stream shade, which is considered one of the primary factors influencing stream temperature; leaf and needle litter recruitment, which provides nutrients to streams that support the aquatic food chain; and microclimate (DNR 2013). Negative indicators of riparian habitat function are elevated peak flow, which refers to periods of high stream flow associated with storm events and spring snowmelt, and sediment delivery.
- Water quality is in compliance with state and federal water quality standards, specifically the federal Clean Water Act and the state Water Pollution Control Act (RCW Chapter 90.48).
- The criterion for fish habitat is functioning riparian habitat, with the same previously identified functional indicators.

The analysis also evaluates whether the action alternatives would affect DNR's ability to achieve the objectives of the 1997 HCP riparian conservation strategies.

Scale of Analysis

Because the proposed action is a non-project action under SEPA[5] and takes place over a large landscape scale, this section cannot consider exactly when and where project-specific forest management activities would occur adjacent to aquatic resources. Those decisions would be made at the project-specific (operational) level of planning. This section considers the overall trends and effects of the proposed alternatives on aquatic resources at the scale of the analysis area. The existing riparian conservation strategies and regulatory framework governing water and fish protection remain unchanged under the action alternatives.

How Impacts Are Measured

Potential effects on aquatic resources are considered qualitatively, focusing on the degree to which the management of these resources and the resulting impacts to the key functions they provide might be changed by the proposed alternatives.

■ Summary of Direct, Indirect, and Cumulative Impacts

As described in Section 3.4, forest management activities that could affect aquatic resources are addressed by an extensive framework of regulations, policies, and plans including the Forest Practices Act and Board Manual, SEPA, and the riparian conservation strategies of the 1997 HCP and the RFRS.

The proposed alternatives do not change this existing regulatory framework. DNR would continue to implement the riparian conservation strategy objectives of the 1997 HCP and *OESF HCP Planning Unit Forest Land Plan*, which are designed to achieve long-term, continuous landscape-level restoration of riparian functions over time. Therefore, no significant, direct impacts to aquatic resources are expected as a result of implementing a long-term marbled murrelet conservation strategy under any of the alternatives.

Indirect adverse effects may occur as follows:

- Through localized increases in forest management activities that could occur in areas where current marbled murrelet restrictions would be lifted under one or more of the alternatives.
- Through conservation measures that limit potential harvest or thinning in some riparian areas (for example, within occupied sites or special habitat areas).

The following sections focus on these potential indirect effects of the alternatives on key functions of aquatic resources. These effects are generally considered to be minor or beneficial at the scale of the analysis area.

[5] Non-project actions are "governmental actions involving decisions on policies, plans, or programs that contain standards controlling use or modification of the environment, or that will govern a series of connected actions." (SEPA Handbook, Chapter 4)

Indirect Effects on Key Functions of Aquatic Resources

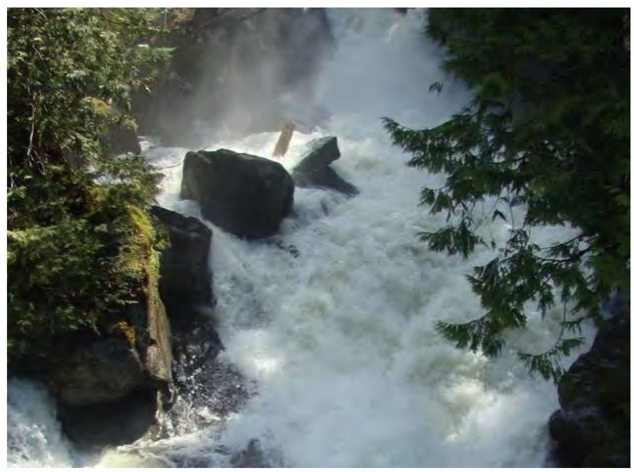
LARGE WOODY DEBRIS RECRUITMENT

DNR has defined riparian management zones based on the area of influence for large woody debris recruitment. The 1997 HCP riparian strategies are specifically designed to promote the long-term recovery of large woody debris recruitment potential within this zone.

Example of Large Woody Debris. Photo: DNR

None of the action alternatives would significantly alter how DNR manages for large woody debris recruitment. Even on lands where potential timber harvest activities may increase under one or more of the alternatives, riparian buffers would remain and continue to provide large woody debris.

PEAK FLOW



Stream in Peak Flow Condition. Photo: DNR

The term "peak flow" refers to periods of high stream flow associated with storm events and spring snowmelt. In western Washington watersheds with significant snow, peak flow occurs during winter storms when heavy rain falls on top of an existing snow pack, dramatically increasing the amount of runoff. These are commonly referred to as "rain-on-snow" events.

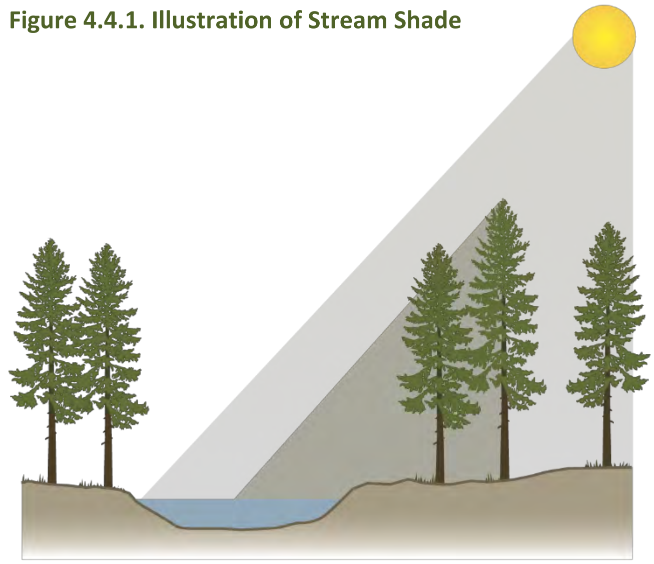
Alternatives C through H would increase long-term forest cover across the analysis area, which would have the potential to reduce peak flows, rather than increase them.

While Alternative B results in less long-term forest cover than the no action alternative, it does not alter DNR's existing approach to address peak flows through watershed-level planning. This approach ensures that measurable increases in peak flow conditions are avoided and are consistent with the *Policy for Sustainable Forests*, Forest Practices Act and Board Manual, and 1997 HCP (which includes objectives for hydrologic maturity in the rain-on-snow zone).

STREAM SHADE

Stream shade refers to the extent to which incoming sunlight that would otherwise shine on the stream channel is blocked by trees, hillslopes, or other features. Stream shade is considered a primary factor that keeps water temperatures sufficiently cool to support native fish species (Beschta and others 1997) (refer to Figure 4.4.1).

Figure 4.4.1. Illustration of Stream Shade



Accordingly, the Forest Practices Act and the 1997 HCP riparian conservation strategies specifically emphasize protection and restoration of stream shade. Therefore, even though some localized increases in timber harvest may occur under all action alternatives, the stream shade functions of riparian areas would be maintained under all alternatives as required by the existing riparian management framework.

FINE SEDIMENT DELIVERY

Increased levels of fine sediment can have detrimental effects on both water quality and fish habitat (Hicks and others 1991, Cederholm and Reid 1987). Forest roads and road-drainage features near streams are the most common source of fine sediment on state trust lands (DNR 1997, Potyondy and Geier 2011). The Forest Practices Act sets strict requirements for the design, operation, and maintenance of forest roads to avoid and minimize these impacts.

None of the action alternatives would substantially change the overall density of forest roads (refer to Section 4.8, "Forest Roads"). Additional miles of road may be needed to avoid marbled murrelet habitat impacts. However, none of the action alternatives would alter existing forest practices regulations or DNR procedures regarding road design and maintenance (refer to Section 4.8, "Forest Roads"). Therefore, none of the alternatives are likely to increase fine sediment delivery to wetlands, streams, or other waters.

LEAF AND NEEDLE LITTER RECRUITMENT

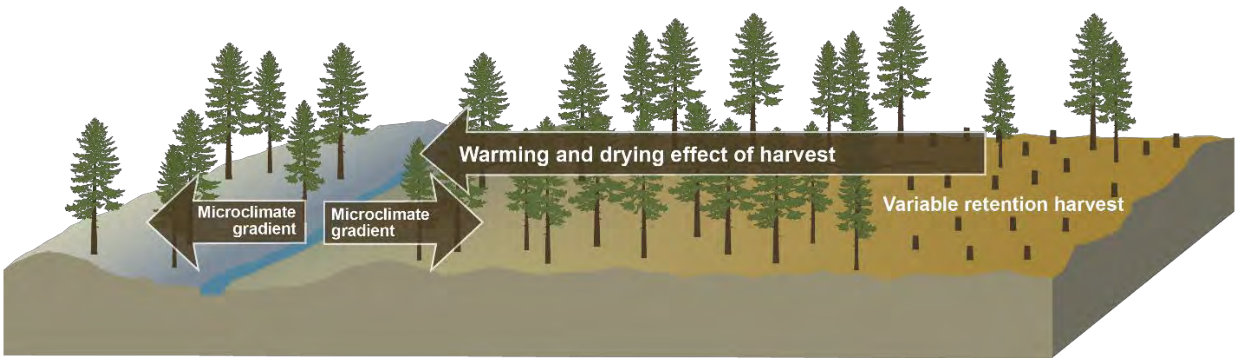
Leaf and needle litter are organic debris produced by the forest canopy that provide nutrients to streams that support the aquatic food chain. Leaf and needle litter accounts for the majority of nutrient inputs in small headwater streams and is critically important for the healthy function of these ecosystems (Wallace and others 1997).

Generally speaking, the majority of leaf and needle litter recruitment comes from vegetation within one site-potential tree height of a stream (Forest Ecosystem Management Assessment Team (FEMAT 1993), and these zones are already protected by the HCP riparian conservation strategies. Therefore, none of the alternatives are likely to alter leaf or needle litter recruitment.

MICROCLIMATE

Forest cover surrounding wetlands and streams creates a microclimate that lowers the temperature of air, soil, and water and increases humidity (Meehan 1991, Naiman 1992). Removing significant amounts of forest cover within or adjacent to riparian areas can alter microclimate and harm moisture-dependent species such as amphibians and a wide range of invertebrates, plants, and fungi (Spence and others 1996) (Figure 4.4.2).

Figure 4.4.2. Timber Harvest Effects on Riparian Microclimate

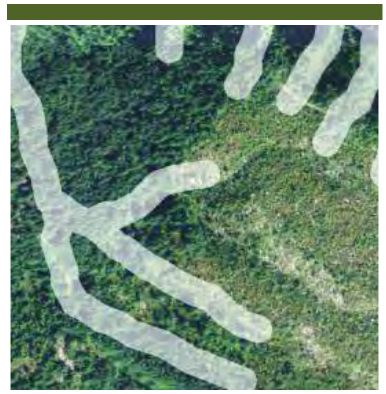


Studies by Brosofske and others (1997) demonstrated that streams exert a cooling effect on both soil and air temperatures at distances of up to 164 feet (50 meters) from the stream. In addition, they noted increased relative humidity at distances up to 122 feet (37 meters) from the stream. The heating and drying effects of harvest can extend up to approximately 545 feet (166 meters) into the surrounding unharvested areas (Chen 1991, Chen and others 1995, FEMAT 1993).

Timber harvest may occur well within this 545-foot (166-meter) zone of influence, potentially affecting the microclimate in adjacent areas of long-term forest cover. However, microclimate is a relatively small component of overall riparian health. Changes in microclimate are not expected to significantly affect riparian habitat function within long-term forest cover or within the analysis area as a whole.

Using “stringer” configuration as a proxy for potential risk of changes to microclimate (refer to Text Box 4.4.1 and Chapter 2), only Alternative B would result in a net increase in stringer habitat across the analysis area (a 4 percent increase compared to current conditions under Alternative A). Under all other alternatives (Alternatives C through H), riparian management zones within the stringer configuration would decrease between 3 and 24 percent from current conditions in Alternative A. Forest cover adjacent to riparian habitat and associated microclimate function values would increase as forest stands within long-term forest cover mature.

Text Box 4.4.1. How do Isolated Riparian Areas Factor Into Aquatic Resource Impacts?



Long-term forest cover includes riparian areas that are less than 656 feet (200 meters) wide. These “stringers” are predominantly narrow riparian management zones where adjacent uplands have not been designated as long-term forest cover.

Indirect and Cumulative Effects on Riparian Restoration Strategies: Limitations on Active Management

Some riparian harvest (including hardwood conversions) and thinning is allowed or even prescribed under the 1997 HCP riparian conservation strategies and the RFRS, through which DNR implements the HCP westside riparian conservation strategy. Conservation measures proposed under the action alternatives would restrict harvest of riparian areas within occupied sites, occupied site buffers, marbled murrelet management areas (MMMAs), special habitat areas, and P-stage habitat greater than or equal to 0.47 identified in Alternatives C and E. Under Alternative G, no harvest of any P-stage value is allowed within the OESF HCP Planning Unit. These conservation measures prohibit thinning of riparian areas in the special habitat areas of Alternatives C, D, E, G, and H. Refer to Table 2.2.5 in Chapter 2 for details on thinning rules in conservation areas.

Since implementation of the RFRS, DNR has been commercially thinning only a small portion of the total riparian acres available with timber sales, for ecological or administrative reasons. Non-commercial thinning would still be allowed in most areas, so the overall effect of this reduced ability to conduct commercial thinning within RMZs, while conceptually adverse, is not likely to significantly reduce the ability of DNR to reach aquatic resource management objectives defined in the 1997 HCP.

None of the alternatives are likely to result in adverse impacts on aquatic resources that would significantly contribute to cumulative effects of forest management activities on aquatic habitats.

Table 4.4.1. Summary of Potential Impacts to Aquatic Resources

Key questions	Criteria	Measures	Potential impacts
How would the alternatives affect riparian functions, including riparian habitat, wetlands, water quality and quantity, and fish populations and habitat?	Functions of riparian and wetland habitat for wildlife and water resources are maintained (1997 HCP, *Policy for Sustainable Forests*).	Degree to which these functions are already adequately protected by the existing framework of regulations, policies, and plans. The degree to which the alternatives would change allowable forest management activities.	The existing framework of regulations, policies and plans would adequately address potential effects on aquatic resources. All action alternatives would maintain or enhance aquatic functions, with the possible exception of riparian microclimate, which could see increased impacts under Alternative B (which has less long-term forest cover than the no action alternative).

Key questions	Criteria	Measures	Potential impacts
Would marbled murrelet conservation areas or measures restrict DNR's ability to conduct active management under the HCP riparian conservation strategies to restore functioning riparian habitat?	No substantive change in DNR's ability to reach riparian strategy objectives on state trust lands.	Qualitative review of the type of restrictions in active management of riparian areas under each alternative.	Restrictions in commercial thinning within special habitat areas under Alternatives C, D, E, G, and H could potentially delay some riparian management zones from reaching restoration objectives in these areas. This delay, in turn, may affect one or more of the various indictors of riparian functioning. However, these effects are not likely to significantly reduce the ability of DNR to reach aquatic resource management objectives defined in the 1997 HCP riparian conservation strategies.

4.5 Wildlife and Biodiversity

This section considers whether any of the strategies to conserve marbled murrelet habitat could have unintended consequences to other species of wildlife, particularly federally listed species or other wildlife species that are sensitive to disturbance, have low population levels or restricted ranges, or are otherwise important for recreational, commercial, cultural, or ecological values.

DNR-Managed Lands in South Puget Planning Unit. Photo: DNR

Analysis Question

Could areas proposed for marbled murrelet conservation under the action alternatives potentially impact federally listed species or other wildlife species?

Evaluation Criteria

This analysis considers the following criteria:

- Wildlife habitat and species diversity, and the ecological functions needed to support them within the analysis area, are maintained by the alternatives.
- Northern spotted owl habitat targets and conservation strategies are maintained by the alternatives.
- Species listed as threatened or endangered do not experience adverse impacts from the alternatives.

Scale of Analysis

For this RDEIS, wildlife habitats and biodiversity are considered in terms of trends over the analysis area and through the planning period (five decades).

How Impacts Are Measured

Impacts are measured based on the degree to which alternatives would potentially change 1997 HCP strategies for species other than the marbled murrelet or the *Policy for Sustainable Forests'* objectives.

The degree to which the alternatives would affect habitat and species diversity is measured by considering species-habitat associations and trends in forest stand development stages.

Effects on regionally important species are considered based on a qualitative assessment of anticipated habitat changes (based on long-term forest cover conditions).

■ Summary of Direct, Indirect, and Cumulative Impacts

Habitat and Species Diversity

All alternatives are expected to maintain overall wildlife habitat and species diversity across DNR-managed lands, as habitat both within and outside of long-term forest cover would continue to be managed to improve forest productivity, wildlife habitat, and species diversity.

Silvicultural methods such as variable retention harvest and variable density thinning will continue to create and maintain differing wildlife habitats and biodiversity within the working forest landscape (DNR 2013, p. 3.23).

Within the analysis area, overall habitat and species diversity would remain similar to that which would occur under the no action alternative. Some localized impacts to the habitat supporting some species guilds may occur, but these impacts pose little to no risk to overall species diversity (refer to Chapter 3 for a description of guilds).

INCREASE IN LONG-TERM FOREST COVER AND STRUCTURALLY COMPLEX FORESTS

All alternatives except Alternatives A and B would result in a net increase in long-term forest cover on DNR-managed lands. (Under Alternative A, which reflects current management practices, long-term cover would not increase from current conditions; under Alternative B, long-term cover would decrease from current conditions) A small increase in structurally complex forests and associated wildlife diversity would be expected over time under these alternatives, accompanied by a corresponding decrease in ecosystem initiation stage forests and associated wildlife communities.

Alternatives C, D, and E would result in larger but very similar amounts of long-term forest cover, adding between 17,000 and 22,000 acres compared to the no action alternative. Alternative F would add the largest amount of long-term forest cover (142,000 acres), Alternative G would add 43,000 acres, and Alternative H would add the least at 10,000 acres. These increases may have local effects on wildlife habitats within special habitat areas, emphasis areas, and marbled murrelet management areas, where most additional long-term forest cover would be established. The wildlife guild associated with ecosystem initiation stages could be locally affected as those forests enter the competitive exclusion stage, which supports fewer species. Wildlife guilds associated with more structurally complex forests would benefit as forests mature over time.

REDUCTION IN EARLY STAGE FORESTS AND ASSOCIATED WILDLIFE

Lands outside of long-term forest cover can be harvested, providing ecosystem initiation stage forests. Within long-term forest cover, areas available for harvest are reduced under all action alternatives except Alternative B. Alternative F would result in the greatest increase in long-term forest cover compared with the other alternatives, with an approximate increase of 24 percent (142,000 acres) in long-term forest cover compared to Alternative A.

INCREASED PATCH SIZE/DECREASED EDGE

The area of interior forest, defined as long-term forest cover at least 328 feet (100 meters) from any edge where active forest management may occur, decreases under Alternative B and increases under Alternatives C through H. Under Alternative B, the area of interior forest decreases by 16 percent. Increases under Alternative C through H range from 17 percent under Alternative H to 122 percent under Alternative F (refer to Figure 4.6.2 under "Marbled Murrelet" in this RDEIS for the increase in interior forest by landscape). This increase in interior forest is expected to benefit interior guild species (species that avoid edges or otherwise require large blocks of interior forest).

Increases in interior habitat will result in localized reductions of edge-associated species. However, all alternatives would maintain a majority of long-term forest cover within stringer and edge configurations. Therefore, impacts to edge habitats and associated wildlife guilds and species diversity are not expected to be significant.

REDUCED DISTURBANCE AND FOREST MANAGEMENT ACTIVITIES

All alternatives would reduce disturbance during the murrelet nesting season (April 1 through September 23), which would likely benefit other species of wildlife that breed during the same periods. Proposed conservation measures under the action alternatives also would result in changes to road construction, with most new road construction likely to occur outside marbled murrelet conservation areas.

Sensitive and Regionally Important Wildlife

None of the alternatives are likely to affect populations of species listed in Appendix L at the scale of the analysis area. Species associated with ecosystem initiation forests may experience some local declines under Alternatives C through H.

All of these changes would potentially increase breeding and resting/hiding habitat for several sensitive species and reduce foraging habitats. However, these effects would be noticeable for the most part only at the local level, primarily within designated special habitat areas, emphasis areas, and marbled murrelet management areas. At the scale of the analysis area, populations and distribution of sensitive species on DNR-managed lands would be maintained.

GAME SPECIES

Black bears often select structurally complex forests for denning. Therefore, bear populations may benefit from additional denning habitat provided by forest stands managed to develop marbled murrelet habitat under all alternatives. However, it is unlikely that additional den habitat would significantly increase bear populations, as other factors such as hunting pressure, food availability, and density-dependent competition affect bear population.

Increasing long-term forest cover, as would occur under Alternatives C through H, would increase the amount of structurally complex forest over time. Structurally complex forests are likely to provide cover habitat for deer and elk. (Cover habitat is used for protection from predators and inclement weather.) Proportional decreases in timber harvest activities could decrease foraging habitat in some areas (reducing the amount of forest in the ecosystem initiation stage), but this decrease is not expected to be significant at the scale of the analysis area. No alternative is expected to have negative effects for deer or elk.

Text Box 4.5.1. How Will the Strategy Affect Elk Habitat?

Photo: WDFW

Elk feed in cleared areas but seek cover in forested areas. The proposed alternatives generally would increase cover habitat while decreasing foraging habitat. This effect would be in proportion to the amount of additional long-term forest cover designated under each alternative. While foraging habitat may decrease locally in certain areas (particularly under Alternative F), this decrease is not expected to be sufficient in scale to reduce overall health, population growth, or distribution of elk herds.

BIRDS

Forest owls may benefit from long-term forest cover designation, although reductions in edge habitat may result in local reductions in foraging habitats. Similarly, edge-associated species, including red-tailed and sharp-shinned hawks and great horned owls, could potentially decline locally where additional long-term forest cover is designated. Finally, the alternatives would have mixed and primarily localized effects on neo-tropical migratory birds, with a moderate increase in species associated with structurally complex and interior forests (for example, Townsend’s warblers) and moderate decreases in species associated with ecosystem initiation stage forests (for example, willow flycatchers). However, similar other species discussed, there would be no significant impacts at the scale of the analysis area.

Table 4.5.1. Endangered Species Act-Listed Species and Potential for Adverse Impacts

E means Endangered, T Means Threatened

Species	Federal status	Potential for adverse impacts from marbled murrelet conservation alternatives
Columbian white-tailed deer (*Odocoileus virginianus leucurus*)	s	None. Habitats associated with the Columbian white-tailed deer are protected by the 1997 HCP riparian and wetland conservation strategies. This species is peripheral to DNR-managed forestlands.
Gray wolf (*Canis lupus*)	E	None. Habitats associated with the gray wolf are protected by the 1997 HCP gray wolf conservation efforts.
Grizzly bear (*Ursus arctos horribilis*)	T	None. The combination of 1997 HCP riparian, wetland, and uncommon habitats and northern spotted owl conservation strategies protect grizzly bear habitat. This species is a rare occurrence on DNR-managed forestlands.
Mazama pocket gopher (*Thomomys mazama subspecies*)	T	None. Mazama pocket gophers occupy prairie-like habitat—areas that are relatively open, with short-statured vegetation and few woody plants. This type of habitat and this species is peripheral to DNR-managed forestlands.
Northern spotted owl (*Strix occidentalis caurina*)	T	None. Habitats associated with the northern spotted owl are protected by the 1997 HCP northern spotted owl conservation strategy.
Oregon silverspot butterfly (*Speyeria zerene hippolyta*)	T	None. Habitats associated with the Oregon silverspot butterfly are protected by the 1997 HCP Oregon silverspot butterfly conservation efforts. This species is peripheral to DNR-managed forestlands.
Oregon spotted frog (*Rana pretiosa*)	T	None. Habitats associated with the Oregon spotted frog are protected by the 1997 HCP riparian and wetland conservation strategies.
Snowy plover (*Charadrius alexandrinus nivosus*)	T	None. Snowy plovers nest primarily on coastal beaches, dunes, and beaches at creek and river mouths. These habitats are protected by the 1997 HCP riparian and wetland conservation strategies. This species is peripheral to DNR-managed forestlands.
Streaked horned lark (*Eremophila alpestris strigata*)	T	None. Streaked horned larks nest on the ground in sparsely vegetated sites dominated by grasses and forbs and occasionally on beaches or estuaries. Where these habitats occur near DNR-managed lands, they are protected by the 1997 HCP riparian and wetland conservation strategies. This species is peripheral to DNR-managed forestlands.
Taylor's checkerspot butterfly (*Euphydryas editha taylori*)	E	None. Habitats (primarily balds and open grasslands) associated with the Taylor's checkerspot butterfly are protected by the 1997 HCP uncommon habitats strategy.
Western yellow-billed cuckoo (*Coccyzus americanus*)	T	None. Habitats associated with the western yellow-billed cuckoo are protected by the 1997 HCP riparian and wetland conservation strategies.

Northern Spotted Owl

Under the alternatives, designated northern spotted owl conservation areas (nesting, roosting, and foraging and dispersal management areas) will not change in location. DNR will continue to manage for achievement of 1997 HCP habitat thresholds within these areas as well as within each of the landscapes in the OESF HCP Planning Unit.

Alternative F differs from the other alternatives in that it includes mapped, low-quality northern spotted owl habitat (47,000 acres) in northern spotted owl conservation areas and each of the landscapes in the OESF HCP Planning Unit [6] in long-term forest cover. DNR will still be able to perform variable density thinning and other silvicultural treatments in these areas to enhance future northern spotted owl and marbled murrelet habitat, so including this habitat in long-term forest cover should not affect DNR's general management approach to these areas. In addition, long-term forest cover designated outside current northern spotted owl conservation areas, for example in the Straits and South Coast planning units, will provide additional blocks of potential northern spotted owl habitat.

Inclusion of northern spotted owl habitat in long-term forest cover will not have a negative effect on northern spotted owls. Stands that provide habitat will continue to do so. Likewise, stands that do not yet provide northern spotted owl habitat will naturally develop toward habitat conditions, providing benefits to the northern spotted owl.

Silvicultural treatments in designated northern spotted owl conservation areas and landscapes within the OESF HCP Planning Unit will continue according to HCP conservation strategies, except where special habitat areas overlap these areas under Alternatives C, D, E, and G. Areas of overlap cannot be thinned because commercial thinning and regeneration harvests are not allowed in special habitat areas under these alternatives. Thinning is allowed in non-marbled murrelet habitat in special habitat areas under Alternative H, as long as thinning remains consistent with the northern spotted owl conservation strategy in the 1997 HCP.

[6] Low-quality northern spotted owl habitat is the same as Young Forest Habitat in the OESF.

Table 4.5.2. Summary of Potential Impacts to Wildlife

Key questions	Criteria	Measures	Potential impacts
Could areas proposed for marbled murrelet conservation under the alternatives potentially impact federally listed species or other wildlife species?	1997 HCP conservation objectives. Habitat diversity is not lost. Both ecosystem initiation and structurally complex stand development stages (the two stages used most by wildlife) are available in sufficient quantities to support associated species within the analysis area. An adequate mix of habitat types is maintained under the alternatives, including early seral-stage forests and edge habitats, to support wildlife diversity. Landscapes are not dominated by competitive exclusion stage forests with low wildlife diversity.	Total long-term forest cover. Acres of marbled murrelet conservation overlapping spotted owl conservation. Acres of interior forest; Acres of edge forest. Acres of DNR-managed lands affected (for context and scale of effects).	None/beneficial. Wildlife diversity is likely to increase over time with all alternatives. Some local losses of diversity could occur due to fewer acres of ecosystem initiation stage stands, particularly under Alternative F. However, at the scale of the analysis area, such habitats would remain sufficiently abundant to maintain biodiversity on DNR-managed lands. Localized changes in habitat conditions may temporarily affect some sensitive species, but overall amount of habitat available for sensitive species would remain stable or increase on DNR-managed lands. Foraging habitat for deer and elk may be locally reduced where larger blocks of long-term forest cover would be added. This is primarily true of Alternative F. However, foraging habitat would continue to be present at the scale of the analysis area.

4.6 Marbled Murrelet

This section describes the potential effects of the alternatives on marbled murrelet habitat and population.

Analysis Questions

- *How do the alternatives affect marbled murrelet habitat, how are changes to habitat quantity and quality expected to affect the marbled murrelet population, and how do the alternatives increase or reduce risk to murrelet populations?*
- *Do the alternatives provide habitat distribution in high value landscapes for marbled murrelet conservation? These high-value landscapes include the following strategic locations: Southwest Washington, the OESF and Straits (west of the Elwha River), and North Puget.*

Evaluation Criteria

As described in Section 3.6, both the marine and inland habitats[7] of the marbled murrelet play key roles in the life cycle of the species. The proposal involves management activities on forested DNR-managed lands, not the marine environment, and therefore this analysis does not address impacts to the marine environment. This analysis will focus on how inland habitat is affected by the alternatives and how anticipated changes to that habitat will impact the marbled murrelet population in Washington.

Scale of Analysis

This analysis considers all DNR-managed lands within the analysis area, with data summarized by landscape and strategic location (refer to Section 2.3) when important for comparisons among the alternatives. Comparative inland habitat and population data from other conservation zones (refer to Section 3.6) also is considered in order to understand relative impacts of the alternatives.

How Impacts Are Measured

The analysis considers:

- Inland habitat quantity, including anticipated loss and gains of habitat through the life of the 1997 HCP
- Inland habitat quality, including P-stage and edge effects
- Disturbance impacts to inland habitat from forest use and management activities

[7] Inland habitat means marbled murrelet habitat on land, in other words nesting habitat. The term "inland habitat" is used in this section and in Section 3.6 of this RDEIS to distinguish inland habitat from marine habitat.

- Amount and quality of inland habitat in strategic locations, which are geographically important areas to the murrelet
- Relative impacts of each alternative to the marbled murrelet population in Washington using a population viability analysis model that considers two future scenarios for marbled murrelet demography

■ Summary of Direct, Indirect, and Cumulative Impacts

DNR's forest management activities cause both direct and indirect impacts to marbled murrelets. Direct impacts in this analysis are those that result from both short-term and long-term changes to inland habitat from implementation of each alternative. For the purposes of this analysis, indirect impacts are associated with non-harvest activities such as recreation, road management, and special uses.

Timber harvesting can result in both direct and indirect effects to murrelets. These effects can include the direct loss and fragmentation of habitat, increased risk of nest predation near harvest edges, habitat degradation associated with harvest edges, disruption of nesting behaviors associated with noise and visual disturbance, and the potential for direct mortality of murrelet eggs or chicks if an active nest tree is felled (USFWS 1997). Loss of inland habitat was the primary reason for the listing of the murrelet as a threatened species in 1992, and habitat loss continues to be an important stressor affecting murrelet trends (Raphael and others 2016). The amount and distribution of inland habitat is the strongest indicator associated with the distribution and trends of murrelets at sea. Areas with greatest inland habitat loss correspond directly to areas of the greatest declines in murrelet numbers at sea. Over the past 15 years, both the loss of inland habitat and declines in murrelet numbers have been highest in Washington compared to Oregon and California (Raphael et al. 2016).

Loss of inland habitat reduces nest site availability and displaces murrelets that have nesting fidelity to the harvested area. The effects of displacement due to habitat loss include nest site abandonment, delayed breeding, failure to initiate breeding in subsequent years, and failed breeding due to increased predation risk at marginal nesting sites. Each of these outcomes has the potential to reduce the nesting success for individual breeding pairs, and ultimately could result in the reduced recruitment of juvenile birds into the local population (Raphael and others 2002). The best available information regarding murrelet responses to inland habitat loss indicate that individual murrelets directly affected by habitat removal are essentially removed from the breeding population due to displacement and predation effects, although these effects may take several years to manifest (Raphael and others 2002).

The alternatives propose to conserve inland habitat and recruit new habitat in existing conserved forestlands and in designated murrelet-specific conservation areas, which will result in new and higher-quality habitat developing over time. DNR will harvest habitat in other areas.

This section compares the relative impacts of the action alternatives and how these impacts ultimately affect the marbled murrelet population associated with DNR-managed lands.

Direct Impacts: Habitat Loss and Gain

Ongoing forest management within the analysis area will result in short-term losses of mostly low-quality inland habitat under all alternatives except alternatives F, G and H, and long-term gains of both low- and high-quality habitat within long-term forest cover.

PROTECTION OF OCCUPIED SITES

All of the alternatives protect occupied sites, which are habitat patches of varying size in which murrelets are assumed to nest based on field observations. Alternatives B through H use occupied sites that were identified through HCP survey work and expanded by the Science Team Report (adding approximately 16,000 acres as compared to the no action alternative). Timber harvest would be prohibited in these areas, as would most of the forest management and land use activities that remove inland habitat. In isolated cases, limited forest management activities may occur within an occupied site, such as a road construction or individual tree removal. All action alternatives except Alternative B include 164- or 328-foot (50- or 100-meter) buffers on occupied sites. Alternatives C through H use special habitat areas, emphasis areas, or MMMAs that further increase the security forest[8] around some occupied sites in strategic locations.

Table 4.6.1. Comparison of Occupied Site Protection Strategies Among Alternatives

Occupied site protection	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Increases acres of occupied sites compared to current practice	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Applies occupied site buffers	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Includes additional security forest acres for selected occupied sites	No	No	Yes—special habitat areas and emphasis areas	Yes—special habitat areas	Yes—special habitat areas and emphasis areas	Yes—MMMAs	Yes—special habitat areas and emphasis areas and MMMAs	Yes—special habitat areas
Applies conservation measures[b] to protect occupied sites from disturbance	No[a]	Yes	Yes	Yes	Yes	Yes	Yes	Yes

[a] The interim strategy does require timing restrictions for some forest management activities near occupied sites.

[b] Refer to Chapter 2 for conservation measures.

[8] A closed-canopy forest stand over 80-feet tall that is located adjacent to marbled murrelet habitat and provides security from windthrow, predation, and other disturbances.

The use of buffers and other protective measures on occupied sites reduces the risk to inland habitat from predation and other disturbances. Since marbled murrelets frequently re-use their nesting areas (Nelson 1997), enhancing the protection of occupied sites is a strategy that benefits marbled murrelets in many ways, including potentially reducing predation and thus increasing productivity, reducing the potential for habitat to be lost to natural disturbance over time, and likely reducing the risk of birds having to change nest locations.

HABITAT LOSS FROM HARVEST

Outside of long-term forest cover, habitat for the marbled murrelet will be released for harvest under all alternatives. Although this habitat will be available for harvest, it is not known if it will be harvested. DNR's sustainable harvest calculation forest estate model (DNR 2016) will determine the actual amount of habitat proposed for harvest. In order to evaluate a "reasonable worst case" scenario, the analysis assumes that all of this habitat will be harvested and that harvest of this habitat will occur in the first decade of the planning period for all alternatives. Under DNR's preferred alternative, Alternative H, harvest of 3,600 adjusted acres (approximately 11,000 raw acres) of marbled murrelet habitat that DNR otherwise would be authorized to harvest upon amendment of its incidental take permit would be delayed (metered) until the end of the first decade following implementation. Metering will maintain habitat capacity while additional habitat is developed under the long-term conservation strategy. These metered acres will become available for harvest at the beginning of the second decade.

For analysis, inland habitat is described as either low quality (P-stage value 0.25 to 0.36) or high quality (P-stage value 0.47 to 0.89). Table 4.6.2 estimates the acres of low-quality and high-quality habitat that will be released for harvest in the first decade outside of long-term forest cover.

The potential exists for new road construction to occur in occupied sites, occupied site buffers, and marbled murrelet conservation areas under all alternatives (refer to Table 2.2.6). Under Alternatives B, E, and F, new road construction would be allowed in these areas following consultation with USFWS but would be avoided if possible. Under Alternative H, new road construction would be allowed only when no other route is feasible (if in marbled murrelet habitat, DNR will consult with USFWS to minimize impacts). Under Alternatives C, D, and G, new road construction would only be allowed in these areas if required by state or federal law or emergency. The amount of new road construction through occupied sites, occupied site buffers, or special habitat areas is unknown but is expected to be minimal because DNR will avoid these areas when possible.

Table 4.6.2. Estimated Acres of Habitat (Raw Acres) Released for Harvest in the Analysis Area by the End of the Analysis Period

		Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Low-quality habitat loss to harvest (P-stage value 0.25–0.36)	Southwest Washington strategic location	4,241	7,844	4,459	4,458	4,458	1,769	2,443	5,068
	OESF and Straits (West of the Elwha River) strategic location	7,167	9,166	7,370	7,901	6,685	3,934	1,054	6,884
	North Puget strategic location	13,009	13,304	12,009	12,033	11,675	7,751	11,092	11,550
	Other high value landscape	7,115	9,187	8,864	8,865	8,871	5,669	8,866	8,845
	Marginal landscape	1,082	1,715	1,715	1,715	1,715	1,711	1,715	1,715
Subtotal		32,614	41,216	34,417	34,972	33,404	20,834	25,170	34,062
High-quality habitat loss to harvest (P-stage value 0.47–0.89)	Southwest Washington strategic location	7	259	0	175	0	76	0	174
	OESF and Straits (West of the Elwha River) strategic location	739	1,593	0	1,319	0	468	0	1,139
	North Puget strategic location	2,523	2,568	0	2,353	0	1,403	0	1,553
	Other high value landscape	1,082	1,542	0	1,442	0	881	0	1,238
	Marginal landscape	97	97	0	97	0	93	0	97
Subtotal		4,448	6,059	0	5,386	0	2,921	0	4,201
Total acres		**37,063**	**47,272**	**34,417**	**40,357**	**33,404**	**23,754**	**25,170**	**38,264**

Most harvest of inland habitat outside of long-term forest cover in the first decade is expected to be in low-quality habitat. Of the total habitat released for harvest under each alternative, 87 to 100 percent is low quality. The most habitat released for harvest overall is under Alternative B, followed by Alternatives

D, H, A, C, E, G, and F. In order of most to least high-quality habitat released for harvest are alternatives B, D, A, H, and F. Alternatives C, E and G included rules that prohibit the release of high-quality habitat. Alternatives F and G release fewer acres than Alternative A, the no action alternative.

As explained previously, Alternative H meters 3,600 adjusted acres of habitat (approximately 11,000 raw acres) during the first decade after implementation. In Southwest Washington, Alternative H releases approximately 800 more acres of low-quality habitat and approximately 200 more acres of high-quality habitat than Alternative A. For all landscapes combined, Alternative H releases less high-quality habitat than Alternatives A, B, and D and releases less low- and high-quality habitat combined than Alternatives B and D.

HABITAT GAINS

Throughout long-term forest cover for all alternatives, inland habitat will increase in amount and quality over time. This habitat gain would occur under the no action alternative as the interim strategy continues to be implemented. By the final decades of the 1997 HCP, initial habitat loss outside long-term forest cover will be outpaced by gains in habitat within long-term forest cover, in which forest cover will be maintained through the current regulatory framework. Gains are expected under every alternative (refer to Table 4.6.3 and Figure 4.6.1). Alternatives C through H provide more low-quality habitat in the final decade of the planning period than Alternative A in two of the strategic locations, Southwest Washington and North Puget. Alternatives C through H also provide more high-quality habitat in the final decade of the planning period than under Alternative A in all three strategic locations, Southwest Washington, OESF and Straits (west of the Elwha River), and North Puget.

Table 4.6.3 Estimated Acres of Habitat in the Final Decade of the Planning Period in Long-Term Forest Cover, by Landscape or Strategic Location and Alternative

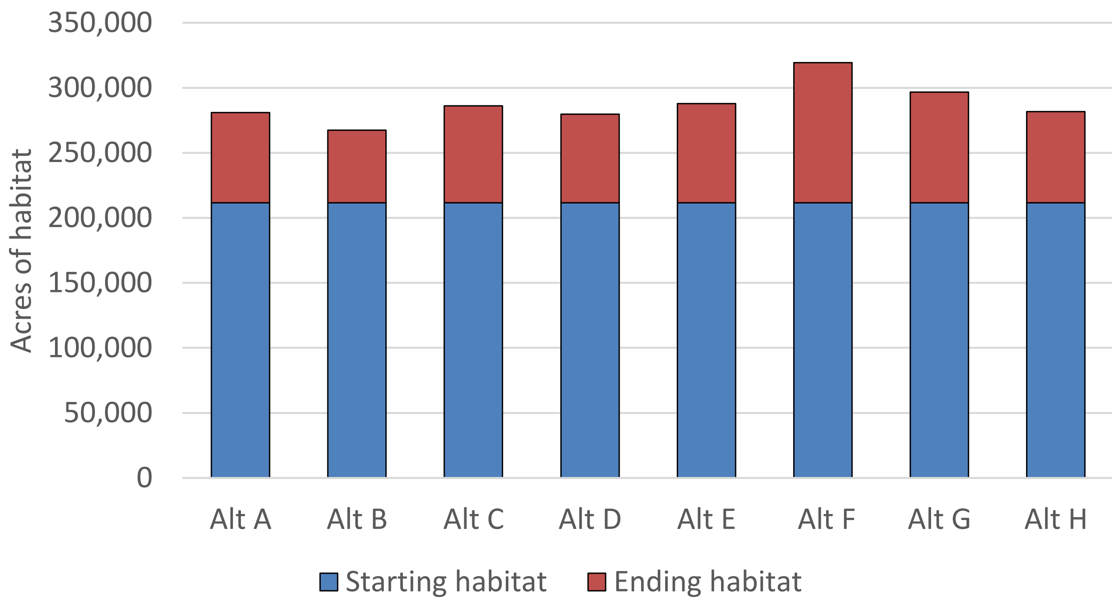
	Landscape	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Final decade potential low-quality habitat	Southwest Washington strategic location	11,291	11,140	11,706	11,706	11,706	12,202	11,738	11,593
	OESF and Straits west of the Elwha River strategic location	5,034	3,578	4,047	4,446	4,471	4,599	4,424	4,285
	North Puget strategic location	21,623	21,341	22,420	22,625	22,853	30,061	22,969	22,265
	Other high value landscape	41,319	37,531	38,343	38,341	38,335	47,112	38,329	38,313
	Marginal landscape	22,564	22,234	22,234	22,234	22,234	22,239	22,234	22,234
Total low-quality habitat		101,831	95,824	98,750	99,352	99,599	116,213	99,694	98,690
Final decade potential high-quality habitat	Southwest Washington strategic location	26,140	22,371	28,125	27,390	28,126	31,537	30,592	26,980
	OESF and Straits (west of the Elwha River) strategic location	69,764	67,836	71,594	69,570	72,373	76,001	77,278	71,016
	North Puget strategic location	49,505	49,092	53,420	50,716	53,575	58,185	54,980	52,040
	Other high value landscape	30,307	29,433	31,264	29,803	31,253	34,528	31,259	30,024
	Marginal landscape	3,397	2,878	2,978	2,878	2,978	2,882	2,978	2,878
Total high-quality habitat		179,113	171,610	187,381	180,357	188,305	203,133	197,087	182,938
Combined totals		**280,945**	**267,434**	**286,130**	**279,708**	**287,906**	**319,347**	**296,783**	**281,627**

NET HABITAT BY END OF PLANNING PERIOD

If the proposed harvest of 24,000 to 47,000 acres (depending on alternative) of inland habitat outside long-term forest cover during the first decade for Alternatives A through H and the predicted habitat development in long-term forest cover during the 5-decade planning period are considered together, the result should be a net increase of raw habitat acreage for every alternative, including the no action alternative (Alternative A) (Refer to Figure 4.6.1).

Alternatives C, E, F, G and H result in more total inland habitat than Alternative A. Alternative C, E, F, G, and H will all have more total high-quality habitat than Alternative A. Alternatives B and D will result in less total habitat and less high-quality habitat than either Alternative A or the other action alternatives.

Figure 4.6.1. Growth of Habitat Through Time, by Alternative



Accounting for Habitat Quality

Although every alternative shows a net gain of habitat acres through the life of the 1997 HCP, the *quality* of this habitat is influenced primarily by P-stage and edge effects. Other factors, including whether the habitat is in an interior forest condition, the geographic location of habitat, and the timing of habitat development, also factor into overall habitat quality.

P-STAGE AND HABITAT QUALITY

In the calculation of impacts and mitigation in the analytical framework (refer to Appendix B), acres of inland habitat lost or gained are adjusted by their P-stage values, which reflects the quality of that habitat based on its probability of being used for murrelet nesting. An acre of the lowest quality habitat (P-stage value 0.25) is therefore "worth" only 0.25 acres in terms of its habitat quality. Multiplying the acres of habitat projected to grow within the planning period by their P-stage value creates a more accurate picture of the mitigation value of these acres, as compared with the non-adjusted acres reported in the previous section. Both adjusted and non-adjusted acres are reported in this analysis for purposes of comparing the alternatives. P-stage also is combined with other adjustment factors (refer to the following section).

INTERIOR FOREST HABITAT

Larger patches of habitat within interior forest ("interior forest habitat"), which is habitat located away from forest edges, are more likely to help protect nesting marbled murrelets from the effects of predation, changes to microclimate, and other types of disturbance events and activities. Interior forest habitat is not subject to these edge effects. Chapter 2 provided summary data on the relative interior and edge conditions expected in long-term forest cover under each alternative. This section further analyzes the differences among the alternatives relative to the protection and development of interior forest habitat.

Patterns of habitat development differ by alternative within landscapes and among landscapes. Development of habitat in areas of interior forest may be most important in terms of developing functional habitat for the marbled murrelet over time.

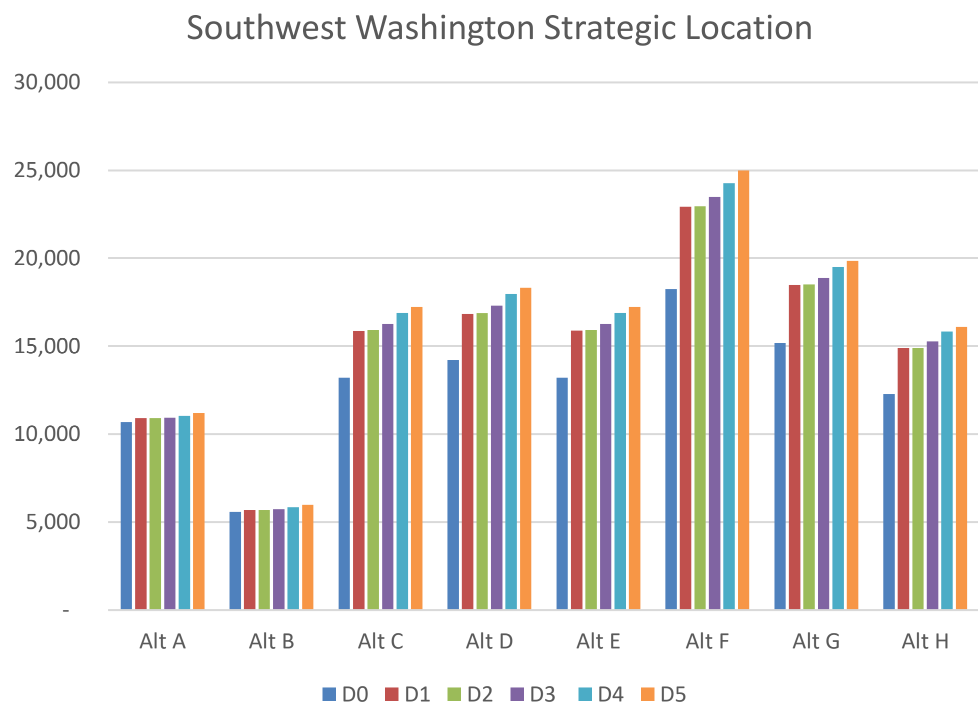
Alternatives A, F, G, and H apply 328-foot (100-meter) buffers around all occupied sites. Alternatives C, D, and E also apply 328-foot (100-meter) buffers around all occupied sites, except in the OESF HCP Planning Unit, in which occupied sites that are 200 acres in size or larger receive 164-foot (50-meter) buffers. These buffers effectively increase the area of interior forest habitat associated with occupied sites and minimize the potential for edge effects from future management in these sites. Table 4.6.4 shows the overall change in interior forest habitat and Figure 4.6.2 shows how interior forest habitat is expected to develop in each of the landscapes. Alternative B does not apply any buffers, so it is expected that occupied sites likely will degrade over time as predation and windthrow erode occupied sites. Some interior forest habitat will develop in other areas of long-term forest cover under Alternative B to partially offset losses to occupied sites.

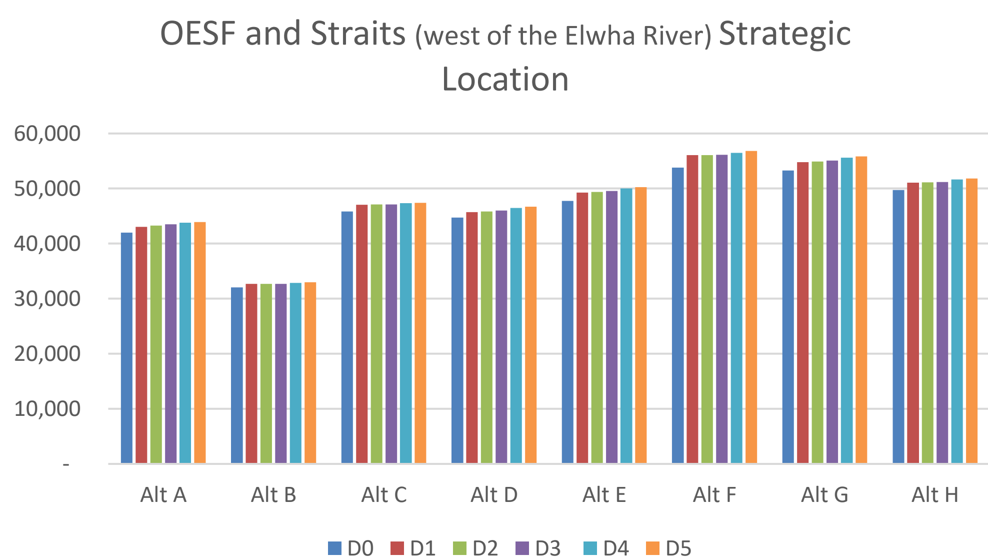
Table 4.6.4. Change in Raw Acres of Interior Forest Habitat Between Existing Conditions and Decade 5, by Alternative

	Alt A	Alt B	Alt C	Alt D	Alt E	Alt F	Alt G	Alt H
Existing conditions	84,536							
Decade 5	105,658	84,715	119,046	118,161	122,978	165,980	134,748	121,579

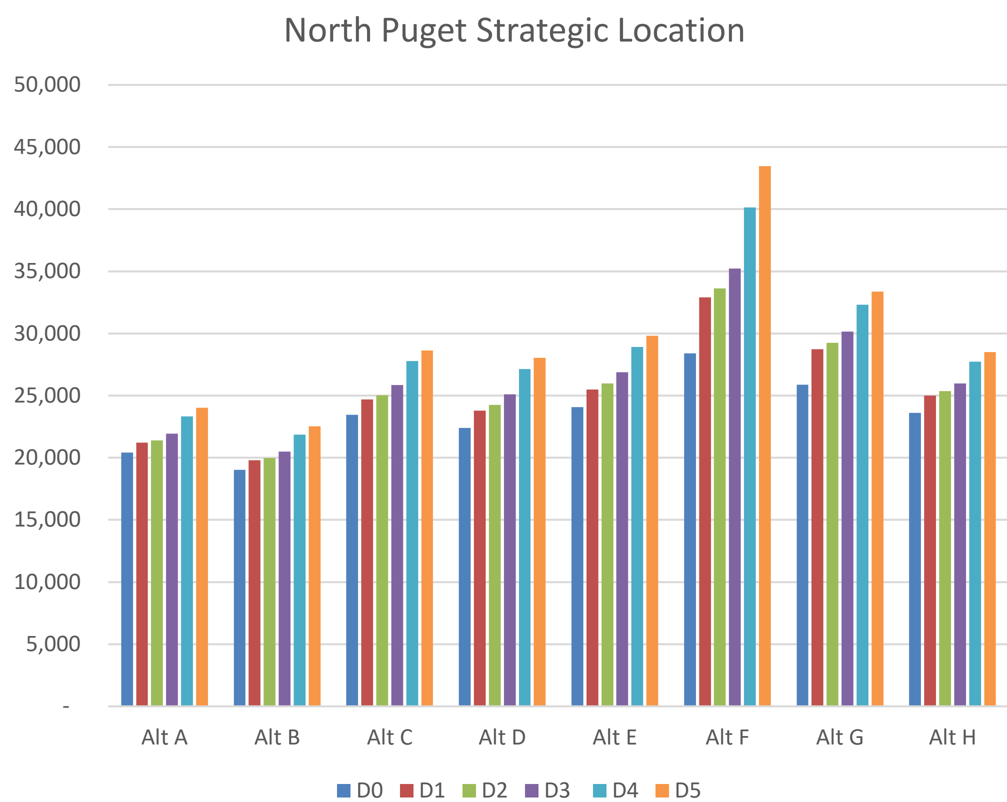
The total amount of interior forest habitat increases under all alternatives. Alternative H contains more interior forest habitat in decade five than Alternatives A, B, C, and D. Alternatives G and F contain more interior forest habitat in Decade 5 than Alternative H.

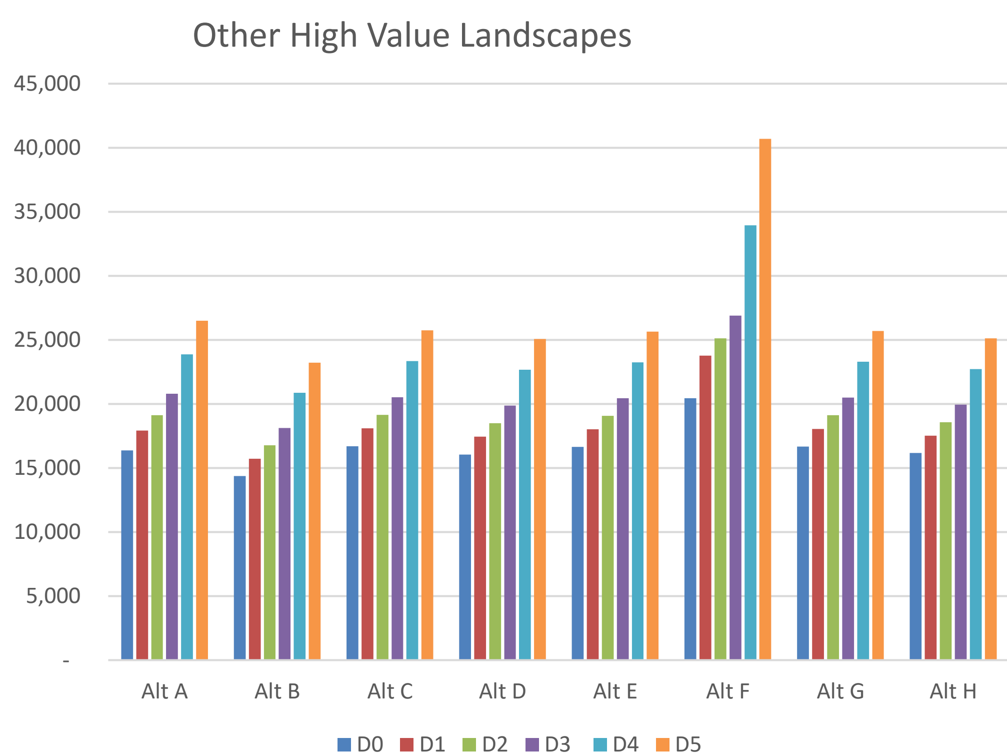
Figure 4.6.2. Estimated Growth of Interior Forest Habitat Among Landscapes[9]

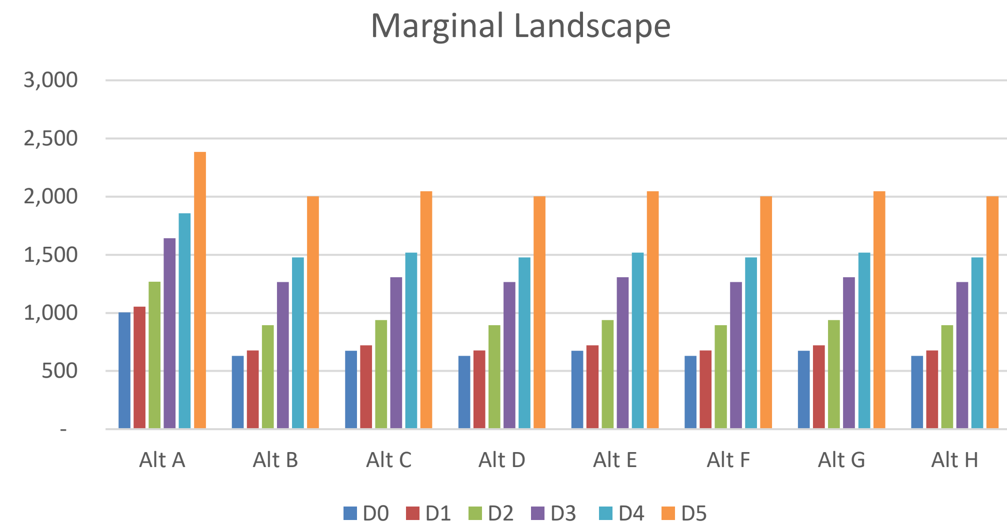




[9] In the short term, loss of mostly low-quality habitat outside of long-term forest cover will occur under any alternative, including the no action alternative. This habitat loss is not in occupied sites. Within the first two decades, growth of new habitat and development of higher-quality habitat outpaces this initial habitat loss.


North Puget Strategic Location
50,000
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
-
Alt A
Alt B
Alt C
Alt D
Alt E
Alt F
Alt G
Alt H
D0 D1 D2 D3 D4 D5


Other High Value Landscapes
45,000
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
-
Alt A
Alt B
Alt C
Alt D
Alt E
Alt F
Alt G
Alt H
D0 D1 D2 D3 D4 D5



Compared to Alternative A, Alternatives C through H conserve more interior forest habitat in Southwest Washington, the OESF and Straits (west of the Elwha River), and North Puget landscapes because these alternatives incorporate marbled murrelet conservation areas in addition to existing occupied sites. Alternative B conserves less interior forest habitat than Alternative A in these landscapes. In the other high value and marginal landscapes, which are lower priority areas for conservation, the results are different. In the other high value landscapes, only Alternative F conserves more interior forest habitat than Alternative A. In the marginal landscape, all action alternatives conserve less interior forest habitat than Alternative A. Overall, Alternatives C through H reduce edge effects on murrelet habitat by strategically configuring some areas of long-term forest cover in different ways, which results in a somewhat greater proportion of interior forest habitat than Alternative A, the no action alternative.

Increases in interior forest habitat are expected to benefit marbled murrelet by reducing edge effects and predation and therefore may increase nest success and population numbers over time.

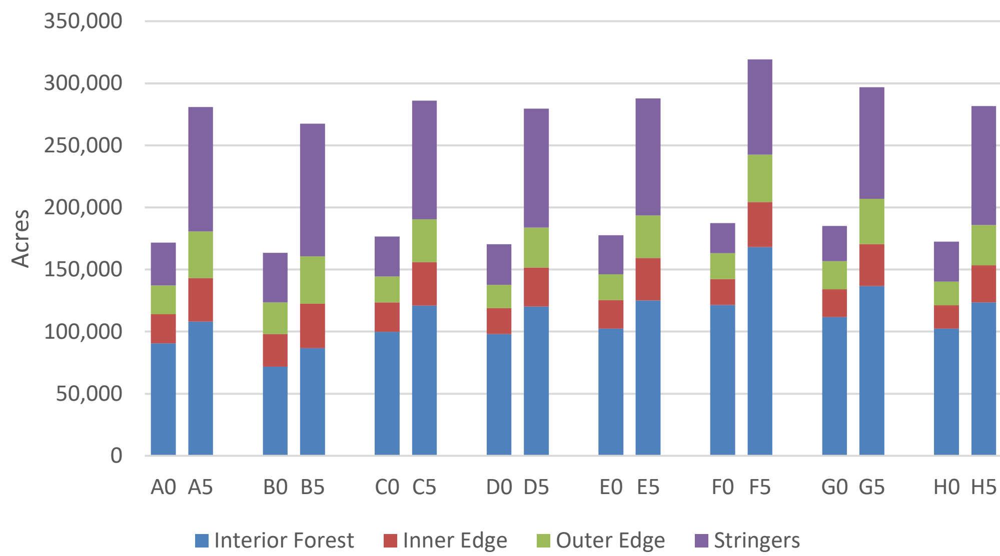
EDGE EFFECTS

Habitat that is not in interior forest is considered edge habitat (including habitat located in stringers). Habitat in an edge condition is subjected to a number of edge effects, including changes to microclimate, increased risk of predation, increased windthrow, and other types of disturbances (refer to Section 3.6 and Appendix I). Because the amount and composition of marbled murrelet-specific conservation areas differ among alternatives, there are different amounts of edge habitat.

Figure 4.6.3 compares the acres of habitat in different interior and edge conditions based on current conditions versus projected edge conditions for all alternatives at the end of the planning period (Decade 5). Stringer habitat also is presented (refer to Figure 4.6.3).

Figure 4.6.3. Current and Ending (Decade 5) Habitat, by Alternative and Edge Position

In the horizontal axis, numbers indicate the decade. For example, A0 means Alternative A, Decade 0.



Under all alternatives, existing edges within long-term forest cover soften and disappear over time as younger forests within long-term forest cover mature. Limitations on timber harvest and related activities (such as road construction) mean that the creation of new edges in habitat also will diminish significantly through time in long-term forest cover under all alternatives. Under all alternatives except Alternative B, occupied sites are buffered and existing edges will soften and disappear as forests within the buffers mature. Under Alternative B, forests surrounding occupied sites will be subject to harvest resulting in hard edges, therefore increasing the amount of edge. Reduction in edge is expected to benefit marbled murrelets by reducing the potential for edge effects and predation, potentially increasing nest success and population numbers over time. Increases in edge are likely to decrease the nesting success of murrelets within occupied sites, as well as eroding the amount of habitat over time due to increased windthrow.

Roads

While existing forest edges in long-term forest cover will soften and abate over time as forests mature, many roads through long-term forest cover will be maintained under all alternatives because they are part of a greater transportation network. These roads will have chronic edge effects on habitat in long-term forest cover. The additional negative edge impacts of roads are anticipated to have minor impacts in overall habitat quality. Roads in habitat are assumed to create negative edge effects on habitat but to a lesser degree than that caused by adjacent harvested and replanted stands. About 5 percent of habitat is estimated to be affected by road edges throughout the planning period.

Stringers

All alternatives also project a relatively high amount of habitat in a stringer condition. These habitat stringers are primarily managed for riparian conservation and will never develop interior forest habitat because of their configuration. Habitat in stringers may provide some isolated nesting opportunities, likely with reduced nest success rates. Thinning of habitat in stringers, and all other long-term forest cover areas, is not allowed under any alternative to protect marbled murrelets that may be using these areas. For the purposes of calculating mitigation and the effects of each alternative on marbled murrelet, stringers are assumed to have no value as habitat.

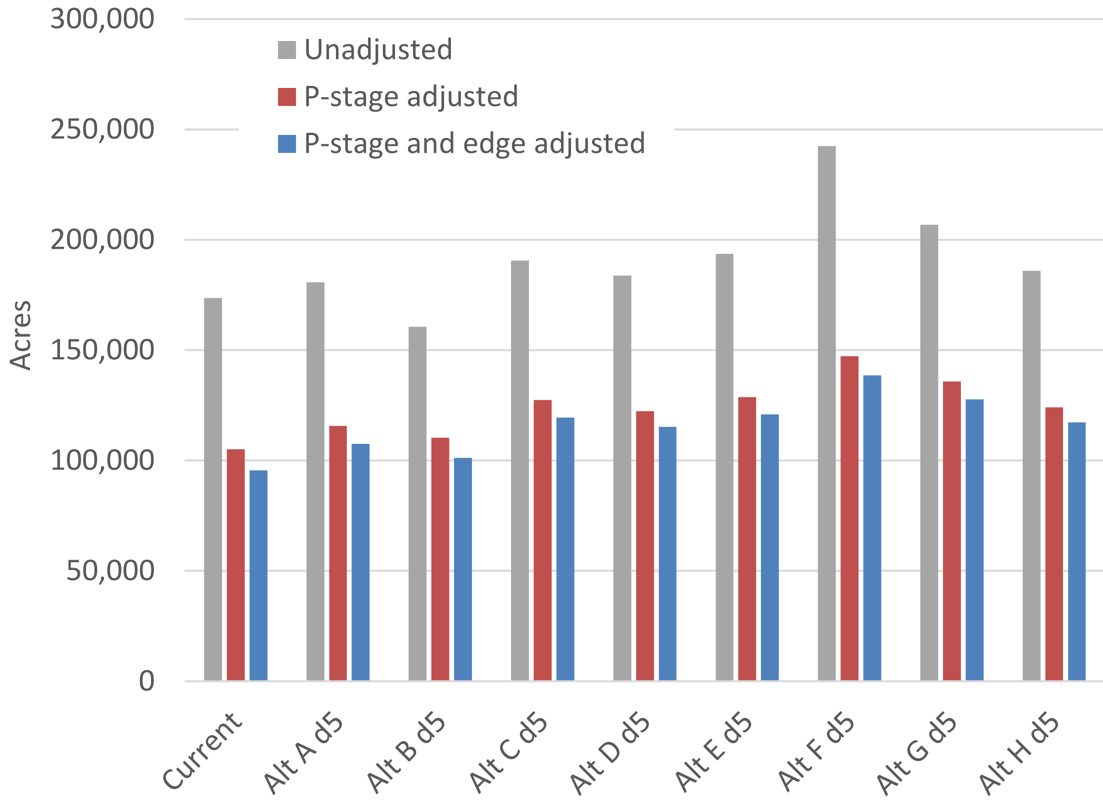
HOW P-STAGE AND EDGE INFLUENCE HABITAT QUALITY

Figure 4.6.4 compares the influence of P-stage to the influence of edge effects. In this graphic, acres of inland habitat (excluding stringers) are adjusted for P-stage alone (by multiplying the habitat acreage by its P-stage value, shown in red) and for both P-stage and edge condition (shown in blue). In Decade 5, the average acreage adjusted for P-stage alone is 65 percent of the average, unadjusted habitat acreage, while the average acreage adjusted for both P-stage and edge is 61 percent of the average, unadjusted habitat acreage (Figure 4.6.4).

While edge effects will negatively impact habitat quality in all alternatives, there is little difference in the level of edge influence among Alternatives C through H. Alternative B is the only alternative that has less unadjusted, P-stage adjusted, and edge and P-stage adjusted habitat than Alternative A in Decade 5, although it does contain more P-stage adjusted, and edge and P-stage adjusted habitat than under current conditions at Decade 5.

Figure 4.6.4. Comparing the Influence of P-stage and Edge Effects: Current Murrelet Habitat Across all DNR-Managed Lands (Excluding Stringers) Compared With Estimated Future (Decade 5) Murrelet Habitat, by Alternative

In the horizontal axis, "d" means decade. For example, d5 means Decade 5.



HOW LOCATION INFLUENCES HABITAT QUALITY

As described in Chapter 2, Section 2.3 of this RDEIS, another factor influencing habitat quality among the alternatives is geographic location. To reflect this, the analysis area has been divided into landscapes: high-value landscapes, which includes both the strategic locations and other high-value landscapes; and marginal landscapes. The action alternatives place proportionately less inland habitat conservation in the marginal landscapes, where distance from high-quality marine habitat, lack of occupied sites, and extensive anthropogenic development limits the marbled murrelet conservation potential of state trust lands. Conversely, proportionately more conservation is proposed for strategic locations (Southwest Washington, OESF and Straits (west of the Elwha River), and North Puget) within the high-value landscapes, where the highest levels of marbled murrelet use of state trust lands occur and where inland habitat is in close proximity to marine foraging areas. For example, some areas of the OESF are in close proximity to important marine foraging areas such as the Strait of Juan de Fuca and Pacific Ocean. Intermediate amounts of conservation occur in the other high-value landscapes, with emphasis on conservation in areas closest to marine waters. Within all of these high-value landscapes, habitat value is determined only by those factors already described, P-stage and edge effects.

Within the marginal landscapes, habitat value is reduced to 25 percent of its value based on P-stage and edge effects. Regardless of alternative, approximately 8 and 9 percent of inland habitat is expected to be located within the marginal landscape in the South Coast and South Puget HCP planning units, respectively, by Decade 5.

TIMING OF HABITAT LOSS AND DEVELOPMENT

Inland habitat that exists today currently provides nesting opportunities for murrelets and is therefore more valuable than habitat that will develop in the future (as forests mature). If inland habitat is impacted today, the offsetting mitigation (habitat of the same value becoming available to the murrelet) may not happen for several decades. The analytical framework takes this into account by adjusting the value of mitigation through time, which is expressed by decade through the life of the 1997 HCP.

The decadal adjustment factor is based on how much inland habitat develops in a particular decade, as well as the decade in which that habitat is realized. For example, the total inland habitat that develops in long-term forest cover from the present into the first decade receives full mitigation credit to offset harvest in the managed forest within that first decade; all of the acres are counted. However, the total inland habitat that develops between the first and second decades receives only 80 percent of the total credit because the habitat that grows during this decade will contribute to murrelet conservation for less time in four out of the five total decades (80 percent of decades). Growth occurring between the second and third decades receives 60 percent credit (three out of five decades of growth), and mitigation credits are calculated in this way through the end of the 1997 HCP (refer to Appendix I).

Putting it All Together: Quality of Habitat Gained and Lost Through Time

The overall losses and gains in inland habitat quantity can be modified by all of the factors affecting habitat quality as listed previously: P-stage, edge, location, and the timing of the growth of new habitat. These factors are described in further detail in Appendix H. Inland habitat with little value (stringers) is excluded outright, and habitat in edge condition or located in the marginal landscape are assumed to have reduced quality.

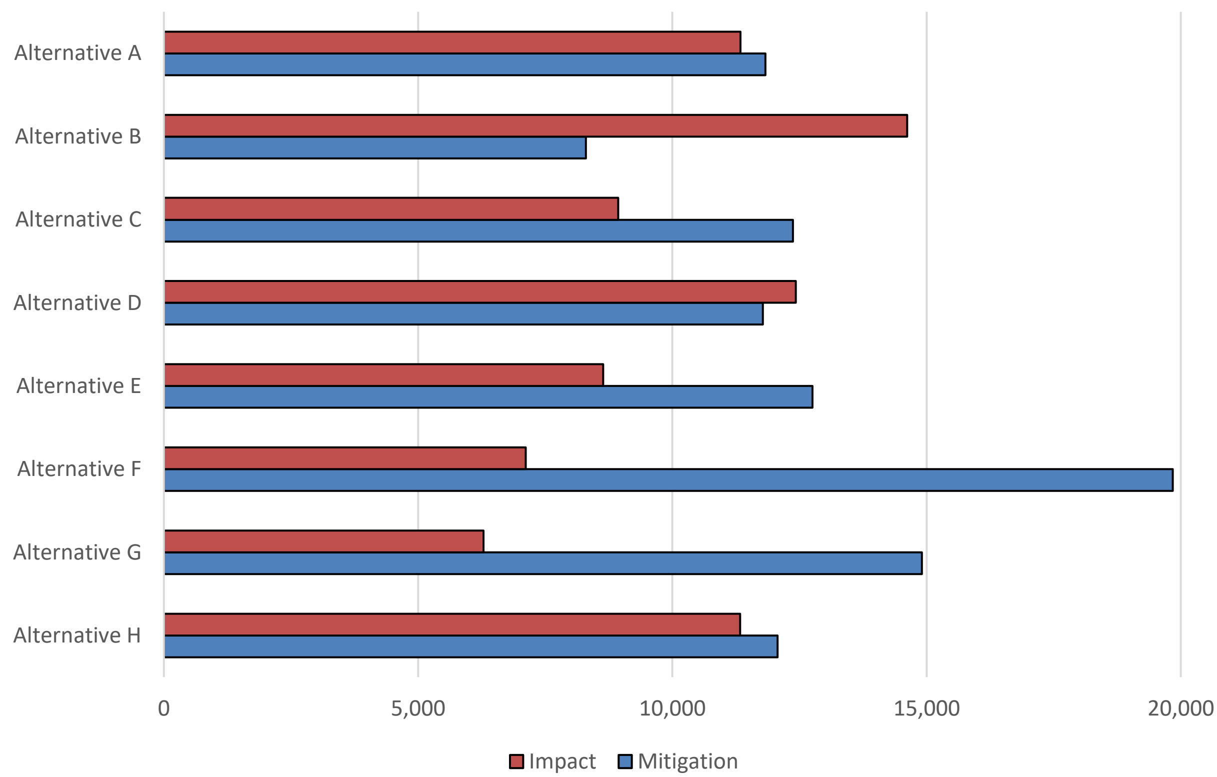
The result of these modifications can be reflected as a comparison of “impact” (habitat loss) to “mitigation” (habitat gain). As shown in Figure 4.6.5, Alternative F has the highest ratio of mitigation to impact at around 2.8:1. Alternatives C, E, and G show significantly more mitigation than impact over the planning period, while Alternatives A and H show only slightly more mitigation than impact. Alternatives B and D result in impact exceeding mitigation, with Alternative B having the greatest amount of impact compared to mitigation.

Under every action alternative, mitigation credit is assigned to inland habitat that currently exists or develops within long-term forest cover through the life of the 1997 HCP. Mitigation acres can be estimated and compared against potential impacts, which is the loss of inland habitat outside of long-term forest cover. Appendix H provides a detailed description of how DNR and USFWS (the Joint Agencies) estimated potential impact and mitigation acres under the proposed action.

It is important to recognize that while specific outcomes are presented, there are uncertainties associated with these estimates of impact and mitigation acres. These uncertainties include the following: habitat selection by marbled murrelets is complex and poorly understood, and forest growth and future habitat development may be influenced by many factors (such as climate change or natural disturbance) as described in Appendix E. These projections of future habitat development are estimates which may or may not be realized over time. In addition, there are potential impacts to the species that are not clearly understood. Debate remains in the scientific community on how certain impacts (such as noise disturbance) may or may not affect the species.

The Joint Agencies worked together on developing the P-stage model and the analytical framework for the purposes of developing and analyzing the alternatives. These tools are useful for understanding relative impact and mitigation for the different alternatives. The population viability model also is relevant for further interpretation of potential impacts. Refer to Figure 4.6.5 for a summary of impacts (for example, mostly habitat loss) and mitigation acres (habitat development over time) as measured by adjusted acres expected under each alternative.

Figure 4.6.5. Adjusted Acres of Habitat Loss (Impact) and Gain (Mitigation) by the End of the Planning Period, by Alternative and Adjusted for Quality



Gains and losses are not equally distributed among landscapes. Table 4.6.5 shows the net acres in each strategic location when adjustments are made for habitat quality (P-stage, edge effects, and time).

Table 4.6.5. Acres of Mitigation Minus Impact, by Landscape or Strategic Location and Alternative

	Mitigation minus impact[a] (quality and time adjusted acres)							
Landscape or strategic location	**Alt. A**	**Alt. B**	**Alt. C**	**Alt. D**	**Alt. E**	**Alt. F**	**Alt. G**	**Alt. H**
Southwest Washington strategic location	2,995	1,268	2,590	2,397	2,571	3,414	2,560	751
OESF and Straits west of the Elwha strategic location	1,356	-1,567	735	-399	1,303	2,722	3,742	434
North Puget strategic location	-2,878	-3,113	-177	-1,938	54	2,663	927	-1,072
Other high value landscapes	-1,047	-2,910	181	-706	178	3,935	1,388	627
Marginal landscape	62	-3	10	-5	10	-8	9	-5
Total (net)	488	-6,325	3,339	-651	4,116	12,726	8,626	735

[a] Positive values occur when mitigation exceeds impact, negative values when impact exceeds mitigation.

Changes in acres are strongly related to the condition of these landscapes at the beginning of the planning period. North Puget begins the planning period with a greater inventory of low-quality habitat and older non-habitat and therefore shows a significant increase in habitat quality through time. For landscapes that begin with a relatively high proportion of protected, high-quality habitat (including OESF and Straits [west of the Elwha River]), negative acres can result for alternatives that shift the conservation focus from these areas to other locations. Southwest Washington, where conserved high-quality habitat is currently scarce, show gains in habitat under all the alternatives.

Although impact exceeds mitigation in the North Puget strategic location under Alternatives C, D and H, the difference is less than under Alternative A, the no action alternative, and overall mitigation exceeds impacts under Alternatives C, E, F, G, and H. In addition, mitigation exceeds impacts in the Southwest Washington and OESF and Straits (west of the Elwha River) strategic locations under Alternatives C, E, F, G, and H.

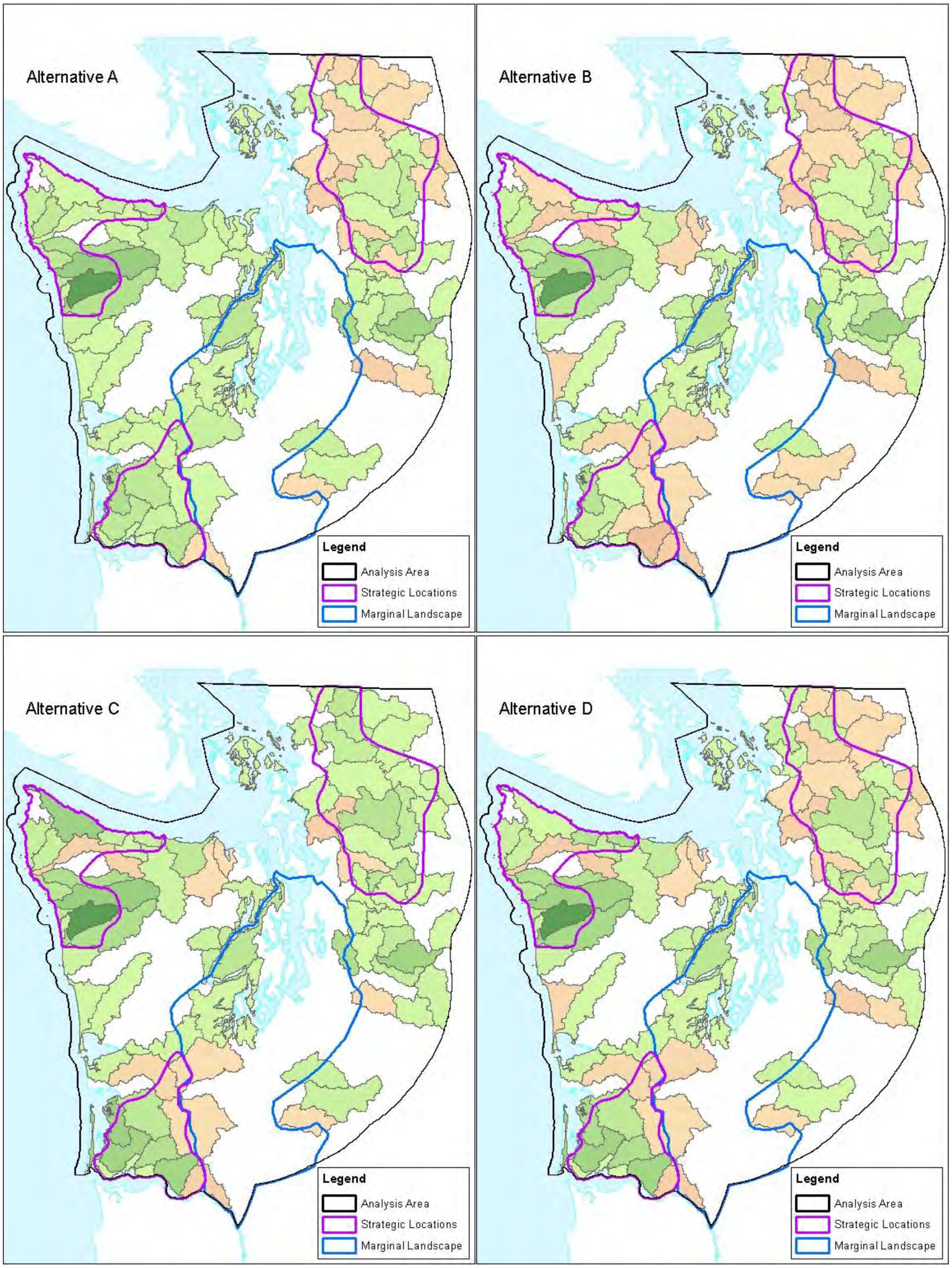
■ Habitat Distribution

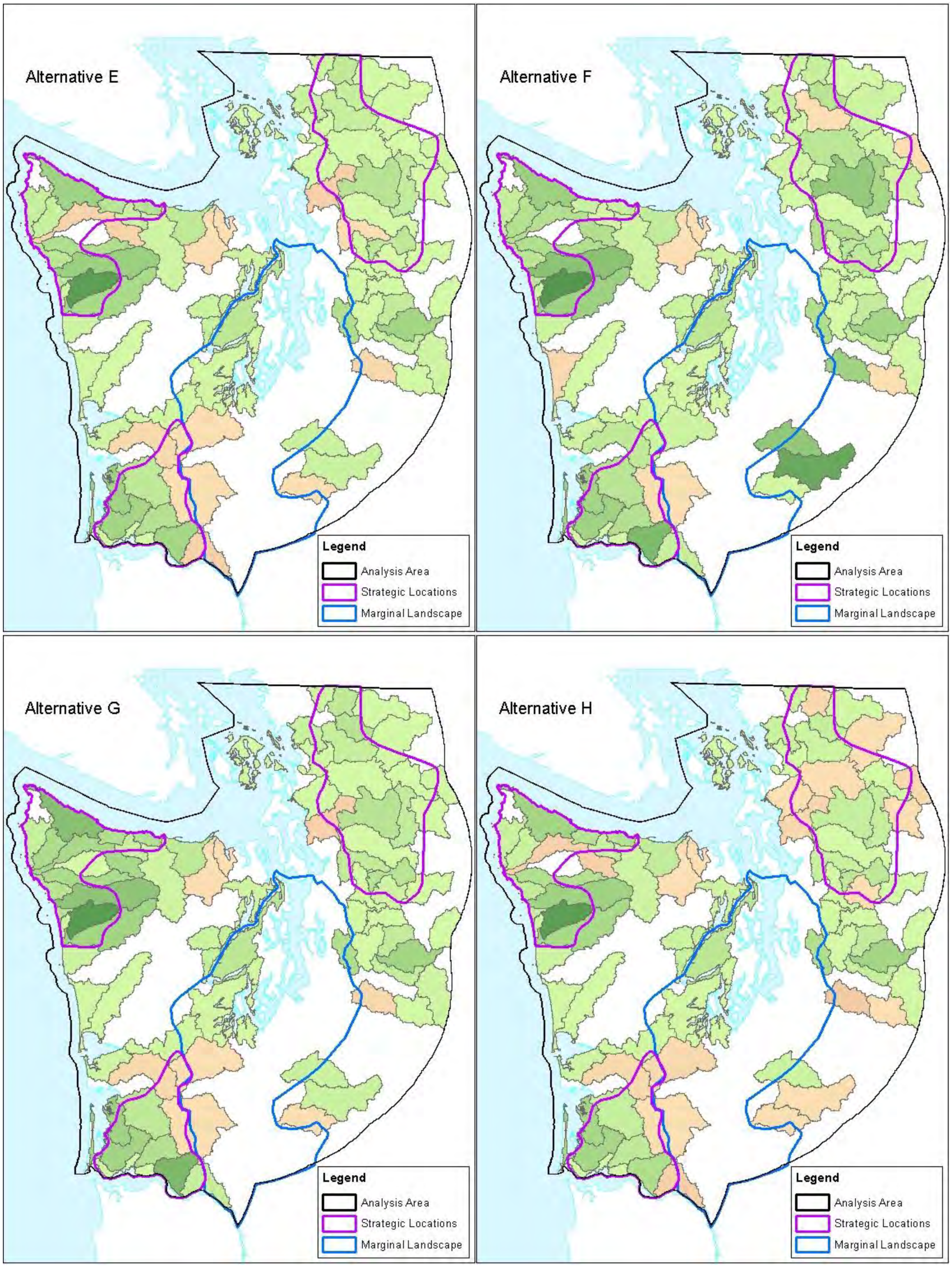
DNR conducted a distribution analysis comparing current and future habitat for each action alternative. The distribution analysis evaluates the change in acres of inland habitat (adjusted for P-stage and edge) from current conditions to the end (Decade 5) of the analysis period. Refer to Appendix H for a description of adjusted acres.

Habitat Location

As described in Chapter 3 of this RDEIS, an analysis was conducted to determine how inland habitat is distributed across the landscapes at a watershed scale. Under all alternatives, the adjusted acres of inland habitat increase in more watersheds than they decrease by Decade 5. Under alternatives C through H, more watersheds increase in adjusted acres and fewer decreased in adjusted acres than under Alternative A. Conversely, under Alternative B, fewer watersheds increase in adjusted acres and more watersheds decrease in adjusted acres than under Alternative A. Alternative B negatively affects distribution due to the decline of habitat in the northern half of the North Puget strategic location. Alternatives C through H improve the distribution of habitat compared to Alternative A. These alternatives result in a larger increase in adjusted acres in the strategic locations than Alternative A (Figure 4.6.6). In Figure 4.6.6, adjusted acres increase from current conditions in watersheds shown in green and decease from current conditions in watersheds shown in tan. Darker colors show larger changes (only watersheds containing at least 50 adjusted acres in Decade 5 are shown).

Figure 4.6.6. Change in Adjusted Acres by Watershed Between Current Conditions and Decade 5, by Alternative




Alternative E
Legend
Analysis Area
Strategic Locations
Marginal Landscape
Alternative F
Legend
Analysis Area
Strategic Locations
Marginal Landscape
Alternative G
Legend
Analysis Area
Strategic Locations
Marginal Landscape
Alternative H
Legend
Analysis Area
Strategic Locations
Marginal Landscape

Proximity to Occupied Sites

Research has shown that marbled murrelets are less likely to occupy inland habitat if it is more than 3.1 miles (5 kilometers) from existing occupied sites (Meyers and others 2002). Under Alternatives C through H, the area of inland habitat conserved within 3.1 miles (5 kilometers) of occupied sites increases as compared to Alternative A. Under Alternative B the area decreases (Table 4.6.6).

Table 4.6.6. Acres of Habitat at Decade 0 and Decade 5 in Long-Term Forest Cover Within 3.1 miles (5 Kilometers) of an Existing Occupied Site

	Alt A.	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Decade 0	130,000	124,000	135,000	130,000	135,000	141,000	142,000	132,000
Decade 5	178,000	167,000	183,000	178,000	184,000	199,000	192,000	180,000

USFWS designates critical habitat based on primary constituent elements (USFWS 2015). One element for inland habitat is forested areas within 0.5 mile (0.8 kilometers) of potential nest trees that have a canopy height of at least half the site potential tree height. While potential nest trees are present throughout habitat on DNR-managed lands, occupied sites represent locations of known nesting behavior. Under Alternatives C through H, the area of habitat conserved within 0.5 mile of occupied sites increases, as compared to Alternative A. Under Alternative B, the area decreases (Table 4.6.7).

Table 4.6.7. Current and Ending (Decade 5) Habitat in Long-Term Forest Cover Within 0.5 mile (.8 km) of an Existing Occupied Site

	Alt A.	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Decade 0	80,000	78,000	83,000	83,000	84,000	84,000	85,000	83,000
Decade 5	94,000	87,000	96,000	96,000	97,000	98,000	99,000	95,000

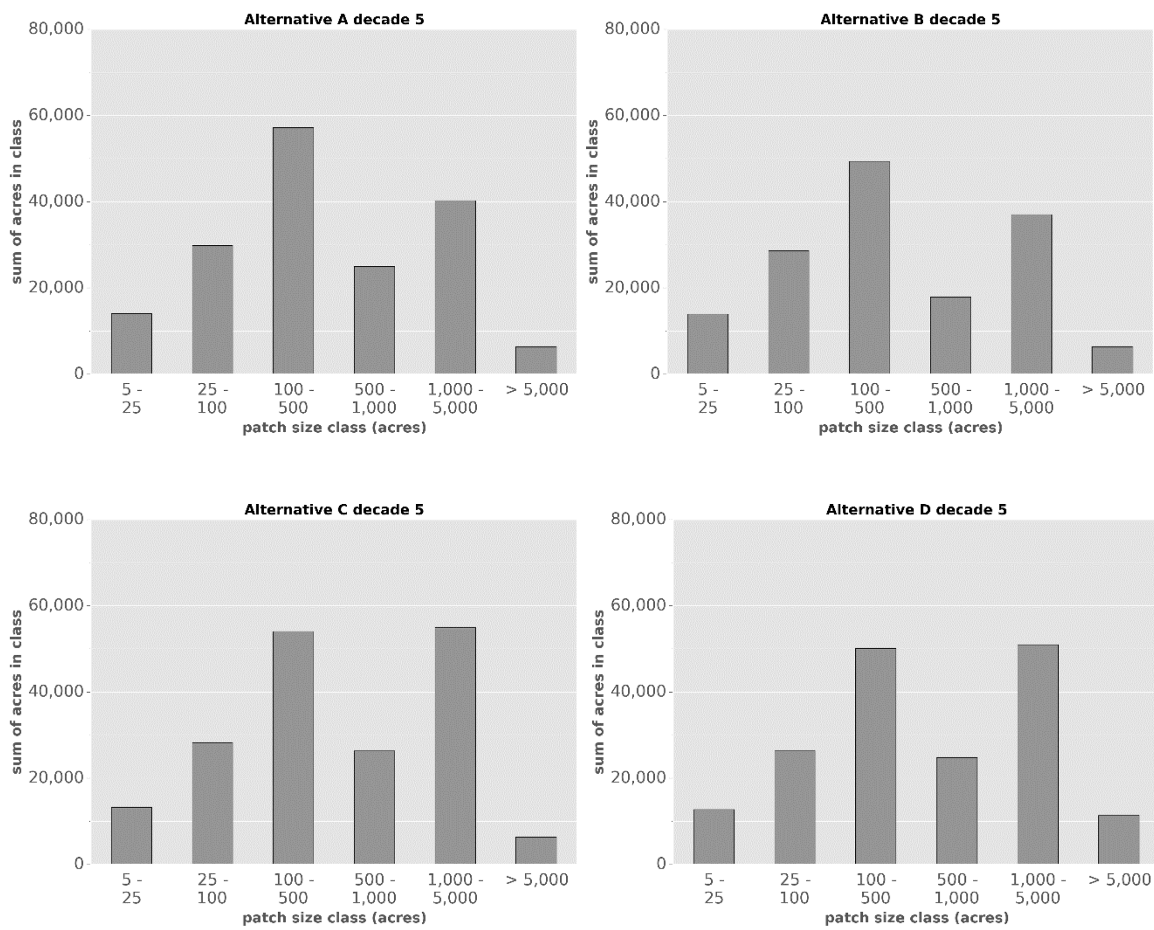
Habitat Patch Size

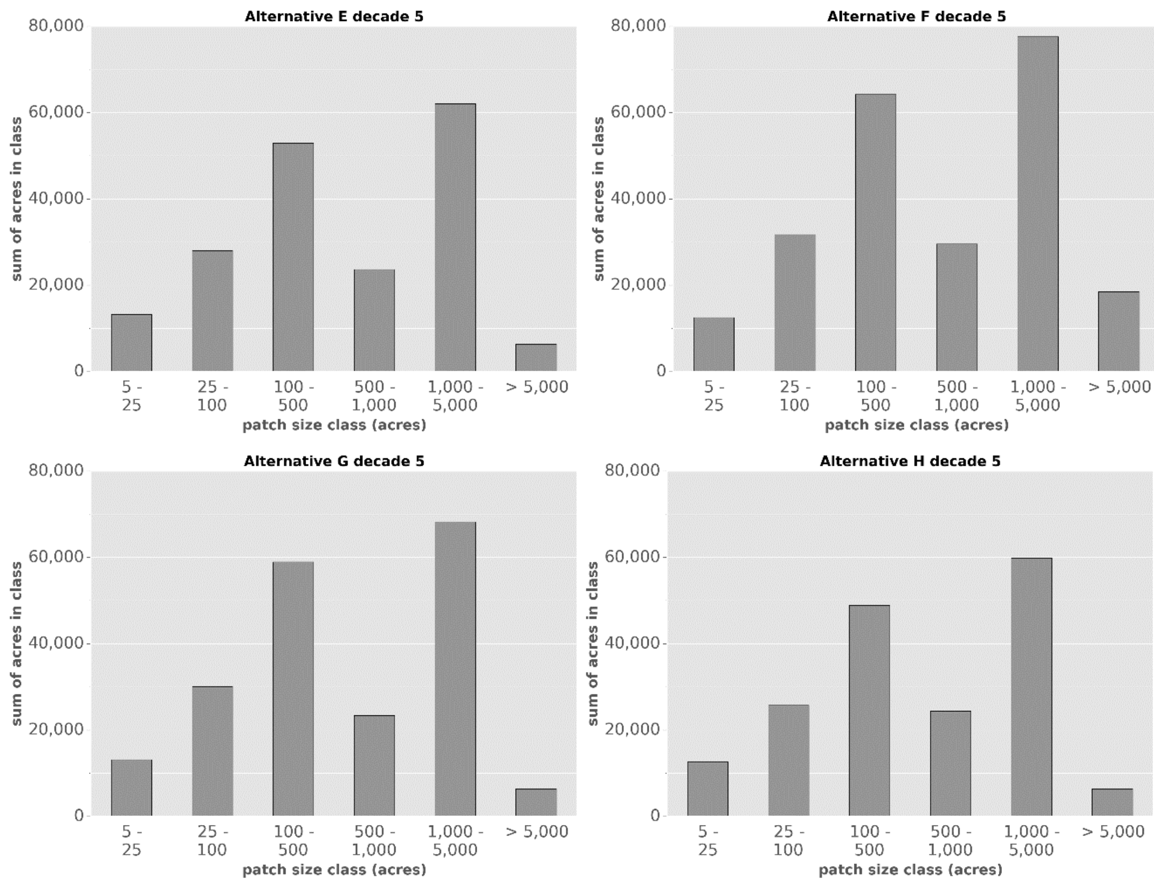
As inland habitat develops under each alternative, the number of habitat patches five acres or larger will increase, as will the total area of habitat in these patches (Table 4.6.8). Differences between the alternatives are most apparent for habitat patches equal to or larger than 1,000 acres. More habitat patches and more area in habitat patches will benefit marbled murrelet by providing more potential nesting sites and reducing edge effects compared to current conditions. Compared to Alternative A, Alternatives C through H increase the number of acres in patches greater than or equal to five acres and the number of acres in patches greater than or equal to 1,000 acres. Under Alternative B, the number of acres in both patch size categories decreases (Table 4.6.8 and Figure 4.6.7) (for current size distribution of habitat patches, refer to Table 3.6.3).

Table 4.6.8. Ending (Decade 5) Habitat Patches

	Alt A.	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
# patches ≥ 5 acres	2,025	1,950	1,925	1,846	1,911	1,996	1,966	1,817
Sum of area in patches ≥ 5 acres	180,000	160,000	190,000	183,000	193,00	242,000	207,000	185,000
# of large patches (≥ 1,000 acres)	23	21	29	29	32	44	35	31
Sum of area in large patches (≥ 1,000 acres)	54,000	50,000	68,000	69,000	75,000	103,000	82,000	73,000

Figure 4.6.7. Ending (Decade 5) Size Distribution of Habitat Patches



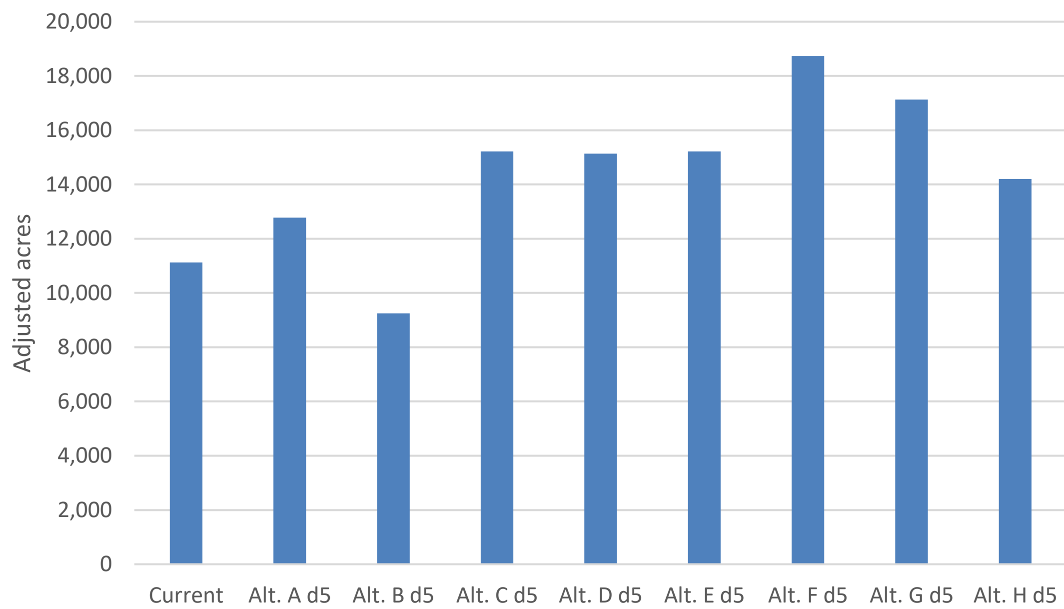


Alternatives C through H provide more area in patches greater than or equal to 1,000 acres than Alternative A. These large patches are expected to provide large areas of interior forest habitat, and so may benefit marbled murrelet reproduction.

Focus on Southwest Washington

USFWS identified DNR-managed lands in southwest Washington as important for marbled murrelet recovery because of the lack of federal lands in this landscape to provide for marbled murrelet conservation (USFWS 1997). Much of the existing inland habitat and most known marbled murrelet occupied sites in southwest Washington are located on DNR-managed lands. The Southwest Washington strategic location covers this area. The Joint Agencies identified a range of conservation options for these lands to maintain and improve the distribution of inland habitat in this important area. The no action alternative would protect approximately 84 percent of all known habitat in this strategic location. Alternatives C, D and E would protect approximately 83 percent of the habitat, Alternatives F and G would protect 91 percent of the habitat, and Alternative H would protect 80 percent. Alternative F protects the most habitat, approximately 91 percent, while Alternative B protects the least, 70 percent (significantly less than the no action alternative). All alternatives, except Alternative B, result in an increase in habitat in interior forest condition and increase in habitat capacity as compared to Alternative A (Figure 4.6.8).

Figure 4.6.8. Current and Decade 5 Adjusted Acres of Inland Habitat in the Southwest Washington Strategic Location



Effect on Marbled Murrelet Populations

The analysis in this RDEIS measures the amount and quality of inland habitat harvested, conserved, and developed over the analysis period. However, the amount and timing of inland habitat conserved and developed may not directly translate to immediate murrelet population growth or decline. Uncertainties about marbled murrelet survival, reproduction rates, dispersal, and other environmental influences may affect how the population responds to increased inland habitat.

To help understand how marbled murrelet populations might respond to the variations in inland habitat under each alternative, the Joint Agencies engaged Dr. Zach Peery of the University of Wisconsin, an expert population ecologist and marbled murrelet biologist, and Gavin Jones, a Ph.D candidate in Dr. Peery's lab, to develop a population viability model that incorporates the analytical framework and habitat estimates. The model provides a comparison of how each alternative might perform as a long-term conservation strategy with respect to the marbled murrelet population in Washington. This model is not intended to provide an absolute estimate of population response for a

Text Box 4.6.1. What is New in the Population Viability Analysis for the RDEIS?

In this RDEIS, just as it was in the 2016 DEIS, a P-stage value of 1 indicates an occupied site. This value was assigned in the P-stage model to all acres within an occupied site, regardless of the forest condition of those acres. For example, some occupied sites may include areas of non-habitat.

For the population viability analysis in this RDEIS, Dr. Zach Peery and Gavin Jones modeled the actual P-stage value of all acres within occupied sites, instead of simply assigning the entire occupied site a value of 1. They also modeled the growth of forests in occupied sites over the analysis period. The Joint Agencies believe these methods result in a more accurate representation of marbled murrelet habitat and more accurately reflect an increase in nesting carrying capacity over the analysis period.

particular alternative. Instead, it is intended as a tool to determine how each alternative might perform compared to each other. The model used demographic information obtained through intensive field studies and available in published reports. It was based on a reasonable understanding and interpretation of murrelet ecology and habitat relationships, as well as detailed assessments of forest conditions in Washington, especially on DNR-managed lands.

On DNR-managed lands, the P-stage model was available to project future habitat growth and quality increase. This type of information was not available on non-DNR-managed lands, so Maxent[10] data were used for all other lands. Maxent does not project habitat into the future, so habitat quantity and quality were assumed to be static on non-DNR-managed lands.

As is common in population viability analyses, a number of simplifying assumptions regarding murrelet demography, dispersal, and breeding biology were required. Also in common with most population viability analyses, model predictions of risk and population size are best viewed in a relative sense. The uncertainties underlying the population viability model do not support absolute predictions of ending population size (for example, the exact number of murrelets at a given point in time). Instead, the model outputs are best used as relative comparisons of risk and potential for recovery among the management alternatives.

Population viability model predictions included in this RDEIS must be considered in light of uncertainty about the effects of stressors in the marine environment and future changes in climate, as too little is known about these non-forest influences to incorporate them into the model structure. Model predictions also must be considered in light of the assumption that habitat capacity will remain static on non-DNR-managed lands. This assumption was made because habitat changes on non-DNR-managed lands have not yet been modeled. For a detailed presentation of modeling methods, results, and discussion, including assumptions and limitations, refer to Appendix C.

Two different scenarios encompass the principal hypotheses regarding uncertainty over the environmental factors that influence murrelet population decline:

- A “risk analysis” scenario was based on the assumption that both inland habitat loss and other chronic environmental stressors such as marine conditions are responsible for the murrelet population decline observed in Washington. This scenario used relatively pessimistic demographic rates that result in a declining murrelet population with less ability to use inland habitat as it develops.
- An “enhancement analysis” scenario assumed that loss of inland habitat is primarily responsible for the population decline and uses more optimistic demographic rates that result in a murrelet population with greater capacity to use inland habitat as it develops.

To focus on relative differences between the alternatives, murrelets in Washington were assumed to belong to two simplified subpopulations (on DNR-managed lands, and on non-DNR-managed lands), with habitat conditions artificially held constant on non-DNR-managed lands. Simulations of the

[10] Maxent is a type of habitat model.

Washington population assumed that the two subpopulations were connected by dispersal, while simulations of the population on DNR-managed lands alone assumed no dispersal. The model simulated murrelet populations over 50 years in response to the current and projected future habitat conditions proposed under each alternative. All simulations begin with a population assumed to be approximately 67 percent greater than the carrying capacity[11] (*K*) of existing habitat in order to simulate the observed rate of decline. Researchers conducted 10,000 simulations with biologically appropriate levels of random variation in survival and reproductive rates for each alternative to produce two informative outputs: average ending population size and the proportion of model runs that fell below specified fractions of the initial population size as a measure of "quasi-extinction probability." The quasi-extinction probability is the probability of the population dropping below a certain fraction of the starting population. A population that has reached quasi-extinction may have too few adults to assure persistence of the species.

In interpreting the results of these simulations, readers should keep in mind that the results for the Washington population are greatly influenced by the assumption that murrelet habitat capacity will remain stable on non-DNR-managed lands. In fact, inland habitat is expected to increase on federal lands over the next 50 years as a result of the *Northwest Forest Plan*. Therefore, at least with the optimistic demographic rates used in the "enhancement analysis," one would realistically expect population growth in Washington beyond what is presented in the results of the simulations. This effect of a simplifying assumption used for the population viability model exemplifies the reasons that make it appropriate to view the population viability model results as a way to compare alternatives to one another, but not to make true projections about future marbled murrelet population sizes.

Detailed results can be found in the report (Peery and Jones 2018, Appendix C); results are briefly summarized here.

RISK ANALYSIS

When the population viability model focused on just the theoretical population on DNR-managed land, differences among alternatives in population response and the probability of quasi-extinction were distinguishable. This analysis considers both one-quarter and one-eighth of the starting population when evaluating for quasi-extinction. The DEIS reported quasi-extinction at one-eighth; the one-quarter threshold was added to the RDEIS because it offers the greatest distinction between alternatives.

Alternative F resulted in the greatest number of female murrelets (196) and the lowest quasi-extinction probability (36 percent if the quasi-extinction threshold is one-quarter and 7.6 percent if the quasi-extinction threshold is one-eighth). Alternative G was similar to Alternative F, with the second-highest number of female murrelets (194) and the second-lowest quasi-extinction probability (37 percent if the quasi-extinction threshold is one-quarter and 7.4 percent if the quasi-extinction threshold is one-eighth). Alternative B resulted in the lowest population size (123 female murrelets) and highest quasi-extinction probability (67 percent if the quasi-extinction threshold is one-quarter and 26 percent if the quasi-extinction threshold is one-eighth).

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[11] The maximum population size of the species that the environment can sustain indefinitely, given the food, habitat, water, shelter, and other necessities available in the environment.

When the Washington population was evaluated, only small differences among alternatives could be seen in projected population size and the probability of quasi-extinction. During the 50-year model period, all alternatives had similar probabilities of quasi-extinction (31 to 34 percent if the quasi-extinction threshold is one-quarter, and 4.7 to 5.5 percent if the quasi-extinction threshold is one-eighth). Similarly, under all alternatives, after an initial annual decline of approximately 5 percent, populations continued a steady decline of approximately 1.0 percent per year for the remainder of the modeling period (ending populations ranged from 1,090 to 1,116 female murrelets).

The initial population decline of both the Washington population and the population on DNR-managed lands was related in part to the assumption (in keeping with the empirically measured current murrelet population trajectory) that the population began above carrying capacity. All alternatives allow for harvest of inland habitat in the first decade. Under alternatives A through E, this harvest results in a reduction of carrying capacity. The reduction of carrying capacity in these alternatives leads to differences in the severity and duration of the initial steep population declines. Alternatives B and D showed initial declines noticeably steeper than the baseline decline caused only by the initial, baseline difference between population size and carrying capacity (refer to Appendix C, Figure 4). Under alternatives F through H, carrying capacity is maintained or increases as inland habitat development equals or exceeds loss due to harvest in the first decade. Since the magnitude of the carrying capacity increase is small, these alternatives were not easily distinguishable from the baseline in the first decade.

ENHANCEMENT ANALYSIS

The hypothetical population limited to DNR-managed lands, assuming no dispersal, had very low probabilities of quasi-extinction under all alternatives, ranging from 0.25 percent for Alternative F up to 1.4 percent for Alternative B if the quasi-extinction threshold is one-quarter, and from 0 to 0.04 percent if the quasi-extinction threshold it one-eighth. All alternatives began with declining populations during the first two decades, except for alternatives F and G, which declined for one decade. After the respective declines, populations responded with gradual increases in response to increasing habitat for the remainder of the modeling period. Alternative F resulted in an ending population of 646 female murrelets, while Alternative B resulted in 378 female murrelets. Table 4.6.9 shows the mean ending female population sizes by alternative.

Similar to the risk analysis, few differences among the alternatives were apparent at the statewide scale. For the Washington population, probability of quasi-extinction (dropping to one-quarter or one-eighth of the initial population) was much less than one percent for all alternatives. While murrelet numbers initially declined in the first decade because the population was assumed to be over *K*, the population stabilized for the remainder of the planning period for all alternatives. Alternative F was projected to support the largest ending population (2,700 female murrelets) and Alternative B the smallest (2,453 female murrelets).

Table 4.6.9. Enhancement Analysis for Simulated Sub-Population on DNR-Managed Land, by Alternative

	Projected mean population sizes after 10,000 simulations (number of female marbled murrelets)							
Year	**Alt. A (no action)**	**Alt. B**	**Alt. C**	**Alt. D**	**Alt. E**	**Alt. F**	**Alt. G**	**Alt. H**
0	542	542	542	542	542	542	542	542
10	406	378	427	403	426	453	450	432
20	373	314	413	369	420	464	455	406
30	392	321	441	392	446	508	493	424
40	429	350	484	432	493	569	543	462
50	474	387	533	479	547	646	600	510

COMPARING MODELED POPULATION RESPONSES AMONG THE ALTERNATIVES

For the sub-population on DNR-managed lands, Alternative B resulted in the lowest ending populations and the highest probability of quasi-extinction. Assuming a quasi-extinction threshold of one-quarter, Alternative F resulted in the highest population by the end of the planning period and the lowest quasi-extinction probability. Under the risk scenario, the simulated populations continued to decline even though *K*, which was directly related to adjusted habitat acreage, increased under all alternatives. However, the enhancement scenario suggested a different pattern with gradual population increases reversing the initial declines in response to increased habitat on DNR-managed lands. Refer to Figure 4.6.6.

As projected by the population viability analysis, marbled murrelet populations respond to changes in the quantity and quality of habitat available (Figures 4.6.10, 4.6.11). Alternatives that conserve and grow the largest acreage of habitat over the next 50 years are expected to produce the largest murrelet populations over the long term. The sensitivity analysis also demonstrated that habitat quality also is expected to influence murrelet populations. Harvest of high-quality habitat and interior forest habitat will cause larger initial reductions in populations than harvest of lower-quality or edge habitat (refer to Appendix C)

Model results for the Washington population of marbled murrelets showed no substantial difference in population size or quasi-extinction probability among the action alternatives (Figure 4.4.6, Appendix C).

Figure 4.6.9. Simulated Population Responses, by Alternative, for the Sub-Population on DNR-managed Lands Under the Enhancement Analysis (Copied from Peery and Jones 2018, Refer to Appendix C)

Projected murrelet population sizes as a function of proposed management alternatives. In each panel, the solid colored line represents the mean annual population size averaged over 10,000 simulations, the dashed colored lines represent the 5%, 25%, 50% (median), 75%, and 95% quantiles, and the grey lines represent a random subsample (n = 10) of individual simulation outcomes. The bottom-right panel ("Alternative means") plots the mean from each alternative on a single graph for the purposes of comparison. Note that in this set of graphs, the line representing the 50% quantile (median) is not visible because it is obscured by the line representing the mean.

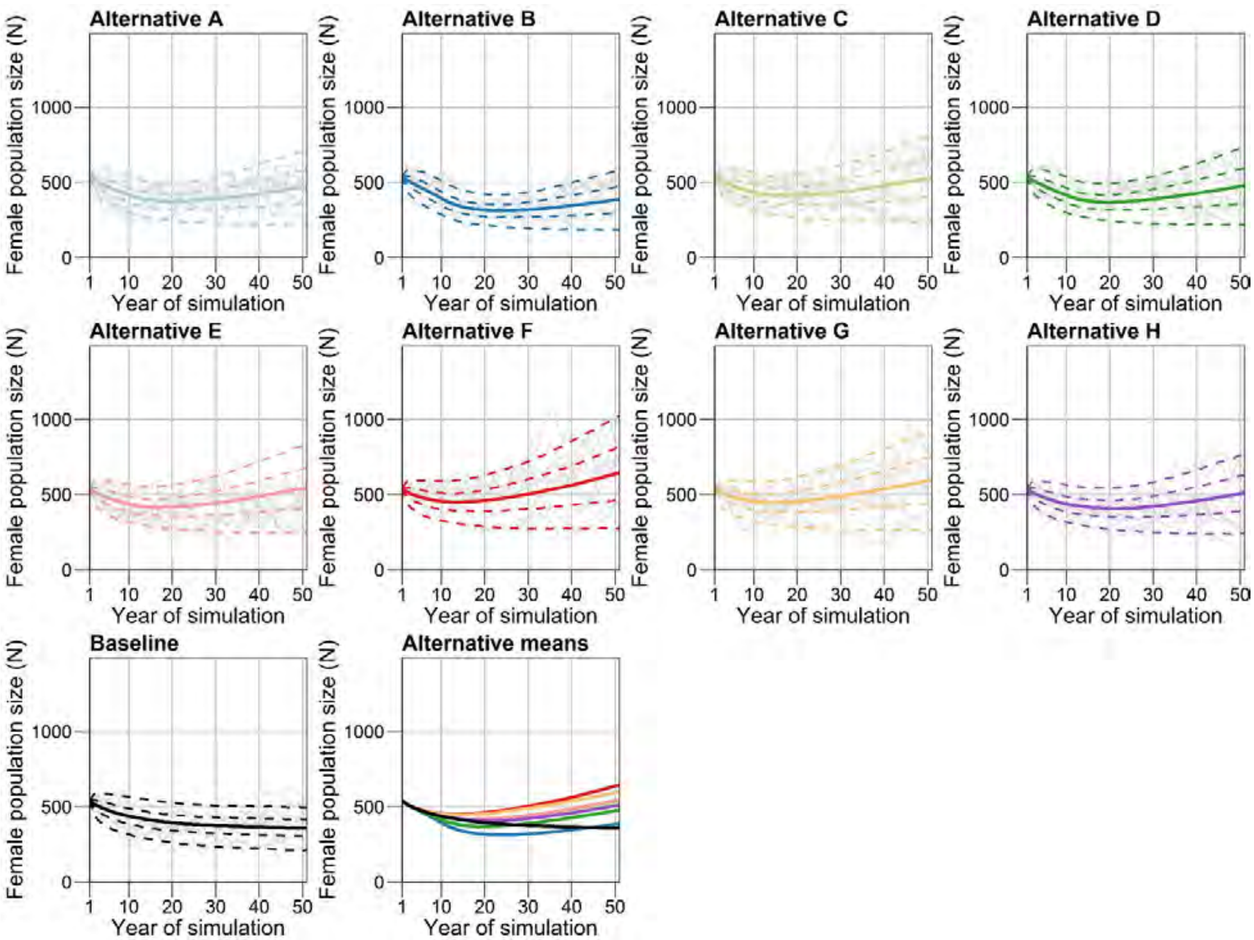


Figure 4.6.10. Relationship Between Population Viability Analysis Results (Female Murrelet Population on DNR-Managed Lands in Year 50 Under the "Enhancement" Scenario) and Raw Acres of Inland Habitat Projected for Year 50 by Alternative

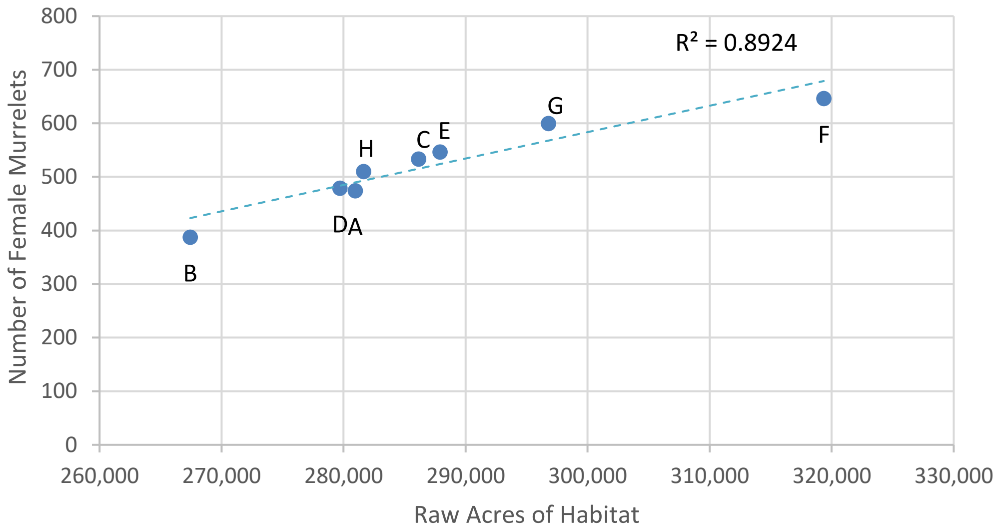
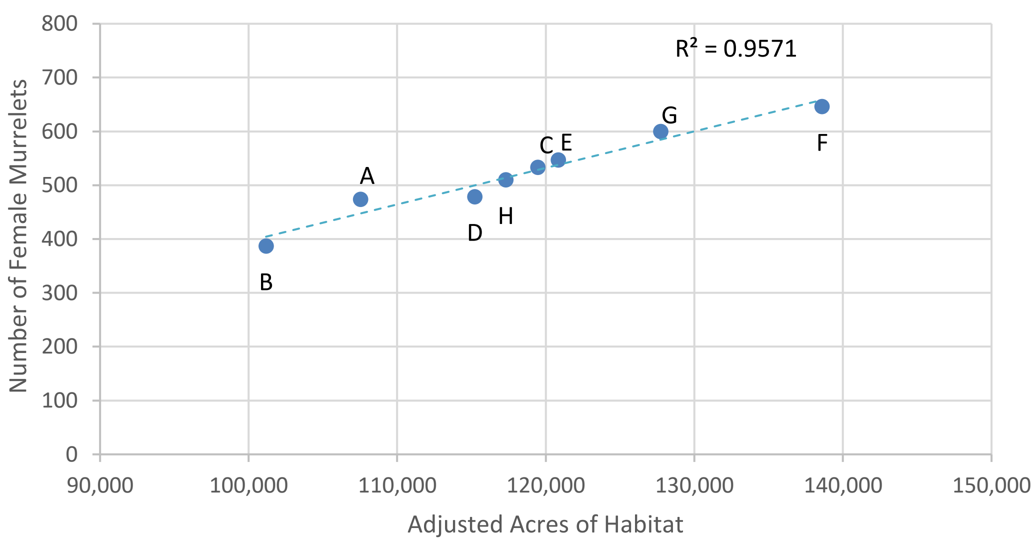
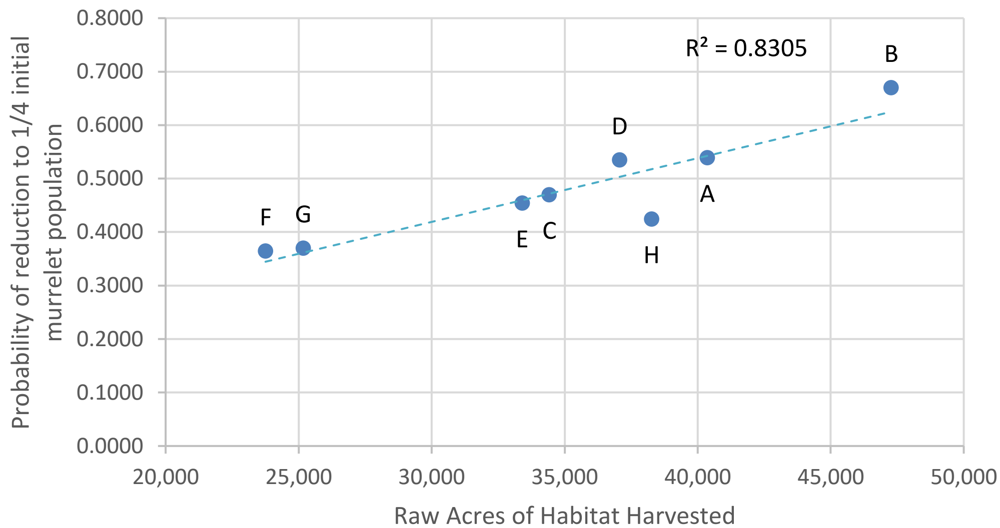


Figure 4.6.11. Relationship Between Population Viability Analysis Results (Female Murrelet Population on DNR-Managed Lands in Year 50 Under the "Enhancement" Scenario) and Adjusted Acres of Inland Habitat Projected for Year 50, by Alternative



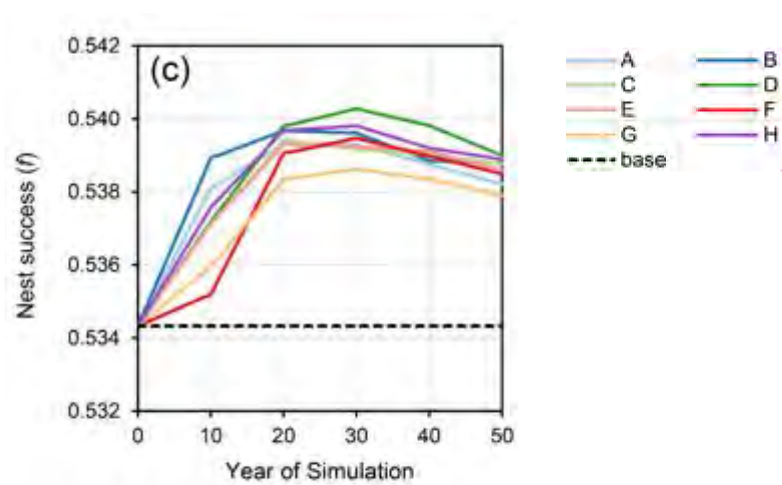
Although there is some correlation, raw acres alone do not determine whether the population reaches the quasi-extinction threshold. Consider Alternative H (Figure 4.6.12). Alternative H conserves a similar number of acres of inland habitat than other alternatives, but it has a lower likelihood of the female murrelet population declining to a quasi-extinction threshold of one-quarter of the current population (Figure 4.6.12). The reason for this lower likelihood is that Alternative H meters the harvest of habitat in the first decade of the analysis period.

Figure 4.6.12. Relationship Between Raw Acres of Habitat and Quasi-Extinction Probability



Nesting success is expected to increase, albeit by less than one percent, relative to initial nesting success under all alternatives. The highest rates of nesting success occur in decades 2 and 3, depending on the alternative. Alternative D results in the highest rate of nesting success, followed by Alternatives H, B, F, C, A, E, and G, but note that all increases are between 0.75 percent and 1 percent (Figure 4.6.13).

Figure 4.6.13. Nesting Success (Perry and Jones 2018)



HABITAT CAPACITY

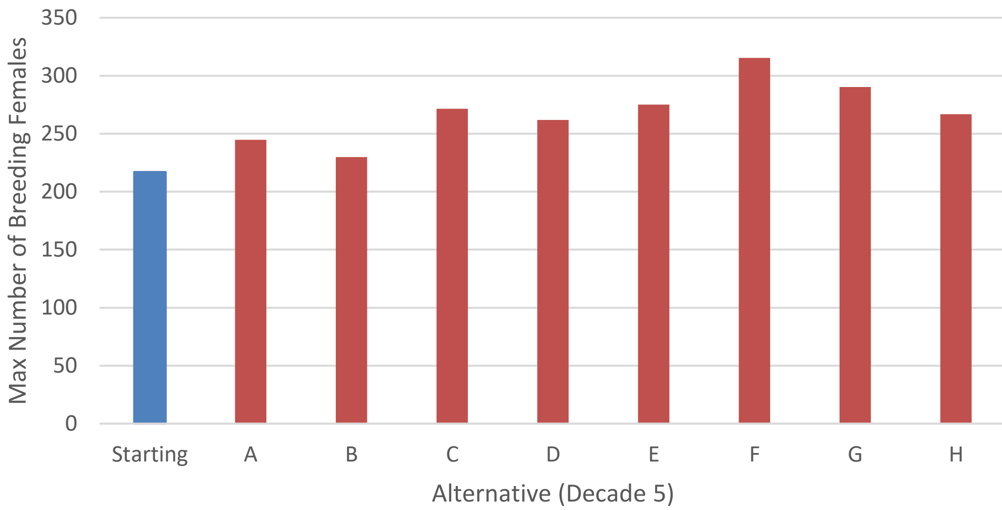
To provide context for the population viability analysis results, which considers how each alternative might perform compared to each other, the Joint Agencies added to this RDEIS a supplemental analysis of changes in habitat capacity.[12] The population viability analysis is based in part on the changing carrying capacity of inland habitat on DNR-managed lands. Both the "risk" and "enhancement" scenarios in the population viability analysis began with the assumption that of the 542 female murrelets associated with DNR-managed lands, 217 females would be able to find nesting sites (along with an equal number of males, for 217 breeding pairs) on the approximately 94,000 adjusted acres of habitat currently available on DNR-managed lands (432 adjusted acres per pair). As the amount of habitat changes, the carrying capacity also changes, leading to decreases or increases in the number of adults able to find habitat.

In addition to carrying capacity, the population viability analysis incorporates the processes of reproduction, mortality, and movement between populations, as well as year-to-year variation. To give context to the population viability analysis results, the Joint Agencies also looked at changes in habitat capacity over the next 50 years. Habitat capacity is a simpler measure, because it does not rely on assumptions about fecundity[13] or survival, and does not track changes in population over time. For each alternative, the Joint Agencies calculated habitat capacity by dividing the Decade 5 adjusted acres of habitat by 432 to derive estimates of the number of breeding females the habitat could support. In addition to nesting female murrelets, the population also would include an equal number of nesting male murrelets, plus some number of juveniles and non-breeding adults. The resulting numbers can be compared with the starting 217 females expected to be able to nest currently on DNR-managed lands.

Figure 4.6.14 shows the Decade 5 habitat capacity estimates for each alternative. Only Alternative B has a lower projected habitat capacity than Alternative A, and Alternatives C through H have higher habitat capacities. Ending habitat capacity is highest for Alternative F. All alternatives are projected to have a net increase in habitat capacity between now and Decade 5.

[12] The maximum number of female murrelets expected to breed if habitat use continues as estimated in the population viability analysis.
[13] The natural ability to reproduce.

Figure 4.6.14. Decade 5 Habitat Capacity Estimate for Each Alternative Compared with Current Habitat Capacity



Impacts to Marbled Murrelets by Alternative

In a new analysis for this RDEIS, the Joint Agencies examined the alternatives to describe their consequences for marbled murrelets. In contrast to the rest of the RDEIS, which compares alternatives to one another, and particularly to the no-action (Alternative A), the summary text and tables in this section are meant to provide information regarding each alternative in comparison to existing conditions.

In the tables in this section, the Joint Agencies summarize the effects of each alternative on inland habitat quantity and quality, and the resulting effects on murrelet populations (Table 4.6.10); each alternative's approach to reducing risk for murrelet populations (Table 4.6.11); and the effects of each alternative on the distribution of murrelets in Washington (Table 4.6.12).

POPULATION CHANGE

In general, the murrelet population is expected to be responsive to changes in the quantity of inland habitat. According to the population viability analysis, alternatives that release the largest acreage of inland habitat for harvest in the first decade will have the largest initial reduction in murrelet populations, and alternatives that conserve and grow the largest acreage of inland habitat over the next 50 years are expected to produce the largest murrelet populations over the long term (Figure 4.6.10). As shown by the sensitivity analysis in the population viability analysis, habitat quality also is expected to influence murrelet populations. Harvest of high-quality, interior forest habitat will cause larger initial reductions in populations than harvest of lower-quality habitat or habitat in edge condition. Alternatives that conserve and grow larger amounts of high-quality, interior forest habitat over the next 50 years are expected to produce the largest murrelet populations over the long term (Figure 4.6.11).

The population viability analysis, described in Appendix C and summarized in “Effects on Marbled Murrelet Populations” in this chapter, is a tool to compare alternatives to one another, rather than to make absolute predictions about future marbled murrelet populations. However, both the risk and enhancement scenarios in the population viability analysis were designed in keeping with current population declines. It is reasonable to conclude that the early population trajectories in the population viability analysis may be similar to the initial population response. Later population trajectories of the population viability analysis depend greatly on adult survival, as modeled, as well as other factors.

For comparison with the population viability analysis results, the Joint Agencies also examined habitat capacity, which was calculated as the maximum number of female murrelets expected to breed if habitat use continues as estimated in the population viability analysis. Table 4.6.10 summarizes the habitat and population changes modeled for each alternative.

POPULATION RISK

In addition to considering the likely population response to the alternatives, it is also important to consider risks to the murrelet population from the alternatives. Risks to individual murrelet nests, such as the risk of nest predation or the toppling of the nest tree, become population risks if enough individuals are affected.

Each alternative takes a different approach to protecting nests sites from these risks, including special habitat areas, emphasis areas, MMMAs, and buffers around known occupied sites. Most alternatives include 328-foot (100 meter) buffers around all or most known occupied sites. Some alternatives include 164-foot (50 meter) buffers in some areas, and sites with these smaller buffers would be subject to some edge effects, including predation risk and loss of habitat due to windthrow.

Special habitat areas are designed to recruit security forest, reduce edge and fragmentation, and improve productivity within occupied sites by reducing predation and disturbance. In order to maximize productivity of currently occupied sites, special habitat areas are designed to exclude active management within their boundaries, except in Alternative H. Under Alternative H, some thinning is allowed within special habitat areas. For example, thinning of non-habitat within occupied site buffers is allowed only to enhance or maintain security forest with windfirm canopies. Outside of occupied site buffers, thinning of non-habitat is allowed only within northern spotted owl habitat management areas with the goal of improving stands to develop into northern spotted owl habitat.

Emphasis areas, which are designed to provide security forest within 0.5 miles of occupied sites, reduce fragmentation, and grow new habitat, allow some active management within their borders. MMMAs cover more area than emphasis areas or special habitat areas and are designed to increase habitat around occupied sites via active management.

The population viability analysis included measures of population risk via the quasi-extinction probability. For each alternative, the Joint Agencies considered the modeled probability that, in the next 50 years under the “risk” scenario, the Washington murrelet population and the murrelet population on DNR-managed lands will reach one-quarter of its initial size. This quasi-extinction threshold is a representation of what may happen if murrelet populations continue on their current downward trajectories and allows for the greatest distinction between alternatives (Figure 4.6.12).

Other risks to murrelet populations were not captured by the modeling framework of either the population viability analysis or the impact and mitigation calculations. For example, as described in Appendix E, the P-stage habitat model may misclassify some forest habitat. Natural disturbances, including landslides, windthrow, and wildfires, may remove large or small areas of inland habitat, in addition to the acres released for harvest. Alternatives with more adjusted acres of mitigation have more buffer for these disturbances, whereas alternatives that have an impact greater than mitigation have no buffer for natural disturbance. Table 4.6.11 summarizes each alternative's approach to population risk.

DISTRIBUTION OF HABITAT

Effective murrelet conservation depends on conserving inland habitat, reducing short-term risks, and improving habitat distribution in strategic locations. Distribution of habitat is an aspect of the alternatives analysis that the population viability analysis does not address and is evaluated separately. The alternatives vary in the distribution of conserved habitat among the strategic locations and other high-value landscapes. (The strategic locations were selected as areas important to the distribution of murrelets because of the lack of federal lands in these areas and the proximity of DNR-managed lands to marine waters in Southwest Washington, the western portion of North Puget, and the northwest Olympic Peninsula.)

To evaluate habitat distribution, the Joint Agencies examined the change in adjusted acres between decades 0 and 5, and the mitigation or impact in each strategic location, which includes a time-adjustment factor. When impacts exceed mitigation, even if the end result is a larger amount of habitat in the strategic location, existing gaps in habitat distribution may persist or new gaps may be temporarily created.

Particular conservation areas were identified as being important to murrelet distribution at a local landscape scale. For example, in the northwest OESF, the Clallam area was identified as representing an important conservation opportunity that would result in a reduction in the distribution of habitat if not conserved. In Southwest Washington, some alternatives provide protection in key areas, but the level of conservation applied to the Elochoman area varies by alternative. In North Puget, DNR-managed lands bridge a gap between the marine waters to the west and inland habitat on federally managed lands to the east. Most special habitat areas, emphasis areas, and MMMAs in North Puget are in this gap and vary by alternative. Refer to the maps in the alternative profiles in Chapter 2 and Appendix F for more information.

The watershed analysis shown in Figure 4.6.6 also includes important information about changes in distribution of inland habitat under each alternative. Table 4.6.12 outlines each alternative's performance with respect to these aspects of distribution.

Table 4.6.10. Summary of Changes in Population and Habitat Modeled for Each Alternative, as Compared With Current Estimates

In this table, "PVA" stands for population viability analysis.

Population response	Existing Conditions	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Habitat released for harvest (acres)	n/a	37,000	47,000	34,000	40,000	33,000	24,000	25,000	38,000
High quality habitat released for harvest (acres with p-stage ≥ 0.47)	n/a	4,000	6,000	0	5,000	0	3,000	0	4,000
Habitat in Decade 5 (acres)	212,000	281,000	267,000	286,000	280,000	288,000	319,000	297,000	282,000
High quality habitat in Decade 5 (acres with p-stage ≥ 0.47)	103,000	179,000	172,000	187,000	180,000	188,000	203,000	197,000	183,000
Habitat in Decade 5 in interior forest (acres)	85,000	106,000	85,000	119,000	118,000	123,000	166,000	135,000	122,000
Habitat in Decade 5 (adjusted acres)	95,000	108,000	101,000	119,000	115,000	121,000	139,000	128,000	117,000
Habitat capacity in Decade 5 (nesting female murrelets)	217	245	230	272	262	275	315	290	267
PVA DNR murrelet population, year 10 (all female murrelets, risk scenario)	542	304	275	327	302	331	368	367	350
PVA DNR murrelet population, year 10 (all female murrelets, enhancement)	542	406	378	427	403	430	453	450	432

Population response	Existing Conditions	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
PVA DNR murrelet population, year 50 (all female murrelets, risk scenario)	542	151	123	172	151	175	196	194	178
PVA DNR murrelet population, year 50 (all female murrelets, enhancement)	542	474	387	533	479	547	646	600	510

Table 4.6.11. Summary of the Approach to Reduce Risk to Marbled Murrelets Incorporated Into Each Alternative

In this table, “LTFC” means long-term forest cover.

Risk Reduction Strategy	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Occupied sites	100-meter buffers on all sites, smaller mapped sites	No buffers on occupied sites	100-meter buffers, except for 50-meter buffers on sites > 200 acres in OESF	100-meter buffers, except for 50-meter buffers on sites > 200 acres in OESF	100-meter buffers, except for 50- meter buffers on sites > 200 acres in OESF	100- meter buffers on all sites	100-meter buffers on all sites	100-meter buffers on all sites
High-quality habitat	n/a	n/a	No harvest	n/a	No harvest		No harvest	n/a
OESF-specific conservation	n/a	n/a	n/a	n/a	n/a	100 meter buffers around all northern spotted owl old forest habitat	No harvest of current marbled murrelet habitat	n/a
Polygons of habitat identified by WDFW (Total 1,503 acres)	74% in LTFC (1,112 acres)	54% in LTFC (811 acres)	56% in LTFC (843 acres)	54% in LTFC (818 acres)	56% in LTFC (843 acres)	91% in LTFC (1,372 acres)	100% in LTFC (1,503 acres)	54% in LTFC (818 acres)

Risk Reduction Strategy	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Emphasis areas	n/a	n/a	7	n/a	7	n/a	8	n/a
Special habitat areas	n/a	n/a	20	32	31	n/a	31	29, thinning allowed in non-habitat
Marbled murrelet management areas	n/a	n/a	n/a	n/a	n/a	66	10	n/a
LTFC in conservation areas (emphasis area, special habitat area, MMMA)	n/a	n/a	67,000 acres	83,000 acres	83,000 acres	207,000 acres	139,000 acres	58,000 acres
"Risk" scenario probability of DNR population dropping below ¼ initial size	53%	67%	47%	54%	45%	36%	37%	42%
Net impact or mitigation (adjusted acres)	500	-6,000	3,500	-650	4,000	13,000	8,500	700

Table 4.6.12. Summary of the Approach to Distribution Incorporated Into Each Alternative

Distribution	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Southwest Washington (WA) change in adjusted acres between decades 0 and 5	1,608	-1,920	4,057	3,967	4,055	7,561	5,958	3,033
Southwest WA impact or mitigation	2,995	1,268	2,590	2,397	2,571	3,414	2,560	751

Distribution	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Elochoman special habitat area or MMMA	No	No	No	No	No	Yes	Yes	Yes
OESF/ Straits change in adjusted acres between decades 0 and 5	2,333	2,122	7,970	6,696	9,023	11,883	12,451	8,400
OESF/Straits impact or mitigation	1,356	-1,567	735	-399	1,303	2,722	3,742	434
Clallam emphasis area or special habitat area	No	No	Yes	No	Yes	No	Yes	Yes
North Puget change in adjusted acres between decades 0 and 5	1,252	297	4,617	2,780	4,996	10,433	6,450	3,930
North Puget impact or mitigation	-2,878	-3,113	-177	-1,938	54	2,663	927	-1,072
Acres in special habitat areas, or MMMAs in North Puget[a]	0	0	11,000	15,000	15,000	35,000	22,000	13,000

Distribution	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Watershed analysis	Habitat declines clustered in North Puget	Habitat declines clustered in North Puget, Straits, south-west WA	Habitat declines clustered in South-west WA, and in some areas of North Puget, Straits	Habitat declines clustered in North Puget, South-west WA, and in some areas of Straits	Habitat declines clustered in southwest WA, and in some areas of North Puget, Straits	Habitat declines in isolated areas of southwest WA, North Puget	Habitat declines clustered in southwest WA, and in isolated areas of North Puget	Habitat declines clustered in North Puget, southwest WA, and in some areas of Straits
Other notes			Includes additional special habitat areas outside of strategic locations	Includes additional special habitat areas outside of strategic locations	Includes additional special habitat areas outside of strategic locations		Includes additional special habitat areas outside of strategic locations	Includes unique special habitat area to reduce existing gap in range between OESF, southwest WA

[a] Not including acres in existing natural resources conservation areas

Conclusions: Changes in Habitat and Population Response

All alternatives increase the acreage and quality of inland habitat over the analysis period. These projected increases are likely positive impacts on the sub-population of murrelets on DNR-managed lands, even when considered against the ongoing 3.9 percent population decline. If habitat is the primary limitation on murrelet population growth, all alternatives result in a reversal of the population decline, with Alternative F resulting in the earliest reversal and greatest population increase. However, under the "risk" scenario, the population continues to decline because this scenario assumes a greater influence from chronic environmental stressors outside the forest. Key comparisons of the alternatives are summarized in Table 4.6.13.

Table 4.6.13. Comparison of Alternatives Based on Key Measures

Measure	Alternatives							
	A (no action)	B	C	D	E	F	G	H
Acres of habitat loss in first decade (not adjusted for quality)	37,063	47,272	34,417	40,357	33,404	23,754	25,170	38,264
Total unadjusted habitat acres (Decade 5)	280,945	267,434	286,130	279,708	287,906	319,347	296,783	281,627
Total adjusted habitat acres (Decade 5)	107,537	101,170	119,463	115,230	120,852	138,593	127,747	117,307
Acres of interior habitat by Decade 5 (percent change from Decade 0)	108,041 (28%)	86,719 (3%)	121,091 (43%)	120,163 (42%)	125,025 (48%)	167,982 (99%)	136,792 (62%)	123,583 (46%)
Decade to habitat recovery[14], adjusted acres	Decade 2	Decade 4	Decade 2	Decade 2	Decade 2	No net loss of adjusted acres	No net loss of adjusted acres	No net loss of adjusted acres
Decade to habitat recovery, raw acres (excluding stringers)	Never	Never	Decade 5	Never	Decade 5	Decade 3	Decade 4	Decade 5
Ending female population for sub-population on DNR-managed lands (risk/enhancement)	151/474	123/387	172/533	151/479	175/547	196/646	194/600	178/510
Probability of the DNR sub-population falling below one-quarter of the starting population[15] (risk/enhancement)	53% / 0.62%	67% / 1.4%	47% / 0.45%	54% / 0.67%	45% / 0.38%	36% / 0.25%	37%/ 0.27%	42%/ 0.45%

Alternative B reflects the most harvest of inland habitat in the first decade and never recovers initial level of raw habitat outside of stringers. Alternative D also never recovers starting raw habitat levels; however, Alternatives B and D do recover adjusted acres in decades 4 and 2, respectively. It takes three decades for

[14] Decade to habitat recovery refers to the time it takes for habitat growth in long-term forest cover to compensate for the habitat loss in the first decade as measured in adjusted acres.
[15] A 5 percent decline per year equates to a decline to one-eighth of the starting population in 40 years.

raw acres of habitat in long-term forest cover to exceed loss in Alternative F and five decades in Alternatives E and H. Alternative G recovers initial raw habitat in decade 4. It takes two decades for Alternative E to recover adjusted acres, and alternatives F, G, and H have no net loss of adjusted acres.

The population viability assessment shows that Alternative B has the smallest simulated population by the end of the analysis period, as well as the greatest quasi-extinction probability for marbled murrelet populations among the alternatives.

Alternatives C, D, E, and H are similar in the overall number of acres conserved and the quality of those acres. Although Alternative D proposes the most initial harvest of inland habitat outside long-term forest cover among these four alternatives, the overall value of the habitat retained and percentage of new interior habitat grown is higher than in the no action alternative.

Alternatives C, E and G conserve isolated stands of high-quality habitat, thus raising their overall habitat quality as compared to alternatives D and H. Alternatives C and E differ only slightly in population responses. Alternative G results in higher population responses than C and E. Alternative D lies in the middle of the range of the simulated population. An important distinction for Alternative D is that the loss of higher-quality habitat results in approximately 10 percent fewer murrelets in the modeled marbled murrelet population than in Alternatives C or E. Alternative H is unique, in that some high-quality and some lower-quality habitat is conserved during the first decade through metering. The remaining habitat outside of long-term forest cover is released for harvest during the second decade. Conserving this habitat for the first decade maintains the nesting carrying capacity at baseline, resulting in no short-term decrease in the population due to harvest.

The larger area of long-term forest cover and fewer acres of harvest proposed under Alternative F results in a projected net habitat increase after the first decade, the most gain over time in interior forest habitat, the highest modeled population gains, and the lowest probability of quasi-extinction. Although this alternative conserves the most acres of potential habitat, the average habitat value in the final decade of the planning period is slightly lower than the other alternatives because more lower-quality habitat develops in the conservation areas. Alternative F conserves the most habitat, even when adjusting for edge effects.

Indirect Effects on Nesting Marbled Murrelets: Disturbance

Marbled murrelets use DNR-managed forests year-round. During the nesting season (April 1 through September 23 in Washington), they can be exposed to audio-visual stressors from a variety of land use activities that may have negative impacts on essential behaviors. Harvest and other forest management and forest use indirectly impact habitat quality by increasing the risk of disturbance to nesting marbled murrelets and chicks. Some of these stressors are related to habitat conditions, predator composition, and edges (described in preceding sections), and other stressors are related to noise and visual disturbances from forest use and management activities. Sources of disturbance impacts are diverse and include road construction, maintenance, and use; timber harvest and recreational activities; aircraft; rock pit operations; and more.

A disturbance event is considered significant when an activity causes a murrelet to delay or avoid nest establishment, fly away from an active nest site, or abort an attempt to feed a nestling. Indirect effects of campgrounds and day-use areas include locally increased populations of nest predators. Such events are considered significant when they result in reduced nesting attempts, nest success, fitness, and/or survival of juveniles and adults, thus impacting the population (USFWS 2012).

The effect of many of these disturbances caused by new or expanded land use activities throughout the planning period are reduced by the conservation measures described in Chapter 2. There are also existing and ongoing disturbance effects that DNR evaluated to ensure that mitigation (the growth of new habitat) would be adequate to offset these negative influences over time.

Quantitative estimates of disturbance can be developed by determining the birds' likely response given the proximity, timing, duration, and intensity of stressors, and by converting that information into acres of quality-adjusted habitat exposed to stressors during the breeding season (Appendix I). However, uncertainties over the nature of murrelet responses to the range of potential disturbances, the location of murrelet nests, and the timing and location of potentially disturbing activities do not allow quantitative estimates of disturbance impacts similar to the estimates of habitat quality and quantity used to evaluate the impacts of harvest and development of murrelet habitat. Thus, while the spatial and temporal overlap of potentially disturbing activities with current and future murrelet habitat can be estimated, the impacts of potential disturbance to that acreage cannot be directly compared or tallied with habitat acreage.

Potentially disturbing activities were classified into six groups with similar characteristics, their average spatial and temporal distributions were estimated based on contemporary practices, and their spatial footprints were derived according to the appropriate distances. These disturbance footprints were intersected with the current marbled murrelet habitat map to estimate the areas potentially subject to those various disturbances. The estimates reported in Table 4.6.14 are based on the assumption that disturbance patterns will be approximately constant over the term of the 1997 HCP and that habitat conserved and developed under each alternative is exposed to disturbance approximately in proportion to its abundance. The estimates of annual habitat disturbance are based on the amount of habitat (Appendix H) estimated for the middle of the term of the 1997 HCP, averaged across all alternatives. Cumulative disturbance can be estimated by multiplying acres disturbed annually by 51.

Table 4.6.14. Average Estimated Acreage of Inland Habitat Disturbed Annually During the Nesting Season, by Activity Group

Activity Group	Stressor	Distance	Duration	Response/Impact	Average habitat disturbed annually during nesting season (adjusted acres)[a]
Group 1 (Includes green collecting, pre-commercial thinning, non-motorized trail use, minor road maintenance)	Ground-based noise and visual disturbance	≤328 feet (100 meters)	< 1 day	No significant response based on duration; minimal to no impacts	9,200
Group 2 (Includes firewood collection, road reconstruction, major road and trail maintenance, communications facilities)	Ground-based noise and visual disturbance	≤328 feet (100 meters)	< 7 days	Aborted feedings, adults flushing; disruption of normal behaviors	310
Group 3 (Campground use and maintenance)	Ground-based noise and visual disturbance Predator attraction	≤328 feet (100 meters)	> 1 month	Increased predation risk, aborted feedings, adults flushing; potential injury and/or mortality	142
Group 4 (Includes timber harvest, motorized trail use, new road and bridge construction)	Ground-based noise and visual disturbance	≤328 feet (100 meters)	>7 days, < 1 month	Aborted feedings, adults flushing; disruption of normal behaviors	1,630
Group 5 (Sand and gravel extraction, blasting)	Ground-based noise and visual disturbance	≤ 1,312 feet (400 meters)	>7 days, < 1 month	Hearing damage from blast noise (within 100 m), aborted feedings, adults flushing; injury; disruption of normal behaviors	52

Activity Group	Stressor	Distance	Duration	Response/Impact	Average habitat disturbed annually during nesting season (adjusted acres)[a]
Group 6 (Aerial herbicide application)	Aircraft noise	≤328 feet (100 meters)	< 7 days	Aborted feedings, adults flushing; disruption of normal behaviors	50

[a] These acres were not updated between the DEIS and the RDEIS because they are an average across alternatives in the middle of the term of the 1997 HCP and so are not likely to be significantly different.

The most common and widespread types of disturbance, Group 1 activities (short duration, low intensity), are estimated to occur over 9,200 adjusted habitat acres annually but are not expected to have adverse effects. Group 2 and Group 4 activities are transient, widely distributed ground-based disturbances with similar expected murrelet response, which is disruption of normal behaviors that is estimated to occur over 1,900 acres annually. Groups 3 and 5 are ground-based disturbances from discrete facilities; together, Groups 3 and 5 disturbances are expected to result in disruption of normal behaviors from noise and visual disturbance over 200 acres annually. In addition, Group 3 activities are expected to result in potential injury and/or mortality to murrelets in the form of increased nest predation over 143 acres annually, and blasting (Group 5) within 328 feet (100 meters) of nesting murrelets also could result in injury and/or mortality over about 5 acres annually. Group 6, aircraft noise, is expected to result in disruption of normal behaviors over 50 acres annually. Some of the disturbance estimated in one category will overlap in space and time with disturbance estimated in another category, so estimates of acres impacted may reflect additive impacts.

Estimates of acres of inland habitat gained and lost under the alternatives do not take into account the disturbance acres because those impacts do not result in habitat removal. Instead, the frequency, intensity, and amount of acres impacted from these disturbances informed conservation measures proposed under the action alternatives. These measures are designed to reduce the risk of these impacts and are more fully described in Chapter 2, Section 2.2. Table 4.6.15 summarizes how the conservation measures are expected to affect marbled murrelets.

Table 4.6.15. Summary of Resulting Effects of Key Proposed Conservation Measures on Disturbance

Conservation measure	Potential disturbance impacts addressed	Resulting effect
Limiting harvest and thinning activities (Table 2.2.5)	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Seasonal restrictions avoid activities during the nesting season, including reducing audio-visual disturbance from heavy equipment use, road construction, and related noise.

Conservation measure	Potential disturbance impacts addressed	Resulting effect
Daily timing restrictions on forest health treatment activities in long-term forest cover under all Alternatives	Aborted feedings, adults flushing (flying from nest); potential disruption of nesting behaviors	Reduced risk to marbled murrelet-specific conservation areas from audio-visual disturbances during peak activity periods for nest visits. Occupied sites are further protected from smoke from prescribed burns.
Limiting road construction	Aborted feedings, adults flushing; potential disruption of nesting behaviors	**Alternatives B, E, F, and H:** Creation of edge and audio-visual disturbance may occur as a result of some road construction through murrelet conservation areas including occupied sites, although consultation under Alternatives B, E, F, and H will likely minimize this risk. Habitat located outside occupied sites is subject to ongoing disturbance impacts from road construction. **Alternatives C, D, and G:** Occupied sites, buffers, and special habitat areas will not receive new impacts from roads unless road construction is required by state or federal law or emergency. Risk of road impacts to other resources may increase if more road miles must be built to avoid conservation areas.
Daily timing restrictions on road maintenance, decommissioning, or abandonment	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Reduced risk to nesting birds in occupied sites from audio-visual disturbances during critical feeding hours. Other marbled murrelet conservation areas and habitat throughout the analysis area may experience audio-visual disturbance from these activities.
Seasonally restricting installation and placement of harvest-related infrastructure (tailholds, guyline corridors, etc.)	Habitat removal, aborted feedings, adults flushing; potential disruption of nesting behaviors	Reduces audio-visual disturbance to all marbled murrelet conservation areas under all alternatives.
Limiting salvage and recovery activities during the nesting season under all alternatives (Section 2.2)	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Reduced risk to habitat in marbled murrelet conservation areas from audio-visual disturbance during critical feeding hours. Increases the potential recovery of high-quality habitat if it is damaged. Activities in low-quality habitat outside conservation areas are not restricted, which could result in some site-specific audio-visual impacts from recovery and salvage operations but may also allow more enhancement of low-quality habitat.

Conservation measure	Potential disturbance impacts addressed	Resulting effect
Restricting both location and timing of blasting (Section 2.2)	Hearing damage from blast noise (within 328 feet [100 meters]), aborted feedings, adults flushing; potential injury or disruption of nesting behaviors	Reduced or eliminated impulsive noise impacts to nesting and potentially nesting murrelets within conservation areas. Murrelets nesting outside of these areas may be subject to disturbance from blasting. Alternatives C and D propose the strictest blasting limitations.
Limiting rock crushing and pile driving during nesting season (Section 2.2)	Hearing damage from impulsive noise, aborted feedings, adults flushing; potential harm or disruption of nesting behaviors	Reduced or eliminated impulsive noise impacts to nesting and potentially nesting murrelets during peak nest activity periods.
Limiting aerial activities during nesting season (Section 2.2)	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Audio-visual disturbances from low-flying aircraft (flights conducted or contracted by DNR) on nesting murrelets will be reduced in marbled murrelet conservation areas. Birds nesting outside these areas will be subject to these impacts.
Limiting the location of new or expanded recreation facilities and trails (Section 2.2)	Increased predation risk, aborted feedings, adults flushing; potential harm	**Alternatives C, D, and G**: Risk of habitat removal, direct harm from predators, and increased audio-visual disturbances will be significantly reduced in marbled murrelet conservation areas, except isolated patches of high-quality habitat. Outside conservation areas, disturbance from maintenance activities will be eliminated during critical nest visiting and feeding hours. **Alternatives B, E, F, and H:** Risk of disturbance will be reduced during critical nest visiting and feeding times. This restriction does not address the creation or use of undesignated trails or areas of recreational activities.
Restricting and mitigating the use of easements, rights-of-way, leases, and contracts where DNR has authority to do so	Aborted feedings, adults flushing; potential disruption of nesting behaviors	Reduced risk of audio-visual disturbances for maintenance activities and construction of new facilities during peak nest activity periods in conservation areas.

Potential Changes to Long-term Forest Cover From Natural Events

In addition to the direct impacts to inland habitat from harvest and related activities and the indirect effects from ongoing land use activities within and adjacent to inland habitat, long-term forest cover may be affected through time by disturbances and activities outside of the Joint Agencies’ control. These impacts could come from landslide events, wind and fire events, or undesignated or illegal land use activities. These impacts also could come from new rights-of-way or easements required to provide utilities or road infrastructure or for legally required access to inholdings.

These impacts are anticipated to be generally minor at the scale of all long-term forest cover and insignificant within marbled murrelet-specific conservation areas. For example, only between 4 and 6 percent of the land proposed as marbled murrelet conservation areas and not already deferred for other conservation reasons is identified as having high landslide hazard potential using DNR data (refer to Section 3.1 for a description of these data). That does not mean that 4 to 6 percent of these areas will fail during the planning period. Activities that can trigger landslides will be restricted in these areas (for example, road building and harvest). However, there remains a small risk of habitat loss due to natural landslide events. Similarly, rare weather events such as catastrophic windstorms, while not exacerbated by the proposed alternatives (refer to Section 4.2, Climate), could result in some loss of long-term forest cover. Although potentially locally significant, these losses are not expected to be significant at the statewide scale during the planning period.

Those alternatives with a higher amount of mitigation than expected impacts (refer to Figure 4.6.5) would provide additional capacity to "absorb" or account for these impacts. Alternative F is the most resilient because it conserves the greatest amount of acreage across a wide geography, while Alternative B is least resilient because it conserves the least acreage, does not buffer occupied sites, and is the most geographically restricted.

Summary of Impacts

The marbled murrelet population is declining in Washington. Habitat growth on DNR-managed land appears to have the potential to decrease the rate of this decline under some alternatives. The alternatives offer different approaches to habitat protection and habitat growth that, when analyzed and compared, illustrate some key differences in habitat amount and quality and estimated population response.

Table 4.6.16. Summary of Potential Impacts to Marbled Murrelets

Key question	Criteria	Measures	Potential impacts
How do the alternatives affect inland habitat, and how are changes to habitat quantity and quality expected to affect the marbled murrelet population?	Compliance with Endangered Species Act and 1997 HCP. Need, purpose, and objectives.	Amount and quality of inland habitat gained and lost.	All alternatives result in more habitat gained than lost over time, with improved habitat quality and softened edge effects, except for occupied sites under Alternative B. In the short term, loss of mostly low-quality habitat outside of long-term forest cover will occur under any alternative, including the no action alternative. Within the first two decades, growth of new habitat and development of higher-quality habitat outpaces this initial habitat loss. When adjusted for quality, impacted acres exceed acres of mitigation under Alternatives B and D. Impacted acres and mitigation are most closely aligned in Alternative H when factoring in habitat quality. Under Alternative E, G, and F mitigation acres exceed impacted acres by greater amounts. Alternative F conserves the most additional habitat overall and has the most increase in interior habitat over time. Alternatives C through H also have substantial increases in interior habitat, while Alternative B has a slight reduction.
		Level of disturbance from forest management and land use activities.	Disturbance impacts will be ongoing in long-term forest cover but will be minimized inside occupied sites, occupied site buffers, and special habitat areas. Risk of disturbance within marbled murrelet conservation areas is minimized to the highest degree under alternatives that contain special habitat areas (Alternatives C, D, E, G, and H). There is a slightly higher potential for disturbance in special habitat areas under Alternative H compared to Alternatives C, D, E, and G because thinning in non-marbled murrelet habitat in special habitat areas is allowed under Alternative H. Other conservation measures, described in Section 2.2, will limit the potential for disturbance. Given the relatively small number of acres involved for most disturbance categories, the conservation measures provide a minor benefit. Occupied site buffers are lacking under Alternative B so more disturbance related impacts are expected to occur under that alternative.
		Relative comparisons of population projections over time, including probabilities of quasi-extinction.	Alternatives B and D have the highest probabilities of quasi-extinction, respectively. If inland habitat is the primary limitation on murrelet population growth, all alternatives result in a reduced rate of population decline over the next 50 years, and Alternative F shows the earliest reversal and greatest overall increase in population.

Key question	Criteria	Measures	Potential impacts
Do the alternatives provide habitat in strategic locations for marbled murrelet conservation? These locations include southwest Washington and areas close to marine waters, including OESF and Straits (west of the Elwha River) and North Puget	Compliance with ESA and 1997 HCP. Need, purpose, and objectives.	Relative comparison of habitat conserved in important landscapes identified by Recovery Plan and/or *Recovery Implementation Team Report* (USFWS 2012). Relative comparisons of future habitat development in strategic locations.	**Southwest Washington:** The no action alternative would protect approximately 84% of all known habitat in southwest Washington. Alternatives C through E would protect approximately 83% of habitat in southwest Washington. Alternative F protects the most habitat in southwest Washington, approximately 93%. Alternatives G and H protect 91% and 80%, respectively. Alternative B protects the least, 70% (significantly less than the no action alternative). **Close to marine waters:** Alternatives C, D, E, G, and H provide more murrelet conservation near the Strait (west of the Elwha River) than other alternatives. Alternatives C, E, G and H provide additional habitat in the OESF (including the Clallam Block) and Straits (west of the Elwha River). Alternatives C through H emphasize murrelet conservation in areas west of federal lands in North Puget (closer proximity to marine waters), and Alternatives G and F provides additional habitat in North Puget. Alternative F provides the most overall future habitat in strategic locations.

Minimization and Mitigation for Adverse Impacts

All alternatives use areas of long-term forest cover as the primary conservation strategy to provide both minimization and mitigation for the impacts summarized in Table 4.6.9. These impacts include loss of habitat, ongoing edge effects, and ongoing disturbance. These impacts are mitigated by:

1) Conservation and development of marbled murrelet habitat in long-term forest cover
2) Conservation of habitat in strategic locations on DNR-managed forestlands
3) Conservation measures designed to minimize the impacts of edges and disturbance (refer to Chapter 2 and Table 4.6.8).

4.7 Recreation

This section describes the potential effects of the alternatives on DNR recreation facilities and users in the analysis area.

Analysis Question

How are recreational opportunities on DNR-managed lands affected by the action alternatives?

Evaluation Criteria

Impacts are evaluated against the quality and quantity of recreational opportunities available, as governed by DNR recreation planning policies and the multiple use concept.

Scale of Analysis

The alternatives are analyzed at both the analysis area scale and at a "forest block" scale. For the purposes of this analysis, "forest block" signifies a contiguous area of DNR-managed land. The proposed conservation measures most directly affect recreation in forest blocks where marbled murrelet conservation areas and designated recreation facilities and/or trails overlap.

How Impacts Are Measured

Direct, indirect, and cumulative impacts are measured qualitatively, considering use-level trends through the life of the 1997 HCP and where designated recreation intersects with proposed marbled murrelet conservation areas.

Summary of Direct, Indirect, and Cumulative Impacts

Under the interim marbled murrelet strategy, Alternative A, existing 1997 HCP provisions, and DNR policies for recreation planning will continue to be followed. Alternatives B through H include specific conservation measures that would impact new or expanded recreation in marbled murrelet conservation areas (refer to Chapter 2).

All of the action alternatives have the potential to clarify the geographical information that will be used in recreation planning. This clarification is a positive impact in terms of adding certainty to where and what recreational opportunities will be allowed on DNR-managed lands with marbled murrelet habitat.

There are no significant adverse impacts identified at the scale of the analysis area. However, DNR may need to shift the focus of recreation within some forest blocks where there are marbled murrelet conservation areas in order to accommodate a growing demand for recreation on state trust lands.

Direct Impacts to Recreational Opportunities

Direct impacts to recreation are not anticipated in the popular DNR-managed forest blocks of Capitol, Tiger Mountain, Raging River, Green Mountain, Tahuya, and Elbe Hills state forests. These recreational forest blocks do not have marbled murrelet conservation areas designated under Alternatives B through H; therefore, the conservation measures will not directly affect the management and development of recreation in these areas. These forest blocks could be indirectly affected by the conservation measures if restrictions on recreation within marbled murrelet conservation areas shift more recreation to these forest block (refer to the subsequent subsection, "Indirect Impacts").

For forest blocks with existing, designated recreation areas that are located within proposed marbled murrelet conservation areas, expansions of these facilities or development of new facilities will be limited. As demand for recreation continues to increase, so will public use of these existing areas and potential interest in expanding these areas.

Twelve forest blocks within the analysis area have existing recreational facilities that are located within proposed marbled murrelet-specific conservation areas. Some conservation measures proposed under the alternatives would limit new or expanded recreation within these forest blocks while current uses would remain, as highlighted in Table 4.7.1.

Table 4.7.1. Existing Designated Recreation in Forest Blocks With Marbled Murrelet Conservation Areas

HCP planning unit	Forest block	Type of facility impacted	Known areas with potential limitations on expansion
North Puget	Walker Valley	Motorized trails	Alternative F: MMMA encompasses the northeast portion of the trail system.
Columbia	Elochoman	Motorized trails	Alternative E: Emphasis Area encompasses a trailhead and ORV trail. Alternative F: MMMA encompasses a trailhead and ORV trails.
South Coast	Radar/Bear	Campgrounds	Alternative D: Two campgrounds are within special habitat areas. Alternative F: Two campgrounds are within a MMMA. Alternative H: Special Habitat area encompasses non-motorized trail
Straits	Port Angeles	Motorized trails	All alternatives have occupied sites and/or buffers that overlap motorized trail.
Straits	North Crescent	Motorized trails	All alternatives have occupied sites, buffers, and/or conservation areas that overlap motorized trail.
Straits	North Crescent	Campground	All alternatives have occupied sites and/or buffers that encompass a campground.
OESF	Coppermine	Campground	Alternatives B through H have occupied sites and/or buffers that encompass a campground.

HCP planning unit	Forest block	Type of facility impacted	Known areas with potential limitations on expansion
OESF	Reade Hill	Non-motorized trails	All alternatives have occupied sites, buffers, or conservation areas that encompass non-motorized trail

IMPACTS ON NEW OR EXPANDED RECREATIONAL OPPORTUNITIES: ALTERNATIVES C, D, AND G

Alternatives C, D, and G would restrict recreational development within occupied sites, buffers (including the 0.5-mile buffer in emphasis areas), and special habitat areas. These restrictions mean that the specific geographic areas limited for recreation will be more clearly defined, which could bring more certainty to planning new and expanded recreational opportunities.

Potential impacts to strictly limiting new and expanded recreation opportunities in these forest blocks include the following:

- Increased use of existing facilities and trails, requiring increased enforcement and maintenance.
- Increased volume of use within the forest block, with the possibility of people going off trails or building trails without permission from DNR, requiring increased enforcement and environmental mitigation.
- Development of other forest block more suitable for recreational development, where available.
- Decreased recreation in the forest block.

These potential impacts are not exhaustive. If there is sufficient public interest to expand recreational opportunities near existing designated recreation, DNR will need resources to identify suitable forest blocks for recreational development that are consistent with the intentions and actions of the marbled murrelet conservation strategy and also meet the other land management and environmental obligations of DNR.

Another potential impact of Alternatives C, D, and G involves the requirement to consult with USFWS to abandon or decommission non-designated trails in marbled murrelet conservation areas. Under the interim strategy, there is no specific requirement for consultation if DNR needs to abandon, decommission, and potentially restore non-designated trails anywhere in the state to alleviate safety, environmental, or natural resource concerns. The additional step of consulting with USFWS when needing to abandon a trail in a marbled murrelet conservation area does add some uncertainty to outcomes. However, DNR and USFWS have a long history of working together to efficiently resolve implementation issues, and there is no reason to believe that would change.

IMPACTS ON NEW OR EXPANDED RECREATIONAL OPPORTUNITIES: ALTERNATIVES B, E, AND F

The conservation measure proposed for Alternatives B, E, and F provides DNR the flexibility to assess and potentially develop recreation opportunities within marbled murrelet conservation areas if there are no identified impacts to the marbled murrelet or if impacts can be mitigated through consultation with USFWS. The difference between these provisions and the no action alternative is that there would be a potential for recreational development in occupied sites and buffers, the 0.5-mile buffer in emphasis areas, and special habitat areas. If DNR would like to pursue recreational activities in one of these places, DNR would conduct an impacts analysis and, if impacts were identified, consult with USFWS. Where no impacts to the marbled murrelet are identified, DNR would not have to consult with the USFWS, and new or expanded recreation could move forward in these areas.

Where impacts are identified, DNR may choose not to pursue new or expanded recreation development, or may consult with USFWS. Because these decisions are made on a site-specific basis, it is not possible to describe what potential outcomes could entail. However, DNR and USFWS have a long history of working together to efficiently resolve implementation issues, and there is no reason to believe that would change.

IMPACTS TO MAINTENANCE ACTIVITIES (ALL ACTION ALTERNATIVES)

Daily timing restrictions for maintenance activities likely will have a low to minimal impact on recreation opportunities. The marbled murrelet nesting season (April 1 through September 23) coincides with the most popular season for recreation in many forest blocks as well as the optimal timing for many maintenance activities. Staff would have to schedule maintenance work in marbled murrelet conservation areas outside of the daily timing restrictions during nesting season, but this work likely could be accomplished with reasonable accommodation. Some maintenance activities could reasonably occur outside of the nesting season.

IMPACTS ON NEW OR EXPANDED RECREATIONAL OPPORTUNITIES: ALTERNATIVE H

The conservation measures under Alternative H are the same as for alternatives B, E, and F for developing recreation opportunities within marbled murrelet conservation areas. Under Alternative H, however, DNR would retain the flexibility to decommission or abandon trails in occupied sites, occupied site buffers, and special habitat areas without consultation with USFWS.

Alternative H conservation measures would allow maintenance or improvements within the footprint of existing facilities, trails, trailheads, and recreational sites within occupied sites, occupied site buffers, and special habitat areas. These activities would either occur outside of the nesting season or, if conducted during the nesting season, following daily timing restrictions. These seasonal or daily restrictions could impact the length of time needed to complete some projects.

Alternative H conservation measures also prohibit conversion of non-motorized trails to motorized use within occupied sites, occupied site buffers, and special habitat areas.

Indirect Impacts

An indirect impact of limiting new or expanded recreation development in some areas is that it may increase recreational pressure in other forest blocks. Limiting recreation development could create public pressure to develop recreational opportunities in forest blocks that have not historically had designated recreation or in areas that are less environmentally suitable for recreation. There also is the potential for increased recreational use in forest blocks with developed recreation, leading to increased need for management, maintenance, enforcement, and potentially expansion of designated opportunities.

Limiting recreational trail and facility development in one portion of a forest block might result in increased recreational use of open forest roads, public pressure to expand into other areas, and the development of trails without DNR permission. Increased use, public pressure, and unauthorized trail building could lead to higher resource needs for management, maintenance, decommissioning, restoration, and enforcement.

DISPERSED RECREATION

It is possible that restricting designated recreational development and expansion in forest blocks with marbled murrelet conservation areas could indirectly impact dispersed recreation. Dispersed recreation is accessed from both designated facilities as well as from county roads, forest roads, and adjacent lands. Impacts could range from decreased access to displacing dispersed recreation to other forest blocks that may or may not be suitable for dispersed recreation activities. Unsuitable or concentrated dispersed use of an area can lead to impacts that require management, mitigation actions, enforcement, and the potential need to designate and manage recreational opportunities. Any expansion in recreation management requires additional staff and financial resources.

Cumulative Impacts

The state's population is projected to grow by several million over the next three to four decades. The Washington State Recreation and Conservation Office completed an assessment of supply of outdoor recreation facilities and opportunities in Washington (Recreation and Conservation Office 2013). Their findings suggest that the current supply of recreation is not completely meeting public demand, and meeting that demand is further challenged by the pressures of population growth and urbanization in Washington. These pressures are likely to intensify over the next several decades as land available for recreation becomes more restricted. As a result, existing facilities and trails most likely will see more use and public interest will increase to develop new facilities and new trails (both motorized and non-motorized). There could also be an increase in unauthorized trails being created within DNR's forest blocks. Forest blocks with marbled murrelet conservation areas may experience public pressure for recreation where currently there is not much demand for recreation. If public recreational use and demand begin to impact marbled murrelet conservation areas, DNR may have to increase management and enforcement to limit recreational use of an area and stay consistent with the conservation strategies of the 1997 HCP.

Increases in recreational volumes or expanded recreational development can create conflicts with adjacent landowners, trust income-generating activities, or environmental responsibilities. A variety of stakeholders have an interest in how DNR manages state trust lands, including but not limited to the trust beneficiaries, environmental community, tribes, adjacent landowners, and the recreating public. In the future, if recreation on state trust lands starts to significantly impact the basic activities necessary to fulfill trust obligations, DNR will need to evaluate how to either manage or eliminate recreation, or compensate the trusts for impacts from recreation.

Table 4.7.2. Summary of Potential Impacts to Recreation

Key questions	Criteria	Measure	Potential impacts
How are recreational opportunities on DNR-managed lands affected by the alternatives?	Recreational opportunities are provided consistent with the Multiple Use Concept and other department policies. Pending recreation plans.	Use levels through life of the 1997 HCP (trends). Designated recreation that intersects with marbled murrelet conservation areas.	No impact to existing designated and dispersed uses are expected. Clearly defined marbled murrelet conservation areas could provide more certainty to recreation planning. Restrictions on development in marbled murrelet conservation areas could shift recreation use to other areas or result in undesignated uses. Recreation planning can take into account potential restrictions on development, but restrictions may affect some local user groups.

4.8 Forest Roads

This section describes the potential effects of the alternatives on DNR's network of forest roads in the analysis area, with a focus on whether changes to road use or management would affect other elements of the environment.

■ Analysis Question

Do the action alternatives affect the location, amount, or use of forest roads to the extent that impacts to elements of the environment are increased?

■ Evaluation Criteria

The location of proposed marbled murrelet conservation areas and the proposed conservation measures for these areas are compared against existing rules and policies governing forest roads to evaluate potential impacts.

Scale of Analysis

The alternatives are analyzed at the analysis area scale. The action alternatives, including proposed conservation measures, provide consistency for road work and management among the HCP planning units (refer to Table 3.8.3 for an explanation of differences in road management under the no action alternative).

How Impacts Are Measured

Impacts are evaluated qualitatively by estimating how the alternatives affect DNR road management and road work operations and determining if these effects increase impacts to natural resources. Decisions for locating and managing roads happen on a site-specific basis, for example when evaluating an area for a timber sale, and these areas have yet to be determined. Therefore, the identification of specific impacts tied directly to the alternatives are based on stated assumptions about how the alternatives may affect roads, their location, and management, and how those changes may in turn affect the risk to natural resources.

■ Summary of Direct, Indirect, and Cumulative Impacts

Numerous forest management policies and regulations address the potential environmental impacts from roads (refer to Section 3.8). The conservation measures would impose restrictions on the timing and location of some road-associated activities; however, these restrictions are similar to those currently implemented under the no action alternative. Proposed restrictions on road construction and blasting could have some indirect, localized effects on natural resources. While overall road density is not expected to increase significantly as a result of the alternatives, in some cases, additional road miles may be needed to avoid marbled murrelet habitat and conservation areas. Across the analysis area, it is unlikely that these changes would increase the risk of environmental impacts because of the existing regulations, policies, and guidelines designed to minimize these risks.

Some alternatives could have moderate impacts on road management activities, access to harvestable stands, and recreation use and access. Differences in impacts among the alternatives are highlighted bin the following section.

Effects from Restrictions on Road Location and Road Work

The alternatives designate habitat that must either be avoided completely when locating roads or be subject to a review process that could result in locating roads away from habitat or conservation areas. These measures could result in the need for additional road miles, which could increase the number of stream crossings, or result in the need to construct roads in areas that may pose higher environmental risk. Longer roads in potentially less desirable locations (from a road construction standpoint) may have less impact overall than building through marbled murrelet conservation areas.

Conversely, roads proposed to be built within special habitat areas, occupied sites and buffers, and 0.5-mile buffers on occupied sites within emphasis areas may have less impact than building elsewhere. If the objective is to conduct activities that have the least impact on specific natural resources, the consultation process outlined for Alternatives B, E, F, and H (described later in this section) may allow more flexibility to choose among the best locations with the fewest impacts. All road construction decisions would be evaluated on a case-by-case basis, and existing regulations and design standards would be applied.

NEW CONSTRUCTION AND RECONSTRUCTION: ALTERNATIVES C, D, AND G

Alternatives C, D, and G prohibit new road construction or reconstruction through special habitat areas, occupied sites, and their buffers, including the 0.5-mile buffer around occupied sites within emphasis areas, unless otherwise required by state or federal laws or emergency.

From a road management perspective, these measures provide certainty for the process of assessing road location options, particularly in the North and South Puget HCP planning units. However, these limitations could result in constructing longer roads to avoid certain areas. Longer roads could elevate risks to water quality and/or involve additional stream crossings or elevate risks to other natural resources. The existing regulatory framework would continue to provide environmental protections on a site-by-site basis. Access to operable lands also may be affected, which can have an effect on timber production.

Road reconstruction under Alternatives C, D, and G is more restrictive than the no action alternative. This means that the long-term use of an existing road may be limited if the physical conditions of that road would deteriorate to the point of needing reconstruction. The physical work for road reconstruction is not significantly different from maintenance activities (work is conducted within the existing footprint). The proposed conservation measure that limits reconstruction could mean that DNR would see the elimination of road-decommissioning[16] activities in these areas because there would be no way to reopen the road again. For that reason, roads within special habitat areas, occupied sites and buffers, and the 0.5-mile buffer within emphasis areas may need to be abandoned, not decommissioned.

The indirect impacts of limiting road reconstruction include potentially cutting off access to operable stands, requiring more new road construction, or requiring more maintenance of existing roads. As with road construction, the limitation on reconstruction has the potential to increase impacts to other natural resources. However, existing regulations remain in place to minimize these impacts.

NEW CONSTRUCTION AND RECONSTRUCTION: ALTERNATIVES B, E, AND F

Options for road construction and reconstruction under Alternatives B, E, and F provide more flexibility within marbled murrelet conservation areas than under Alternatives C, D, and G for siting new roads, conducting road work on existing roads, and reconstructing decommissioned roads. Alternatives B, E, and F affect road reconstruction to a slightly lesser extent than Alternative C, D, and G because reconstruction is not prohibited outright within marbled murrelet conservation areas. Under Alternatives B, E, and F, road reconstruction conservation measures are similar to the no action alternative in the OESF (refer to Table 3.8.3) but are more restrictive in the other HCP planning units.

Alternatives B, E, and F potentially allow more road construction through habitat than Alternatives C, D, and G which would not only remove habitat but also could affect the quality of existing habitat by creating more edges. Forest edges created from harvesting and roads impact the security of marbled murrelet habitat by compromising the shape and amount of interior forest patches within Long-term forest cover and introducing predators.[17] Only about 5 percent of habitat is currently impacted by the road edge effect.[18] Due to the individual analysis needed for each road location, site-specific impacts to natural resources cannot be determined at this time. The existing regulatory framework would continue to provide environmental protections designed to minimize risks.

NEW CONSTRUCTION AND RECONSTRUCTION: ALTERNATIVE H

Conservation measures for new road construction under Alternative H are also more flexible than under Alternatives C, D, and G. Alternative H conservation measures allow new road construction through occupied sites, occupied site buffers, and special habitat areas, if no other route is feasible. In occupied sites and buffers, DNR will consult with USFWS to minimize impacts.

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[16] Road decommissioning reduces the need to maintain roads between long periods of timber harvest inactivity, which reduces the long-term maintenance costs of the road and decreases impacts from hauling and other traffic, sediment delivery, and flooding.
[17] Appendix G, "Long-term Forest Cover Focus Paper."
[18] Refer to Section 3.6 and Appendix H, "Potential Impacts and Mitigation Focus Paper."

ROAD MAINTENANCE, DECOMMISSIONING, AND ABANDONMENT (ALL ACTION ALTERNATIVES)

There are no significant differences in terms of road maintenance, decommissioning, and abandonment between the no action alternative and the action alternatives. This type of road work is best conducted during the summer construction season, which aligns with the typically dry marbled murrelet nesting season (April 1 through September 23). Working in wet conditions increases the risk of sediment delivery, reduces the ability to compact road fill or surfacing adequately, and increases damage to existing roads from equipment due to weak soil conditions. Allowing work to occur during the nesting season but within the daily timing restrictions, as proposed under all the action alternatives, is not expected to increase risk to natural resources.

STREAM CROSSINGS (ALL ACTION ALTERNATIVES)

All action alternatives would add approximately 16,000 acres of occupied sites to the conservation strategy compared to the no action alternative. Because of the additional acres in occupied sites, the number of culverts and bridges located within these areas would increase. The number of culverts located within occupied sites and buffers would increase from 212 to 287 and the number of bridges would increase from 39 to 52. Maintenance and replacement work on these structures may be required. Stream crossing replacements are required by the need for fish passage, increased hydraulic capacity, emergency replacement due to failure, or scheduled replacement due to age and deterioration; all of these actions fall under the state or federal law or emergency exemptions provided in the conservation measures. New stream crossing locations would need to follow the guidance for new road construction or road reconstruction under the alternatives. Therefore, the conservation measures of the action alternatives would not increase risk to natural resources.

ROCK PIT DEVELOPMENT AND EXPANSION (ALL ACTION ALTERNATIVES)

Where new construction is prohibited under the interim strategy, rock pits also would be prohibited. Alternatives C, D, G and H do not change this basic limitation, but they expand the areas where this prohibition would apply. Therefore, more valuable rock sources could go undeveloped, creating the need for hauling longer distances to other existing rock pits, developing new rock pits in non-restricted areas, or purchasing material from commercial sources. Increased haul trips on forest roads could increase wear and tear and exacerbate potential environmental impacts. More flexibility is provided under Alternatives B, E, and F, but restrictions on new pit development in the highest priority habitat still is anticipated.

Rock pits can include relatively large areas, and expanding existing rock pits in marbled murrelet conservations areas may have fewer adverse effects for some natural resources than constructing a new rock pit outside conservation areas. As with new road construction, the risk to natural resources would be reviewed on a case-by-case basis. The existing regulatory framework would continue to provide environmental protections.

Noise-Generating Activities

CHANGE IN TIMING OF NESTING SEASON (ALL ACTION ALTERNATIVES)

The action alternatives all expand the nesting season currently followed under the interim strategy (April 1 through August 31) to April 1 through September 23. This expansion would restrict more of the summer construction season and the majority of the hydraulic work window. Shifting road work to outside the summer construction season could affect road stability, resource protection, and project scheduling; however, this shift may not be necessary because most road work can be accomplished outside daily timing restrictions as proposed by the conservation measures. If activities are allowed with daily timing restrictions, there is no increased risk to natural resources.

BLASTING RESTRICTIONS

Compared to the no action alternative, the number of rock pits within occupied sites increases from six to eight, and the number of rock pits within 0.25 mile of an occupied site increases from 27 to 38 under the action alternatives. (This increase is due to the action alternatives using an expanded set of occupied sites, as described in Chapter 2 and Appendix E.) Conservation measures for the action alternatives apply to rock pits located in special habitat areas and within 0.5 mile of an occupied site in an emphasis area.

Table 4.8.1. Number of Rock Pits Affected by Blasting Conservation Measures

Area of blasting restriction	Alt. A	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Occupied sites	0	0	0	0	0	0	0	0
Within 0.25 miles of occupied sites	34	49	40	38	37	31	35	45
Special habitat areas/MMMAs	n/a	n/a	8	23	23	58	23	6
0.5-mile buffer in emphasis areas	n/a	n/a	8	n/a	8	n/a	9	n/a
Total	34	49	56	61	68	89	67	51

Alternatives C, D, G, and H

During the nesting season, blasting associated with rock pits or road building would be prohibited in or within .25 miles of occupied sites, buffers, and special habitat areas. Blasting is prohibited within .5 miles of an occupied site within an emphasis area. The number of rock pits out of production for manufacture, expansion, or development during the marbled murrelet nesting season (when most road work occurs) would increase from 34 to 56 (Alternative C) or 61 (Alternative D) between the no action alternative and the action alternatives.

Blasting restrictions would hamper the production of aggregate from these identified rock pits. Work within rock pits is typically accomplished during the summer construction season when conditions are better than the wetter fall through spring months. Similar to the prohibitions for new rock pit development and expansion, restrictions on blasting activities would create the need for longer haul distances to other existing rock pits or purchase of material from commercial sources.

Impacts on natural resources due to rock blasting would be reviewed on a case-by-case basis and cannot be determined at this time. Creating new rock pits outside of conservation areas could pose more risk to some natural resources than blasting in existing rock pits due to impacts from hauling rock further and impulsive noise effects on other species.

Alternatives B, E, and F

During the marbled murrelet nesting season, blasting could potentially occur in or near marbled murrelet conservation areas, based on consultation between DNR and USFWS to avoid, minimize, and mitigate impacts to nesting birds. Consultation for blasting within the existing footprint of a rock pit would only determine if blasting could be accomplished with daily timing restrictions. If blasting is allowed through consultation, there is no increased impact on natural resources. If not, the same impacts under Alternatives C, D, G, and H would be expected.

CRUSHING RESTRICTIONS (ALL ACTION ALTERNATIVES)

The conservation measures propose to restrict rock crushing within 360 feet (110 meters) of occupied sites. Within these areas, rock crushing must take place outside the marbled murrelet nesting season when feasible; if rock crushing must take place within the nesting season, daily timing restrictions are imposed. Rock crushing typically occurs during the summer construction season, so restricting rock-crushing activities during the nesting season will be challenging, but not impossible, depending on weather. The timing restrictions would not be difficult to follow. The proposed distance buffer for this noise-generating activity is smaller than that applied under the interim strategy (0.25 mile), but the area to which the buffer applies would increase. Because crushing operations are allowed with timing restrictions if working outside the nesting season is unfeasible, the action alternatives would not increase risk to natural resources.

PILE DRIVING (ALL ACTION ALTERNATIVES)

As with rock crushing, pile driving is restricted within 360 feet (110 meters) of occupied sites, which is a decrease in distance from the interim strategy (0.25 mile). Within these areas, pile driving must take place outside the marbled murrelet nesting season when feasible; if pile driving must take place during the nesting season, daily timing restrictions shall be followed. Pile driving is typically associated with bridge construction. Because the nesting season is during the hydraulic work window, conducting this activity outside the nesting season would be unlikely, but daily timing restrictions would be easy to implement. Because pile-driving operations are allowed with timing restrictions if working outside the nesting season is unfeasible, the action alternatives would not increase risk to natural resources.

Indirect and Cumulative Potential Impacts on Road Management

Increasing acres of marbled murrelet conservation may make timber harvesting and road planning more difficult and expensive. Smaller harvestable stands may not have the timber volume to support extraction and could cause more road construction to connect these small harvestable patches into a viable timber sale. This scenario is common in eastside forests where more road is built to reach enough volume to produce income from a timber sale. Even though timber harvesting is still possible, any extra road length or road work affects how much revenue the timber sale is able to produce. The cumulative impacts of road work restrictions; mobilization of harvesting equipment; restrictions on guylines, tailholds, landings, and yarding corridors; and location of marbled murrelet conservation areas could put some additional forestland out of production.

INDIRECT EFFECTS ON ROAD ABANDONMENT

Historically and under the no action alternative, road abandonment has been driven by environmental concerns and protection of resources. The choice to abandon roads is also guided by management decisions concerning use, road density, and costs, but not to the extent of resource protection. Costs, however, are typically driven by environmental concerns. For example, a road will be abandoned if the cost to eliminate fish barrier culverts outweighs the costs and benefits of replacement and reconstruction of the road. Most of the road abandonment activities on DNR-managed lands have been accomplished during road maintenance and abandonment planning, as required by the forest practices rules. Taking more land out of timber production results in reassessing the road network and abandoning the roads that are no longer needed to manage land.

POTENTIAL FOR AN INCREASE IN ROAD MILES

At the scale of the analysis area, overall road miles are not likely to change significantly under any alternative. Road density may remain stable or decrease in areas with road restrictions but could either remain stable or increase in non-marbled murrelet conservation areas where road construction is not as restricted. The use of road abandonment is expected to continue in the future to keep the forest road system mileage in check.

For a particular landscape or watershed, an increase or decrease in road density as a result of added marbled murrelet conservation could be significant. Because new road locations are assessed on an individual basis, the actual impact to the environment could not be evaluated at this time.

NON-TIMBER USE AND ACCESS

Roads are the main access points for public recreation. Road abandonment or restrictions on new road construction or recreational use within marbled murrelet conservation areas could limit access to established recreation sites or areas used for dispersed recreation. Access to non-timber forest products also may be more limited, which could have indirect impacts to local economies. (Refer to "Socioeconomics" in this chapter.) Increases in unauthorized road use or undesignated trail building could result if significant restrictions are put in place on roads in areas of high recreational use. Access to other types of facilities (for example, private inholdings, leased lands, or utility corridors) also could be affected by limitations on road construction or reconstruction.

Summary

Table 4.8.2 provides a summary of potential impacts to forest roads and associated natural resources that are potentially impacted by these roads. Specific adverse impacts are difficult to pinpoint because road management decisions are largely made on a site-specific basis. No changes are proposed to the rules, policies, and procedures that are in place to minimize and mitigate environmental impacts from road construction and management. The conservation measures do propose restrictions on the location of roads and associated rock pits and the timing of road work. These restrictions could result in indirect effects to other natural resources. Strictly limiting road construction in some areas also could cause access problems for operable forest stands and for recreation.

Table 4.8.2. Summary of Potential Impacts to Forest Roads

Key questions	Criteria	Measure	Potential impacts
Do the action alternatives affect the location, amount, or use of forest roads to the extent that impacts to elements of the environment are increased?	Forest practices rules. *Policy for Sustainable Forests.* 1997 HCP.	Required road work (construction, reconstruction, maintenance, decommissioning, and abandonment). Miles and density of roads. Number of rock pits and stream crossings. Timing of activities for environmental protection and optimal construction.	Localized increases in road miles may occur, but road density in the analysis area is unlikely to increase as a result of the alternatives. Increased road abandonment in conservation areas would likely occur. Alternatives C, D, and G: Additional road miles may be needed to avoid construction in marbled murrelet conservation areas. Potential impacts to aquatic resources and wildlife would be minimized through existing regulations, policies, and design guidelines. Alternatives B, E, F, and H: New road development through marbled murrelet conservation areas would remove habitat, create new edge effects, and reduce the quality of the habitat. The consultation process outlined for Alternatives B, E, F, and H allows more flexibility than Alternatives C, D, and G to choose among the best locations with the fewest impacts. Indirect impacts also could occur to recreation and other user access; there is a potential for increased unauthorized use. Restrictions on road reconstruction can cause decreased use of road decommissioning as a management tool and increased construction of duplicate access roads, increasing the road density adjacent to the marbled murrelet conservation areas. Rock pit development could be shifted to

Key questions	Criteria	Measure	Potential impacts
			outside conservation areas, with some localized impacts to other noise-sensitive species and wildlife habitat.

Potential Mitigation for Adverse Impacts

ROAD RECONSTRUCTION

The conservation measures for road reconstruction could be adjusted to apply only to increases in the size of the road prism. For reconstruction that does not increase the existing road prism, a conservation measure similar to road maintenance would be adequate (following daily timing restrictions in proximity to habitat). Reconstruction required to widen the road prism could be treated like new construction and be prohibited in marbled murrelet conservation areas under Alternatives C, D, and G or restricted under Alternatives B, E, F, and H.

BLASTING

Adjusting the restrictions on blasting to allow rock production within the existing footprint of a rock pit, following daily timing restrictions, could reduce the need to develop new pits in other sensitive areas**.** Other rock pit activities such as stripping, ripping, and loading are not covered under the long-term conservation strategy. These activities all include the use of heavy equipment, and guidelines to address these activities could help minimize risks of disturbance to nesting birds.

4.9 Public Services and Utilities

This section describes the potential effects of the alternatives on DNR-managed lands used for providing public services such as energy production and communication.

Bonneville Power Administration Transmission Line Corridor (Upper Left to Center Right) Crossing State Trust Lands in the Green River Area Northwest of Enumclaw. (South Puget HCP Planning Unit)

Analysis Questions

- *Would the alternatives affect siting, management, maintenance, or in-kind replacement of existing communication and energy-related uses?*
- *Would the alternatives reduce high-potential opportunities for DNR to sell additional rights-of-way and leases for new or expanded communications and energy-related uses?*

Evaluation Criteria

The criteria for communications and energy-related uses is that safety and reliability of existing facilities are maintained, state trust revenues are retained, and opportunities for development of high-potential future uses are not irretrievably lost.

The specific performance standards for meeting these criteria are as follows:

- Consistency between murrelet conservation measures (as defined in the alternatives) and existing uses of or contractual agreements for communication and energy-related leases.
- Continuation of access to existing rights-of-way or communication sites.
- Sustained ability to maintain, repair, and replace existing transmission lines or communication facilities as needed to ensure reliability and safety.
- Ability to develop new or expanded transmissions lines, telecommunication sites, and high-potential energy resources consistent with murrelet conservation measures.

Scale of Analysis

General effects of the alternatives on utilities, communications, and energy-related facilities are considered for the analysis area as a whole. Where existing major facilities or potential future uses are located adjacent to specific marbled murrelet conservation areas, effects are noted at the HCP planning unit scale.

How Impacts Are Measured

Potential adverse impacts on communication and energy-related infrastructure and uses are expressed with the following measures:

- Location and extent of marbled murrelet conservation areas adjacent to existing and high-potential future communications and energy-related uses, including transmission lines and oil and gas leases.
- Adequacy of the 1997 HCP to address effects on marbled murrelet habitat from high-potential new uses and from management, maintenance, replacement, or expansion of existing uses.

In addition, the analysis considers qualitatively the status and trends of leases and easements with the amount of marbled murrelet conservation and the conservation measures proposed for each alternative as a general indicator of potential constraints on DNR sales of leases and rights-of-way.

■ Summary of Direct, Indirect, and Cumulative Impacts

Effects of Alternatives on Utility Rights-of-Way

EXISTING RIGHTS-OF-WAY

Increasing marbled murrelet conservation areas on state trust lands could potentially restrict the timing of maintenance and repair activities within existing rights-of-way. Restrictions are most likely where marbled murrelet conservation areas would be established adjacent to existing rights-of-way.

In such areas, transmission line maintenance work, such as vegetation clearing and helicopter-based inspections or transport of materials, would need to follow aerial activity distance thresholds and daily timing restrictions during the marbled murrelet nesting season.

DNR currently does not have all utility corridors mapped, so a complete analysis of where proposed marbled murrelet conservation areas are located near existing corridors could not be done. The agency does have updated data on Bonneville Power Administration transmission line corridors, which cross approximately 118 miles of DNR-managed lands in the analysis area. Table 4.9.1 illustrates the portion of Bonneville Power Administration rights-of-way that currently are located near proposed marbled murrelet conservation areas.

Table 4.9.1. Approximate Mileage of Bonneville Power Administration Rights-of-Way Potentially Affected by Marbled Murrelet Conservation Measures Described in Chapter 2

	Alternative							
	A	B	C	D	E	F	G	H
Miles	8.3	9.3	10.9	9.3	10.9	9.3	10.9	9.3
Portion of Total miles of BPA rights-of-way in analysis area	7%	8%	9%	8%	9%	8%	9%	8%

Most of these corridors do not travel directly through marbled murrelet conservation areas. The most notable overlap of corridors and proposed conservation is located in the following areas:

- The North Puget HCP Planning Unit near Goldbar (U.S. Route 2)
- South Puget HCP Planning Unit in the Green River Watershed (near Enumclaw)
- South Coast HCP Planning Unit east of the Long Beach Peninsula

Only the area in the South Coast HCP Planning Unit would have additional marbled murrelet conservation areas designated on both sides of an existing Bonneville Power Administration corridor. Alternatives C through H include conservation areas around the same corridor east of the Long Beach Peninsula. The length of the corridor included in the conservation area varies by alternative, with a maximum of about 2.5 miles (1.6 kilometers) under Alternative F.

Based on the conservation measures proposed, additional marbled murrelet conservation is not likely to substantially interfere with the ability of utility companies or other easement-holders to maintain system operations, reliability, and safety within the analysis area.

REPLACEMENT PROJECTS AND NEW RIGHTS-OF-WAY

All transmission line structures (for example, steel towers or H-frame wood poles) at some point require replacement. Replacement projects generally involve replacing individual structures, sometimes involving additional clearing in the right-of-way to accommodate larger structures.

New transmission projects also may be planned to meet new or increased energy demands. New projects often occur within and adjacent to existing rights-of-way. Therefore, potential future constraints on transmission line expansion are most likely to occur in

The Radar Ridge Communication Site in Pacific County (South Coast HCP Planning Unit). Photo: DNR areas where marbled murrelet conservation areas would be established adjacent to an existing transmission corridor.

In addition, replacement projects may require expansion of the existing road networks. Alternatives C, D, and G would restrict new road construction within marbled murrelet conservation areas, which could cause conflicts for accessing facilities. Alternatives B, E, F and H provide more potential flexibility to construct roads using a consultation process between DNR and USFWS.

Effects of Alternatives on Leases for Communications and Energy-Related Facilities

Chinook Helicopter Transports a Replacement Structure to a Remote Portion of a Transmission Line Photo: Bonneville Power Administration

COMMUNICATION SITES

Effects of the action alternatives on existing communication sites within the analysis area are limited to distance thresholds for helicopter-based inspections, maintenance, or repairs. Between 0 and 3 existing sites currently are located within proposed marbled murrelet conservation areas. Proposed conservation measures could affect the timing of maintenance and repair activities at these sites. Review and consultation between DNR and USFWS may be necessary to avoid disturbance impacts from these activities, if they must be conducted during the nesting season.

New leases for communication sites will be limited in occupied sites, special habitat areas, and the 0.5-mile buffers on occupied sites within emphasis areas under the proposed conservation measures for all action alternatives. Consultation between DNR and USFWS will be necessary to avoid impacts to habitat in these areas. Specific sites anticipated for new leases cannot be known at this time. Given the amount of land still available for new leases within the analysis area and the availability of existing sites to co-locate new services, new leases are not anticipated to be a major impact to public communication services.

GEOTHERMAL ENERGY PRODUCTION AND OIL AND GAS LEASES

No planned or other reasonably foreseeable geothermal energy sites or oil and gas leases are located within existing or potential new marbled murrelet conservation areas. While Alternatives C through H would increase restrictions on geothermal and oil and gas leases over existing levels, there are no proven or high-potential energy resources that would be irretrievably lost due to any of the alternatives.

Cumulative Effects

Additional restrictions on DNR-managed lands due to marbled murrelet conservation areas that would occur under Alternatives C through H (particularly Alternative F) would add to the extensive set of environmental restrictions that already apply to rights-of-way and leases for communications and energy-related uses. However, due to the relatively small number of acres affected and the existing consultation process used by DNR and USFWS (the Joint Agencies), none of the alternatives are expected to contribute significantly to the cumulative regulatory burden of rights-of-way and leases for communications and energy-related uses.

Table 4.9.2. Summary of Potential Impacts on Public Services and Utilities

Key questions	Criteria	Measure	Potential impacts
Would the alternatives constrain management, maintenance, or in-kind replacement of existing communication and energy-related uses?	Safety and reliability of existing facilities is maintained. Continued ability to produce revenue. Consistency with marbled murrelet conservation. Continued access to existing infrastructure. No substantive reduction in ability to maintain, repair, and replace existing transmission lines or communication facilities as needed to ensure reliability and safety.	Location and extent of additional marbled murrelet conservation areas adjacent to existing and high-potential future communications and energy-related uses.	The addition of marbled murrelet conservation areas and conservation measures may complicate ongoing maintenance, repairs, replacement, and expansion of some communications and energy-related facilities. The review and consultation process provided by the conservation measures should be able to address these complications.
Would the alternatives reduce high-potential opportunities for DNR to sell additional rights-of-way and leases for new or expanded communications and energy-related uses?	Opportunities for development of high-potential future uses are not irretrievably lost.	Consider status and trends of leases and easements, together with the amount of additional marbled murrelet restrictions for each alternative, as general indicators of potential constraints on DNR sales of leases and rights-of-way.	No recognized high-potential sites are located within proposed marbled murrelet conservation areas. However, habitat that develops under the alternatives may become unavailable for communications and energy-related uses where DNR has discretion or authority over siting.

4.10 Environmental Justice

This section describes the potential effects of the alternatives on low-income or minority populations.

■ Analysis Questions

Would the action alternatives result in disproportionately high and adverse impacts on low-income or minority populations?

■ Evaluation Criteria

The criterion for environmental justice is whether the action alternatives would result in disproportionately high and adverse impacts on low-income or minority populations.

Specific measures for evaluating these criteria are as follows:

- Adverse human health effects, including effects on air quality, water quality, noise pollution, traffic, aesthetics, or quality of life, are not disproportionately high and adverse for low-income or minority populations.
- Adverse economic effects do not reduce the economic viability of low-income or minority communities or populations.

Scale of Analysis

Environmental justice issues are considered at the scale of the analysis area for general trends and effects on Hispanic and American Indian communities. The analysis looked for counties that contain both (a) higher than average low-income or minority populations (relative to other counties within the analysis area) and (b) relatively high amounts of state trust lands that would be deferred from harvest under one or more of the alternatives.

Effects related to employment are related to the analysis conducted in Section 4.11, "Socioeconomics." Issues related to traditional tribal access and uses of state trust lands are addressed in Section 4.12, "Cultural Resources."

How Impacts are Measured

The potential for adverse human health effects is measured qualitatively based on the degree to which resources related to human health would be affected, including air and water quality, noise, and the visual environment.

The magnitude of effects is measured by acres of marbled murrelet-specific conservation. The context of local and regional economies is measured with a qualitative review of the literature to determine (a) general occupational and employment conditions and trends for low-income and minority workers, and (b) the degree to which forest-related work contributes to those conditions and trends.

Impacts related to reduced trust payments and potential indirect effects on low-income and minority communities are based on the analysis presented in Section 4.11, "Socioeconomics."

■ Summary of Direct, Indirect, and Cumulative Impacts

Adverse Human Health Effects

The alternatives evaluate varying amounts of marbled murrelet conservation. None of the alternatives would generate toxic waste; air, water or noise pollution; traffic congestion or hazards; or visual blight or otherwise cause environmental harm or risks to human health to any individuals or communities, including low-income or minority communities.

Adverse Economic Effects

HARVEST OF FOREST GREENS AND OTHER NON-TIMBER RESOURCES

Low-income or minority collectors of forest greens are not likely to be disproportionately affected by any of the alternatives. None of the alternatives propose further restrictions on the harvest of forest greens and other non-timber resources. The potential reduction in access to forest green harvest sites due to limitations on road and trail building in marbled murrelet conservation areas under Alternatives C through H is minor in relation to the amount of available collection sites located throughout private, state, and federal forestlands within the analysis area.

TIMBER-RELATED LABOR

Depending upon the alternative, various amounts of land will be available for the full range of management options (refer to Section 4.11, "Socioeconomics"). Some alternatives have more restrictions on timber harvest than others. As described in Section 4.11, Pacific and Wahkiakum counties have the highest potential for reduced timber harvest, and low economic diversity, resulting in potential loss of income to low-income and minority populations. For these two counties, all action alternatives, with the exception of Alternative B, would result in a higher amount of dedicated acreage for marbled murrelet conservation. Pacific and Wahkiakum counties do not have minority or low-income populations higher than the average among counties in the analysis area. Although minority and low-income populations could be negatively affected, the effect will not vary or result in a disproportionate impact from the impact on the rest of the population.

In the context of the more than 2 million acres of private, state, and federal forestlands located in these counties, the expected change in timber harvest is relatively small. The volume of timber harvested on

DNR-managed lands would be reduced, which means fewer workers would be needed on those lands. However, thinning would still be allowed throughout long-term forest cover, with the exception of special habitat areas (under Alternatives C, D, and E) and occupied sites. This work likely would provide economic opportunities for members of low-income and minority communities.

INDIRECT IMPACTS: GOVERNMENT SERVICES FOR LOW-INCOME AND MINORITY POPULATIONS

As discussed in Section 4.11, "Socioeconomics," all counties that have a reduction in acres available for harvest could experience a reduction in local revenues. Counties whose workforce is closely tied to logging, including Pacific and Wahkiakum, would be most affected by Alternatives C through H. This reduction in local revenues in turn could affect government services that may support low-income and minority populations. However, most government services that support low-income and minority populations are provided by state and federal funding rather than local funding, including government services such as Basic Food (food stamps), Supplemental Security Income, State Family Assistance, and the Employment Security Department programs.

Collectively, none of the alternatives is likely to cause disproportionately high and adverse economic effects on low-income or minority communities.

Table 4.10.1. Potential Impacts Related to Environmental Justice

Key questions	Criteria	Measures	Potential impacts
Would the alternatives result in disproportionately high and adverse impacts on low-income or minority populations?	Adverse human health effects, including effects on air quality, water quality, noise pollution, traffic, aesthetics, or quality of life, are not disproportionately high and adverse for low-income or minority populations. Adverse economic effects do not reduce the economic viability of low-income or minority communities or populations.	A qualitative review of the literature to determine general occupational and employment conditions and trends for low-income and minority workers.	None. The proposed action is focused on marbled murrelet conservation, and none of the alternatives would generate toxic waste; air, water or noise pollution; or traffic congestion or hazards or otherwise cause environmental harm or risks to human health to any individuals or communities, including low-income or minority communities. Alternatives C through H are expected to reduce demand for forest sector labor in western Washington. However, the distribution of such effects is not likely to cause disproportionately high and adverse economic effects on low-income or minority populations.

4.11 Socioeconomics

This section analyzes the potential impacts from the alternatives on social and economic values in the analysis area. The analysis questions cover three broad areas: government revenue, employment, and community values.

■ Analysis Questions

- *How do the action alternatives affect trust revenue over the life of the 1997 HCP?*
- *How do the action alternatives affect county and state government revenue from other sources over the life of the 1997 HCP?*
- *How do the action alternatives affect county employment levels over the life of the 1997 HCP?*
- *How do the action alternatives affect environmental services and non-timber economic activities over the life of the 1997 HCP?*

■ Evaluation Criteria

The action alternatives include proposed conservation measures that affect the operation and management of DNR-managed lands with marbled murrelet habitat in the analysis area. The alternatives do not provide a harvest schedule, which is a plan for future harvests.[19]

In this section, potential impacts to revenue are evaluated in a more generalized way by considering acres available for harvest. Over long time periods, such as a harvest rotation, revenue is related to the area available for harvest. The area available for harvest under each alternative is known. This analysis therefore is based on the change of acres available for harvest using a weighted "operable acre" unit (developed and used for this RDEIS analysis only). Operable acres are weighted by their assumed operability potential.

- Uplands with general management objectives are areas where the 1997 HCP, *Policy for Sustainable Forests*, and all relevant laws apply. They are weighted equal to their area in acres.
- Uplands with special objectives are areas where, in addition to general objectives, objectives such as northern spotted owl conservation or hydrologic maturity objectives apply. These acres are weighted at 55 percent of their area because harvest area or volume removal is limited.
- Riparian areas are weighted at 2 percent of their area based on the actual harvest level in these areas over the past ten years.[20]

[19] The long-term conservation strategy will have implications for DNR's sustainable harvest calculation. In a separate action, DNR is updating the calculation, with a separate process for environmental review that analyzes potential harvest levels associated with long-term conservation strategy alternatives. Refer to discussion in Chapter 1, page 1-6. The current version of the financial analysis for that process is included as Appendix P.

- Deferred areas, and non-operable areas such as natural area preserves and natural resource conservation areas, have a weight of 0 because no harvest occurs in these areas.

Scale of Analysis

The scale of analysis in this section varies. Impacts are assessed for counties, trusts, and the Washington State general fund. Impacts are assessed against trust lands in western Washington because of broadly similar operational and financial considerations with the analysis area.

How Impacts Are Measured

Potential impacts to trust revenue, employment, and taxes are evaluated in this analysis. The threshold used for this analysis is a 25 percent reduction in DNR-managed operable acres for most counties and trusts. This threshold is used because it is assumed that counties can accommodate changes in revenue potential of this magnitude. This level of change is allowed between decades in the sustainable harvest level in the *Policy for Sustainable Forest* (DNR 2006a, p.25). This policy was analyzed under SEPA (DNR 2004) and approved by the Board of Natural Resources.

For Pacific and Wahkiakum counties, the threshold is set lower because of the relatively poor economic conditions in these counties and the importance of timber from DNR-managed lands to these counties' economies. Daniels (2004) identified these counties as "DNR counties of concern." Daniels states that these counties "may experience difficulty adapting to changes in DNR forest management strategies." As described in Chapter 3, the economic conditions in Pacific and Wahkiakum counties have not changed markedly since the publication of Daniels (2004). Small reductions in revenue or employment in these counties is expected to have more impact on these counties than other counties.

The impact of the alternatives is expected to be adverse *if* the following criteria are met.

Trust Revenue

- **All trusts in the analysis area except Pacific and Wahkiakum State Forest Purchase and Transfer trusts**: Operable acres available for harvest in a trust decrease by more than 25 percent compared to Alternative A. A decrease of this magnitude is expected to result in a similar reduction in long-term revenue-generating capability.
- **Pacific and Wahkiakum State Forest Transfer and Purchase trusts**: Operable acres available for harvest in each of these trusts is lower than Alternative A, based on the threshold established for this analysis.

Employment

- **Each county in the analysis area except Pacific and Wahkiakum counties**: Operable acres in a county decrease by more than 25 percent compared to Alternative A.

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[20] Acre weightings used in the 2016 DEIS were revised based on an analysis of harvest rates for different land classes between fiscal years 2005 and 2016.

- **Pacific and Wahkiakum counties**: Operable acres in each of these counties is lower than Alternative A.
- **Analysis area**: Operable acres in western Washington decrease by more than 25 percent compared to Alternative A.

Forest Tax

- **Each county in the analysis area except Pacific and Wahkiakum counties**: Operable acres in a county decrease by more than 25 percent compared to Alternative A, and forest tax distributions to the county are equal to at least ten percent of the sales tax distribution.
- **Pacific and Wahkiakum counties**: Operable acres in each of these counties is lower than Alternative A.
- **Analysis area**: Operable acres in western Washington decrease by more than 25 percent compared to Alternative A.

Sales and Other Taxes

- There is high uncertainty regarding the impact of the change in operable acres available for harvest on these tax revenues at the county and state level.

Impacts less than the thresholds described in the preceding list are expected to be negligible.

Key Assumptions

The analysis assumes that each operable acre can generate the same amount of timber volume in the same amount time and that the potential revenue of the timber is the same. In reality, site potential varies across the landscape. Due to the scale of the analysis and the spatial similarity between the alternatives, this variation is expected to be small. Harvest revenue depends on not only site potential, but also species composition, timber quality, management costs, operational difficulty, and availability of markets. For purposes of this generalized analysis, these factors are assumed to be similar between lands conserved under each alternative.

For county-level employment change impacts, two assumptions were made. One assumption is that, within a county, timber harvest volume is closely related to employment levels in timber-related jobs. Another assumption is that workers are not employed outside their home county.

■ Summary of Direct, Indirect, and Cumulative Impacts

Potential impacts to socioeconomics can be summarized under four general categories: trust revenue, tax revenue, employment, and environmental services and non-market values.

Trust Revenue

The analysis in this section compares the proposed alternatives to one another. Assumptions are made about trust revenues in order to make this comparison. These assumptions cannot be carried through to a detailed analysis of local employment impacts or forest tax impacts, but some general conclusions can be reached. Assumptions are stated in the following sections.[21]

IMPACTS TO TRUST REVENUE FROM TIMBER HARVEST

One way to assess the different strategies is to calculate the "bare land value"[22] of lands conserved or released by the different action alternatives as compared to Alternative A. This calculation assumes that the same prescription is applied to all lands affected by the alternative. The prescription assumes that all lands are higher-productivity sites, and that each operable acre is planted with Douglas fir, Western red cedar, or Western hemlock and harvested in a variable retention harvest at age 50. This calculation does not take into account the value of the standing timber on these lands. Not including the value of the standing timber in the bare land value calculations underestimates the impacts to trust revenue. However, assumptions about the productively and rotation length overestimate the impacts if some areas have lower productivity, longer rotations, or lower harvest yields (refer to Appendix M).

Alternative B increases the number of operable acres available for harvest and therefore increases the bare land value of the trust compared to Alternative A. Alternatives C through H reduce the operable acres. The impacts to the trusts increase in this order: Alternative H, Alternative C, Alternative D, Alternative E, Alternative G, and Alternative F (Table 4.11.1).

Table 4.11.1. Change in Management and Bare Land Value From Alternative A

	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Bare land value change	$29 million	-$17 million	-$20 million	-$22 million	-$51 million	-$42 million	-$9 million

Another way to assess the impact is to look at the assumed annual value of timber sales that could have occurred in areas conserved under each alternative or that may occur in the released acres (Table 4.11.2). The analysis uses a similar set of assumptions. Specifically, the assumptions are that harvest volumes yield 32,000 board feet per acre, that the sale price of the timber is $350 per thousand board feet, and that 1/50 of the operable acres are harvested each year.

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[21] DNR's sustainable harvest calculation process analyzes potential harvest levels, including more detailed financial analysis. Refer to Appendix P.

[22] Bare land value (BLV) assesses the present net worth of an infinite number of successive, identical timber harvest rotations. As calculated here, the resulting value does not include any indication of the value of non-timber or non-market values. Revenue sources other than timber harvests could be included in the calculation, if applicable. BLV is calculated as: $BLV = \frac{NFW}{(1+i)^n-1}$, where net future worth (NFW) is calculated as the sum of the future revenue and costs of one rotation, with both revenue and costs compounded until the end of the rotation, i is the annual discount rate, and n is the number of years in a rotation. Note that this calculation assumes that the cost, revenue, and rotation length do not change over time.

Alternatives B through H would provide greater implementation certainty for management than Alternative A. The anticipated result of greater implementation certainty is lower management costs. The magnitude of the reduction in costs is depends on the magnitude of future regulatory changes. Since these changes are not known, the benefit of implementation certainty is not known, but could be substantial.

Table 4.11.2. Change in Estimated Total Value of Timber Sales, by Action Alternative

Assuming Each Operable Acre Yields 32,000 Board Feet per Acre, the Sale Price of the Timber is $350 per Thousand Board Feet, and 1/50 of the Operable Acres Are Harvested Each Year.

	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
Timber sale value change	$ 4 million	-$3 million	-$3 million	-$3 million	-$8 million	-$6 million	-$1 million

CHANGES IN OPERABLE ACRES BY TRUST

For this analysis, lands are grouped either by trust (for the federally granted trusts[23]) or by benefiting county (for State Forestlands[24]). Tables 4.11.3, 4.11.4, and 1.12.5 show the trusts for which the operable acres in western Washington are significantly reduced. The impacts of the action alternatives to trusts and benefiting counties are as follows:

- **Alternative B:** No adverse impacts to any trust, or trust and benefiting county combination. For all trust or trust and benefiting county combinations, the area with a full range of management options either does not change or increases compared to Alternative A.
- **Alternatives C, D, E, and G:** Pacific County State Forest Transfer, Pacific County State Forest Purchase, and Wahkiakum County State Forest Transfer trusts are adversely impacted.
- **Alternative F:** Pacific County State Forest Transfer, Pacific County State Forest Purchase, Wahkiakum County State Forest Transfer, and Whatcom County State Forest Transfer trusts are adversely impacted.
- **Alternative H:** Pacific County State Forest Transfer and Pacific County State Forest Purchase trusts are adversely impacted.

[23] Trusts supported by State Lands, which are lands granted to the state by the Federal government at statehood through the Omnibus Enabling Act of 1889.
[24] State Forest Purchase and State Forest Transfer Lands are combined for this analysis.

Table 4.11.3. Change in Operable Acres Available for Harvest in the Federally Granted Trusts

	Trust(s)	Alt. A (no action) Operable acres	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
			% changes in acres available compared to Alternative A						
Federally granted trusts	Agricultural School Grant	13,000	1%	0%	0%	-1%	-9%	-2%	-1%
	Capitol Building Grant	35,000	5%	-3%	-3%	-3%	-7%	-8%	-1%
	CEP&RI and CEP&RI transferred	16,000	3%	-4%	-6%	-4%	-9%	-4%	0%
	Common School and Escheat	229,000	3%	-2%	-2%	-2%	-6%	-6%	-1%
	Normal School	13,000	4%	-5%	-4%	-6%	-3%	-6%	-4%
	Scientific School Grant	24,000	2%	-2%	-1%	-2%	-16%	-6%	-1%
	University Grant (original and transferred)	17,000	7%	-12%	-20%	-17%	-10%	-18%	-11%
Other lands	Community College Forest Reserve	2,700	0%	0%	0%	0%	-2%	0%	0%
	Community Forest Trust	0	0%	0%	0%	0%	0%	0%	0%
	Land Bank	0	0%	0%	0%	0%	0%	0%	0%
	Water Pollution Control Division Trust Land	3,900	0%	-2%	0%	-2%	0%	-2%	0%
	Other	1	0%	0%	0%	0%	0%	0%	0%

Table 4.11.4. Change in Operable Acres Available for Harvest in the State Forest Trust Transfer Lands by County

State Forest Transfer Trust	Alt. A (no action) Operable acres	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
		% changes in acres available compared to Alternative A						
Clallam County	46,000	9%	1%	3%	-1%	4%	-3%	1%
Cowlitz County	7,000	0%	0%	0%	0%	0%	0%	0%
Grays Harbor County	1,600	4%	4%	4%	4%	-2%	4%	4%
Jefferson County	10,000	3%	2%	2%	2%	2%	2%	2%
King County	10,000	0%	-1%	0%	-1%	-3%	-1%	0%
Kitsap County	4,400	0%	0%	0%	0%	0%	0%	0%
Lewis County	21,000	0%	0%	0%	0%	-1%	0%	0%
Mason County	18,000	0%	0%	0%	0%	0%	0%	0%
Pacific County	7,400	9%	-6%	-11%	-6%	-17%	-6%	-2%
Pierce County	2,900	0%	-1%	0%	-1%	-5%	-1%	0%
Skagit County	43,000	0%	-2%	-1%	-2%	-4%	-3%	-1%
Snohomish County	36,000	0%	-2%	-2%	-2%	-5%	-4%	-1%
Thurston County	14,000	1%	1%	1%	1%	1%	1%	1%
Wahkiakum County	6,000	20%	-10%	-14%	-10%	-27%	-16%	7%
Whatcom County	15,000	0%	-3%	-3%	-4%	-25%	-6%	-1%
Total	242,000	3%	-1%	-1%	-1%	-3%	-3%	0%

Table 4.11.5. Change in Operable Acres Available for Harvest in the State Forest Purchase Trust Lands, by County

State Forest Purchase Trust	Alt. A (no action) Operable acres	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
		% changes in acres available compared to Alternative A						
Clallam County	140	14%	-5%	-5%	-5%	4%	-5%	-5%
Cowlitz County	170	0%	0%	0%	0%	0%	0%	0%
Grays Harbor County	20,000	2%	2%	2%	2%	2%	2%	2%
Jefferson County	10	0%	0%	0%	0%	0%	0%	0%
Kitsap County	50	0%	0%	0%	0%	0%	0%	0%
Lewis County	2,200	0%	0%	0%	0%	0%	0%	0%
Mason County	240	0%	0%	0%	0%	0%	0%	0%
Pacific County	3,500	8%	-24%	-42%	-24%	-36%	-24%	-23%
Pierce County	1,300	0%	0%	0%	0%	0%	0%	0%
Skagit County	1	0%	0%	0%	0%	0%	0%	0%
Snohomish County	1,300	0%	0%	0%	0%	0%	0%	0%
Thurston County	16,000	0%	0%	0%	0%	0%	0%	0%
Whatcom County	620	0%	0%	0%	0%	-10%	-10%	0%
Total	46,000	1%	-1%	-3%	-1%	-2%	-1%	-1%

Tax Revenue

FOREST TAX

Changes in harvest levels have direct impacts on the annual forest tax liability of operators on state trust lands. Harvest volume is expected to either remain the same or increase in each county in the analysis area under Alternative B relative to Alterative A. Forest tax revenue will increase commensurately, assuming no change in the tax rate or timber value. Under Alternatives C, D, E, F, G and H, forest tax distributions from timber harvests on state trust lands are expected to decrease significantly in Pacific and Wahkiakum counties based on the reduction in area available for harvest. The impacts to Pacific County increase in this order: Alternative H, C, E, G, D, and F. Impacts to Wahkiakum County increase in a slightly different order: Alternative H, C, E, D, G, and F.

All alternatives have a negligible impact on the operable acres of state trust lands subject to the forest tax in western Washington. Therefore, impacts to the state of Washington general fund are expected to be negligible.

SALES AND OTHER STATE AND LOCAL TAXES

Counties and the State of Washington receive revenue from sales and other taxes. The revenue from these taxes depends on factors including the tax rate, population, employment, wages, expenditures made by visitors within the county and availability of retail outlets in a county, among other factors. Reduced harvest levels may reduce tax revenue by reducing employment and expenditures by businesses within a county. The impact of harvest reduction on tax revenue is expected to be greatest in counties where timber harvest is a larger component of the total economic activity in the county.

Pacific and Wahkiakum counties are more reliant on timber harvest than other counties in the analysis area. Alternative B is expected to increase harvest in these counties over the no action alternative and therefore result in increased tax revenue in these counties. Revenue is expected to fall in Pacific county under the other alternatives, with impacts to revenue increasing in the following order: Alternative H, C, E, G, D, and F. In Wahkiakum County, the order of impacts from smallest to greatest is Alternative H, C, E, D, G, and F. However, the degree to which these impacts may occur cannot be determined because the relationship between harvest levels and taxable sales and property values in the counties is not known.

Other counties are more economically diversified and less dependent on timber harvest. Any change in tax revenue due to any of the alternatives is expected to be relatively minimal in these counties compared to their sales tax revenues. All alternatives have only a small effect relative to sales taxes from all economic activity in the state; therefore, impacts to the State of Washington general fund are expected to be minimal.

Tax revenue from economic activity on DNR-managed forestlands from sources other than timber harvest (for example, recreation) is not expected to change significantly under any action alternative. Any increases in tax revenue related to other land uses on DNR-managed lands likely will be insufficient to replace tax revenues lost under Alternatives C through H.

Employment

Potential impacts to employment are measured based on the expected change in operable acres. For the analysis area, the change in operable acres ranges from an increase of 3 percent under Alternative B to a decrease of 7 percent under Alternative F (Table 4.11.6).

Table 4.11.6. Change in Operable Acres in the Analysis Area, Compared to Alternative A

State Trust Lands in Analysis Area	Alt. A (no action)	Alt. B	Alt. C	Alt. D	Alt. E	Alt. F	Alt. G	Alt. H
	Operable acres	% changes in acres available compared to Alternative A						
Change in operable acres (percent)	643,000	20,000 (3%)	-11,000 (-2%)	-13,000 (-2%)	-15,000 (-2%)	-34,000 (-5%)	-28,000 (-4%)	-6,000 (-1%)

The harvest level is expected to increase relative to Alternative A (no action) under Alternative B. Employment may increase commensurately, if only slightly. Harvest levels are expected to fall under Alternatives C through H. Adverse impacts are expected in Pacific and Wahkiakum counties under Alternatives C through H due to decreased harvest volume. The impact of Alternative H on Pacific and Wahkiakum counties is expected to be less than alternatives C, D, E, F, or G. Declines in employment in these counties could be locally mitigated if the alternative results in more acres of thinning because thinning requires more labor per unit of volume to harvest (Mason and Lippke 2007). However, mill employment may be reduced if volume from thinning is less than from variable retention harvests. Additionally, Alternatives C through H decrease the area available for thinning; therefore, employment increases due to increased thinning are not expected.

Environmental Services and Non-Market Values

CARBON SEQUESTRATION

All the alternatives are expected to increase the amount of carbon sequestered on DNR-managed lands at a similar rate over the life of the 1997 HCP (refer to Section 4.2, "Climate"). As no alternative proposes the sale of carbon credits, no revenue is expected to be generated for the trusts by carbon sequestration.

OTHER NON-TIMBER LAND USES

It is uncertain how the action alternatives will change how people value non-timber social, environmental, and economic resources. However, because the action alternatives are designed to support the long-term survival of the marbled murrelet, a neutral or positive valuation is expected.

The analysis of impacts to recreation (refer to Section 4.7, "Recreation') shows that the action alternatives do not have a measurable, negative impact on recreation in the analysis area. For mining and other leases, the action alternatives may reduce land available for new activities, but no immediate impacts to planned leases or easements are known since known locations for these leases are far from occupied sites.

The conservation measures associated with the action alternatives do not preclude collection of non-timber forest products, such as salal. Small changes to the annual harvest area and area of closed canopy forest are likely to occur under the action alternatives in the analysis area. These changes will not significantly lessen the availability of non-timber forest products on state trust lands. Therefore, no significant impacts to trust revenue or the public's economic wellbeing due to effects of any of the marbled murrelet long-term conservation strategy on the collection of non-timber forest products is expected.

Cumulative Effects

Alternative B, by increasing the number of operable acres available for harvest as compared with Alternative A, is expected to result in stable or increased harvests levels for all trusts and in all counties in the analysis area, stable or increased revenue for all trust beneficiaries with lands within the analysis area, and stable or increased tax revenue and employment in counties within the analysis area.

By decreasing the number of operable acres available for harvest, Alternatives C, D, E, F, G and H are expected to result in stable or decreased harvest levels on most trusts and in all counties in the analysis area, stable or decreased revenue for most trust beneficiaries with lands within the analysis area, and stable or decreased tax revenue and employment in counties within the analysis area. Revenue from State Forest Purchase and Transfer trust lands is distributed in accordance with RCW 79.64.110. DNR generates the revenue and distributes it to the counties in which the land is located. Counties further distribute funds to taxing districts and local services; therefore, reduced revenues expected under these alternatives could impact these services.

Pacific and Wahkiakum counties are adversely impacted by Alternatives C through H. Under these alternatives, these two counties can expect reduced revenue and employment based on the thresholds established for this analysis. Because these counties currently have low socioeconomic resiliency and below-average economic diversity, and are more heavily dependent on timber harvest for local government revenue, the economies of these counties are less able than other counties to tolerate a reduction in harvest volume.

Analysis Uncertainty

The distribution of marbled murrelet conservation areas, combined with existing conservation, results in potentially operable (harvestable) acres being scattered across the landscape. As a result, forest management activities may be constrained due to operational costs or inaccessibility (for example, if a harvestable stand is located on the other side of a large block of marbled murrelet conservation). Depending on the frequency of this occurrence, the potential for decreased revenue under Alternatives C through H could be higher than anticipated. Likewise, Alternative B may not yield the expected increase in revenue compared to Alternative A.

Table 4.11.7. Summary of Potential Impacts to Socioeconomics

Key questions	Criteria	Measures	Potential impacts
How do the alternatives affect trust revenue over the life of the 1997 HCP?	Operable acres available.	Change in operable acres; reduction in operable acres by over 25% considered adverse.	Overall decreased trust revenue. This impact is adverse for the Pacific County State Forest Transfer, Pacific County State Forest Purchase, and Wahkiakum County State Forest Transfer trusts under Alternatives C, D, E, and G.

Key questions	Criteria	Measures	Potential impacts
			Alternative F adversely impacts Pacific County State Forest Transfer, Pacific County State Forest Purchase, Wahkiakum County State Forest Transfer, and Whatcom County State Forest Transfer trusts. Alternative H adversely impacts Pacific County State Forest Transfer and Pacific County State Forest Purchase trusts.
How do the alternatives affect county and state government revenue from other sources over the life of the 1997 HCP?	Operable acres available.	Change in operable acres.	Overall decreased trust revenue. This impact is likely adverse for Pacific and Wahkiakum counties under Alternatives C through H.
How do the alternatives affect county employment levels over the life of the 1997 HCP?	Operable acres available.	Change in operable acres. Portion (%) of county in harvest-related employment.	Decreased employment is possible in Pacific and Wahkiakum counties under Alternatives C through H.
How do the alternatives affect environmental services and non-timber economic activities over the life of the 1997 HCP?	Opportunities available.	Change in opportunities.	No measurable impacts identified.

Potential Mitigation for Adverse Impacts

The Washington state legislature has authorized the transfer or disposition of certain state trust lands encumbered with long-term deferrals due to Endangered Species Act-listed species. Encumbered State Forest Lands in counties with a population of 25,000 or less, which includes Pacific and Wahkiakum counties,[25] may be transferred into natural resource conservation areas (DNR 2013, RCW 79.22.060, 79.22.140.). The transfer requires compensation to the trusts at fair market value without consideration of the endangered species encumbrances. The counties' beneficiaries receive the appraised timber value, less a management fee, at the time of transfer while the land value must be used to purchase replacement State Forest lands that can generate revenue.

The Washington State Legislature directed the Commissioner of Public Lands to appoint a marbled murrelet advisory committee (Laws of 2018, Ch. 255). This committee is tasked with developing recommendations that achieve the following:

[25] The State Forest Replacement Lands Program also applies to Skamania and Klickitat counties, which are outside the analysis area.

- Support maintaining or increasing family-wage timber and related jobs in the affected rural communities;
- Ensure no net loss of revenue to the trust beneficiaries due to the implementation of addition marbled murrelet conservation measures;
- Provide additional means of financing county services; and
- Contain additional, reasonable, incentive-based, non-regulatory conservation measures for the marbled murrelet that also provide economic benefits to the rural communities.

Implementation of recommendations from this committee may reduce the adverse socioeconomic impacts of some of the alternatives.

4.12 Cultural and Historic Resources

This section considers whether any of the alternatives would unintentionally affect cultural resources.

Analysis Questions

The primary questions addressed regarding cultural resources are the following:

- *Do cultural and historic sites remain protected under the action alternatives?*
- *How would access to cultural resources be affected by the action alternatives?*
- *How would traditional cultural materials and foods, such as fish, wildlife, and plants, be affected by the action alternatives?*

Evaluation Criteria

The primary criterion for cultural and historic resources is that significant sites, access, or materials would not be damaged or destroyed as a result of the alternatives.

Scale of Analysis

Effects on cultural resources are considered at the programmatic level for the analysis area.

How Impacts Are Measured

Impacts will be measured based on a qualitative review of the potential for actions considered under the alternatives to adversely affect cultural and historic resources.

Summary of Direct, Indirect, and Cumulative Impacts

No significant impacts to cultural and historic resources are anticipated under any of the action alternatives. These resources typically are identified by DNR and protected as part of project planning for timber sales and other forest management activities such as construction of recreational trails or communication sites.

Site Protection

Pelton Wheel, Used to Power Historic Mines in DNR's Northwest Region. Photo: DNR

The primary threat to cultural and historic sites is timber harvest and associated road construction and subsequent public access and uses. All action alternatives include measures restricting timber harvest in long-term forest cover and limiting road construction and new recreational facility development in marbled murrelet conservation areas. Alternatives C through H increase the total amount of long-term forest cover compared to the action alternative. Alternative B, while resulting in fewer total acres of long-term forest cover, adds 7,000 acres of occupied sites where harvest would be prohibited.

All action alternatives also would make some currently deferred lands available for potential harvest (refer to Chapter 2, Figure 2.4.1). Alternatives C through H would remove long-term forest cover designation from 1,000 to 4,000 acres in the marbled murrelet marginal landscape and other marbled murrelet high value landscapes, while Alternative B would remove long-term forest cover designation from approximately 24,000 acres in the analysis area (most in the OESF HCP Planning Unit). While change could result in more access to currently unidentified or inaccessible cultural and historic sites within these areas, potential impacts would be addressed under the current regulatory framework at the project-specific level. Existing DNR cultural resource protection procedures would be expected to identify and avoid significant adverse impacts from harvesting stands that are currently deferred under the interim strategy.

Access

Ongoing tribal access and use of DNR-managed lands for collection of traditional cultural materials and food (for example, cedar bark, bear grass, and berries) is not limited under the proposed action alternatives. This type of access is typically coordinated via consultation with regional staff or DNR's tribal liaison office, and this process would be unchanged under a long-term conservation strategy. Where existing roads may be abandoned in proposed marbled murrelet conservation areas, it is possible that some local access issues could occur. It is expected that existing tribal consultation practices would continue to address site-specific access issues.

Traditional Cultural Materials and Foods

Forest stand conditions would be altered over time within lands designated as long-term forest cover, and these changes are likely to alter the abundance and availability of certain traditional materials. Some, such as cedar wood and bark, may increase within long-term forest cover, while others, such as berries, may decrease within areas of mature and maturing forest. While localized changes in habitat conditions may temporarily reduce forage for important species such as deer and elk within long-term forest cover, overall abundance and distribution of culturally important species and other traditional materials would likely remain stable or increase on state trust lands (refer to Section 4.5, Wildlife).

Conclusions

The alternatives are focused on varying levels of long-term forest cover for marbled murrelet conservation purposes, and none of the alternatives would result in direct harm to any cultural resources. Effects that may occur later in time, as projects are implemented under the strategic direction established in the alternative selected, would be addressed through DNR's existing archaeological assessment work and tribal consultation. The effects identified are not sufficiently significant to contribute to cumulative effects related to cultural and historic resources.

Table 4.12.1. Summary of Potential Impacts to Cultural and Historic Resources

Key questions	Criteria	Measures	Potential impacts
Do cultural and historic sites remain protected by the alternatives?	Significant historic, archaeological, and cultural sites would not be damaged or destroyed.	Qualitative.	None. Effects are addressed at the project-specific level (for example, plans for specific thinning operations).
How would access to cultural resources be affected by the alternatives?	Tribal access to the forest would not be lost.	Qualitative.	Some existing roads within marbled murrelet conservation areas may be abandoned under all action alternatives, which could interfere with access to some areas. In areas where access currently is limited under Alternative A, some new roads may be built under the action alternatives, which could increase public access to tribal use areas and/or physically harm unknown cultural or historic sites. However, road locations are assessed for cultural and historic resource impacts at the project-specific level prior to construction, so damage to cultural or historic sites is not expected.
How would traditional cultural materials and foods, such as fish, wildlife, and plants, be affected by the alternatives?	Supplies of culturally important resources would not be lost.	Qualitative.	Changes in habitat conditions over time in long-term forest cover may reduce forage habitat locally for some game species, but overall abundance and distribution of species would remain stable or increase on state trust lands (refer to Section 4.5, "Wildlife"). Fish resources are not expected to be impacted (refer to Section 4.4, "Aquatic Resources").

4.13 Summary of Potential Impacts to Elements of the Environment

Impacts evaluated in this RDEIS relate primarily to the acres of long-term forest cover provided by each action alternative and the proposed conservation measures (for example, measures proposed for thinning, recreation, and road construction).

Compared to the no action alternative, Alternative B would decrease the area of long-term forest cover by 24,000 acres (approximately 2 percent of DNR-managed forestland in the analysis area). Alternatives C through E would increase long-term forest cover by 17,000 to 22,000 acres, Alternative F would increase this area by 142,000 acres, Alternative G would increase long-term forest cover by 43,000 acres and Alternative H would increase it by 10,000 acres.

■ Natural Environment: Earth, Climate, Aquatic Resources, Vegetation, Wildlife, and Marbled Murrelets

Forests within long-term forest cover are expected to become more structurally complex through time and experience less active management. Elements of the natural environment are not expected to be adversely impacted by these changes. Soil resources and areas subject to landslide hazards would continue to be protected by existing DNR policies and procedures. The alternatives are not expected to exacerbate climate change impacts on any element of the environment, and carbon sequestration is expected to be greater than emissions under all alternatives.

Existing riparian protection strategies remain in place under all the alternatives, and aquatic functions are expected to be maintained or enhanced under all alternatives. Minor, localized impacts to microclimate are possible under Alternative B.

Some limitations on thinning (Alternatives C, D, and E) could delay some riparian or natural areas from meeting their restoration objectives within a shorter time frame. However, overall management objectives of the 1997 HCP, *OESF HCP Planning Unit Forest Land Plan*, and natural areas management plans are not impacted.

Many wildlife and plant species would benefit from an increase in structurally complex forest that will occur in long-term forest cover over the planning period. Wildlife diversity is likely to increase over time with all alternatives. Some local changes in habitat conditions may temporarily affect some species, but overall abundance and distribution of species, including listed and sensitive species (not including the marbled murrelet), would remain stable or increase on DNR-managed lands.

In areas where land would be "released" from its current conservation status, the existing framework of regulations, policies, and procedures designed to minimize the environmental impacts from active management would remain in place.

Impacts to Marbled Murrelet Habitat and Populations

Between 2001 and 2016, the marbled murrelet population declined at an average annual rate of 3.9 percent in Washington.[26] While the direct causes for ongoing marbled murrelet population declines are not completely known, the USFWS Recovery Implementation Team identified the most likely primary factors as the loss of inland habitat, including additive and time-lag[27] effects of inland habitat losses over the past 20 years; changes in the marine environment, reducing the availability and quality of prey; and increased densities of nest predators (USFWS 2012, Falxa and others 2016). Recent analysis indicates that the amount and distribution of higher suitability habitat are the primary factors influencing the abundance and trends of murrelet populations. Habitat loss has occurred throughout the listed range of the murrelet, with the greatest losses documented in Washington, where the steepest declines of murrelet populations occurred (Raphael and others 2016).

The final HCP amendment must meet the Section 10 issuance criteria for issuing an incidental take permit. Part of the analysis undertaken by USFWS when issuing an incidental take permit is to consider whether an alternative jeopardizes the continued existence of a species. "Jeopardize the continued existence" is defined in 50 CFR §402.02 as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." This determination is made when USFWS completes a biological opinion on the issuance of the take permit for the HCP amendment.

The Joint Agencies recognize the importance of protecting existing occupied marbled murrelet habitat and recruiting additional habitat in specific areas. The alternatives vary by providing differing levels of habitat protection and recruitment, coupled with some short-term habitat loss. The intent is to improve current population trends through conservation and recruitment of additional habitat on DNR-managed lands.

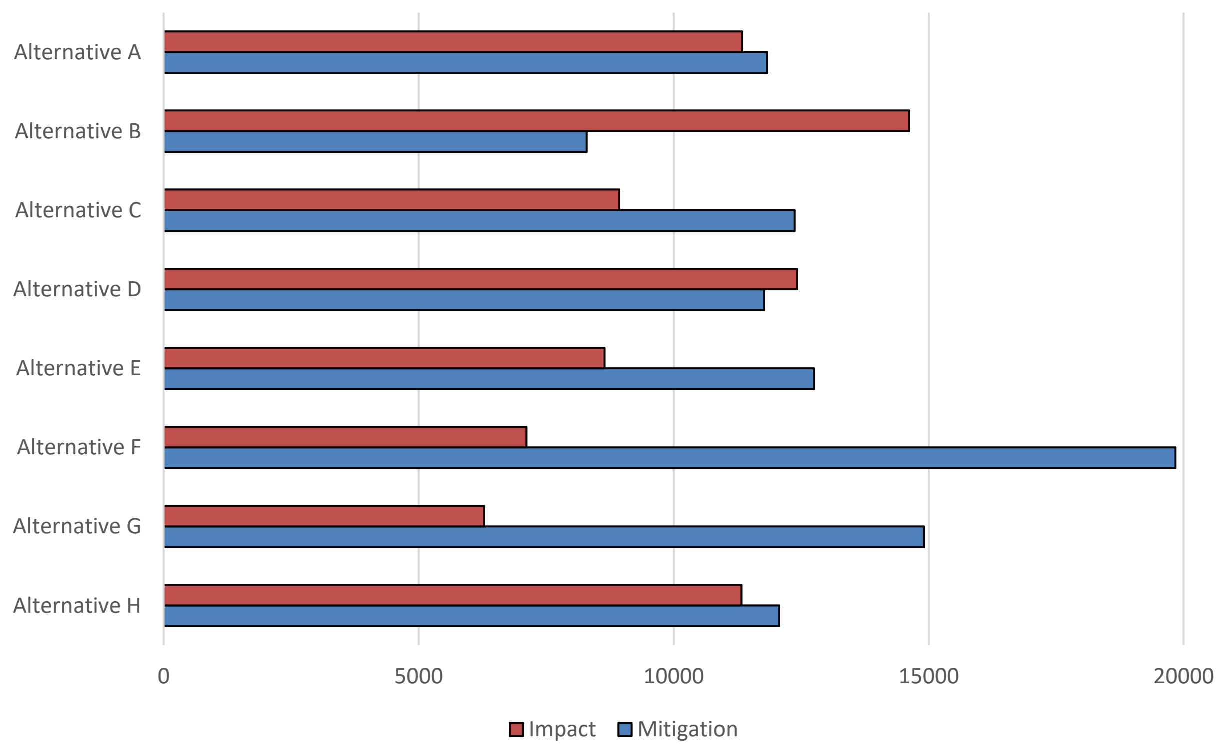
Two analytical approaches were used to evaluate the effects of the proposed alternatives on marbled murrelet habitat and populations. The acreage, quality (as influenced by stand condition and edge effects), and timing of habitat harvested and developed under each alternative provide a relatively direct measure of impacts. Potential consequences of each alternative relative to one other on the Washington murrelet population were evaluated with a population viability analysis model. This model explores two scenarios, both based on the assumption that habitat is the main influence on current population declines: 1) other factors compound the negative effects of insufficient habitat, making it difficult for murrelet populations to respond to increases in habitat availability (risk scenario), and 2) murrelet survival and reproduction are sufficient to allow for population growth as habitat increases (enhancement scenario).

[26] Due to reduced sampling efforts starting in 2014, statewide trend estimates for Washington are only available up to the year 2016 (Pearson and others 2018). This population trend is different than that used in the population viability analysis (a decline of 4.4 percent). The population viability analysis is described in this chapter and Appendix C.

[27] Time lag means a population response that occurs many years after the loss of inland habitat.

For alternatives A through E, habitat loss in the short term (the first decade of the planning period, due to harvest of habitat outside of long-term forest cover) is expected to be mitigated over time by the recruitment of more and higher-quality habitat and an increase in interior habitat in strategic locations within long-term forest cover. However, impacts are not fully mitigated in all alternatives. When the acres of this habitat are adjusted for quality and timing, the cumulative adverse impacts expected to marbled murrelet habitat are exceeded by the mitigation expected under every proposed alternative except Alternatives B and D (Figure 4.13.1).

Figure 4.13.1. Acres of Habitat Loss (Impact) and Gain (Mitigation) by the End of the Planning Period, by Alternative and Adjusted for Quality



The following section summarizes data for the alternatives on population size (numbers), reproduction, and distribution of marbled murrelet. This section does not replace analysis in the biological opinion produced by USFWS as part of issuing an incidental take permit.

Population Size

The population viability analysis shows that alternatives C, E, F, G and H could result in a larger murrelet population than under Alternative A. These differences were distinguishable at the scale of DNR-managed land. The population viability analysis showed little distinction between alternatives at the statewide scale, in term of population size or quasi-extinction probability.

In summary, the population viability analyses suggest that relative to the other alternatives, Alternative B results in the highest risk of local declines and the smallest projected local population sizes during the modeled planning period. Alternatives F and G are projected to result in the lowest risk of local declines, and Alternative F has the largest projected local population sizes, with intermediate results projected under Alternative A and Alternatives C through E, G and H.

Reproduction

Successful reproduction is required to maintain marbled murrelet populations. In addition to the quality and quality of habitat available in the forest environment, reproduction also is impacted by predation and disturbance. The alternatives support marbled murrelet reproduction by reducing disturbance. Alternatives F, G, and H provide 328-foot (100-meter) buffers around all occupied sites to reduce the risk of predation and natural disturbance. Alternative A also has 328-foot (100-meter) buffers, but around smaller occupied sites. Alternatives, C, D, and E have 328-foot (100-meter) buffers around most occupied site, but applies 164-foot (50-meter) buffers on occupied sites over 200 acres in the OESF HCP Planning Unit. Alternative B does not include buffers, which could result increased predation and disturbance of occupied sites. Conservation measures described in Chapter 2 reduce disturbance from management activities and recreation.

In addition to occupied site buffers, special habitat areas, emphasis areas, and marbled murrelet management areas all are intended to provide security forest surrounding murrelet habitat. Each type of conservation area takes a slightly different approach to supporting murrelet reproduction by reducing the likelihood of predation and natural disturbances. In alternatives C, D, E, and G, special habitat areas are also intended to reduce anthropogenic disturbances. Alternatives A and B do not include any of these strategies. Alternative F includes marbled murrelet management areas; alternatives D and H include special habitat areas; alternatives C and E include special habitat areas and emphasis areas, and Alternative G includes all three strategies.

Distribution

Under all alternatives except Alternative B, there are more acres of raw habitat, adjusted habitat, and interior forest habitat in Decade 5 than current conditions in all landscapes. Additional analysis at the watershed scale shows that in Decade 5, adjusted habitat acres will increase in most watersheds in the analysis area under alternatives C, D, E, F, G and H. However, all alternatives include net declines in habitat in some watersheds. In Alternative F, these declines affect only a few isolated watersheds, whereas in Alternative B, large clusters of watersheds are projected to experience habitat declines in all three of the strategic locations.

However, as shown in Table 4.6.4, impacts exceeds mitigation in some strategic locations under some alternatives. Notably, impacts exceed mitigation in the North Puget strategic location under alternatives A, C, E, and H (even though mitigation exceeds impacts in these alternatives at the analysis area scale).[28] The reason is the time it takes for habitat to develop as mitigation in this strategic location. Therefore, there will be a period of time, up to several decades, when there will be less habitat available in North

[28] Impacts exceeds mitigation in both the North Puget strategic location and the analysis area as a whole under alternatives B and D.

Puget than there is now. Only Alternatives B and D result in greater impacts than mitigation in OESF and the Straits west of the Elwha, and only Alternative B shows greater impacts than mitigation in Southwest Washington.

At a smaller scale, alternatives vary in their conservation of specific areas such as the Clallam area in OESF and the Straits, the Elochoman area in Southwest Washington, and areas to the west of federal lands in North Puget. Alternatives A and B include no conservation areas (emphasis areas, MMMAs, or special habitat areas) in these areas. Alternatives C, E, G, and H provide conservation areas for the Clallam area. Alternatives F, G, and H provide conservation areas for the Elochoman area. West of federal lands in North Puget, only Alternatives C thought H include conservation areas. In order from least to most acreage in conservation areas in the North Puget, the alternatives are C, H, D, E, G, and F.

■ Human Environment: Recreation, Forest Roads, Public Services and Utilities, Environmental Justice, Cultural Resources, and Socioeconomics

Some localized impacts to these elements of the human environment are expected as a result of increasing the acres of marbled murrelet conservation and implementing proposed conservation measures. Cumulatively, these impacts are expected to be minor for all elements of the human environment except socioeconomics (refer to the following section), considering the scale of the analysis area and the availability of other DNR-managed lands for these land uses. Impacts are similar across all action alternatives.

Compared to the no action alternative, adding acres of marbled murrelet conservation would result in local reductions in the land available for new or expanded recreation facilities or non-timber leases/ or easements, shifting demand to lands elsewhere within the analysis area. Existing facilities, easements, leases, and land uses would largely remain unaffected, although the timing of some maintenance activities could be impacted.

Where conservation measures limit road development, compensatory increases in road miles may occur nearby, but overall road density in the analysis area is unlikely to increase as a result of the alternatives. Increased road abandonment in conservation areas likely would occur, which in turn could affect recreational use and access within these areas. Continued access to and use of cultural resources is unlikely to be significantly affected, however, and existing DNR policies and procedures for tribal consultation and cultural resource protection will remain in place.

No environmental justice impacts under any alternative are anticipated from this conservation strategy, although local economic impacts in two counties could be adverse (as discussed in the next section).

Socioeconomic Impacts

NEPA requires an examination of socioeconomic impacts of the proposed action. Socioeconomic impacts in this analysis concern the relationship of DNR-managed land to local economies, including county revenues, state trust revenues, employment, and local tax generation. These impacts were measured both qualitatively, by considering how activities on DNR-managed land contribute broadly to the local economy, and quantitatively, by attributing assumed values to the acres that would be available for harvest under each alternative.

The change in the value of operable acres was found to be relatively small at the scale of the entire analysis area. The overall change in operable acres ranges from a 3 percent increase under Alternative B to a decrease of between 1 and 5 percent for Alternatives C through H.

Federally granted trusts (trusts supported by State Lands) would experience gains in operable acres under Alternative B (increases between 1 and 7 percent) and reductions under alternatives C though H. Reductions vary by alternative and trust but are under 10 percent with two exceptions. First, operable acres are reduced on the University Trust by more than 10 percent under alternatives C through H, with a maximum reduction of 20 percent under Alternative D. Second, operable acres are reduced on the Scientific School Trust by 16 percent under Alternative F.

On State Forest Transfer and State Forest Purchase lands, which benefit counties, operable acres remain stable or increase under Alternative B. Under the other alternatives, operable acres remain stable, increase or decrease depending on the county. The largest changes in operable acres are on the State Forest Purchase Trust in Pacific County, with declines of 23 to 42 percent under alternatives C through H. The largest changes in operable acres are on State Forest Transfer Lands in Wahkiakum County, where operable acres decrease 10 to 27 percent under alternative C through G. Under Alternative H, operable acres on State Forest Transfer Lands in Wahkiakum County increase 7 percent. State Forest Transfer Lands in Pacific County decline by 2 to 17 percent under the action alternatives. Under Alternative F, operable acre declines of greater than 10 percent are expected on State Forest Transfer Land in Pierce and Whatcom counties.

Alternative B, by increasing the number of operable acres available for harvest as compared with Alternative A, is expected to result in stable or increased harvests levels on all trusts and in all counties in the analysis area, stable or increased revenue for all trust beneficiaries with lands within the analysis area, and stable or increased tax revenue and employment in counties within the analysis area.

Alternatives C through H, by decreasing the number of operable acres available for harvest, are expected to result in stable or decreased harvest levels on most trusts and in all counties in the analysis area, stable or decreased revenue for most trust beneficiaries with lands within the analysis area, and stable or decreased tax revenue and employment in counties within the analysis area.

Pacific County is most likely to be adversely impacted by Alternatives C through H. Wahkiakum County is most likely to be adversely impacted by alternatives C through G. These counties are more heavily dependent on timber harvest for local government revenue and have below average economic diversity, compared with other counties in the analysis area. The economies of Pacific and Wahkiakum counties are therefore less able to tolerate the reduction in harvest volume anticipated under Alternatives C through G, and Alternative H for Pacific County only, because of their low socioeconomic resiliency.

Some of the adverse economic effects due to reduced timber supply in the near term could be offset over time by the cumulative benefits of improved efficiencies and effectiveness in forest management, additional opportunities for thinning (which is more labor intensive), more regulatory certainty under the Endangered Species Act, and potential use of the State Forest Trust Land Replacement Program in Pacific and Wahkiakum counties.

■ Impacts on DNR Operations

The establishment of discrete marbled murrelet conservation areas under the action alternatives will improve operational certainty (for example, in 1997 HCP implementation, harvest planning, road construction, leasing, and recreation planning) as compared with the no action alternative, which includes operational uncertainty about the exact location and extent of protected habitat. The conservation measures largely acknowledge the need for most DNR routine operations to continue to occur within long-term forest cover and limit restrictions or prohibitions to within specific marbled murrelet habitat areas. Thus active management of forest resources can largely continue, following clear parameters for seasonal timing restrictions and disturbance buffers. For four types of operations within long-term forest cover (thinning, roads, blasting, and recreation), the conservation measures differ among alternatives, with some limiting DNR management activities more than others. Site-specific consultation with USFWS is expected under the proposed conservation measures for some forest management activities.

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Chapter 5

CUMULATIVE EFFECTS

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Chapter 5

Cumulative Effects

This chapter describes the potential cumulative effects of the alternatives, with a focus on how the alternatives relate to other past, present, and future actions that affect elements of the environment.

5.1 Guidance on Assessing Cumulative Effects

Analysis of cumulative impacts can provide more information to advance agency decision making, including the consideration and comparison of significant adverse impacts for all reasonable alternatives.[1] The National Environmental Policy Act (NEPA) and State Environmental Policy Act (SEPA) rules require analysis of cumulative impacts. Council on Environmental Quality (CEQ) regulations include the following definitions and requirements for cumulative effects:

- 40 C.F.R §1508.7 defines cumulative impact as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."
- 40 C.F.R. §1508.25 identifies "cumulative actions" as "actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement." Section §1508.25 also defines that the scope of impacts to be considered in a NEPA document includes direct, indirect, and cumulative impacts.
- 40 C.F.R. §1508.27 specifies that cumulative impacts are one of ten key intensity factors federal agencies must consider in determining the significance of adverse impacts of their actions.

Under Washington State SEPA rules, the scope of impacts analyzed in an environmental impact statement (EIS) includes cumulative impacts (WAC 197-11-060(4)(e); 197-11-792).

[1] Refer to *Considering Cumulative Effects under the National Environmental Policy Act* (CEQ 1997), a handbook providing a framework for advancing environmental impact analysis by addressing cumulative effects.

5.2 Evaluation Criteria

Two main questions are used in this chapter to analyze potential cumulative effects:

- *Would the alternatives involve individually minor but collectively significant actions taking place over a period of time?*
- *Would the incremental impacts of the alternatives, when added to other past, present, and reasonably foreseeable future actions, result in significant adverse effects?*

An action cannot contribute to a cumulative effect on any particular element of the environment if the action does not have any direct or indirect impacts on that element of the environment. Therefore, a primary criterion for determining cumulative effects is whether any individual adverse impacts have been identified for the specific elements of the environment included in the scope of this revised draft EIS (RDEIS).

Individually Minor but Collectively Significant Actions

All action alternatives would establish new designations of marbled murrelet conservation areas, apply new conservation measures, and release some lands for harvest. The underlying regulatory and policy framework governing the management of these Washington State Department of Natural Resources (DNR)-managed forestlands would remain largely unchanged, but the addition or subtraction of acres in murrelet conservation or the change in management of specific conservation areas could cause cumulative effects. Chapter 4 of this RDEIS includes analyses of whether these individual changes could be collectively significant for an element of the environment over the entire analysis area and over an extended planning period.

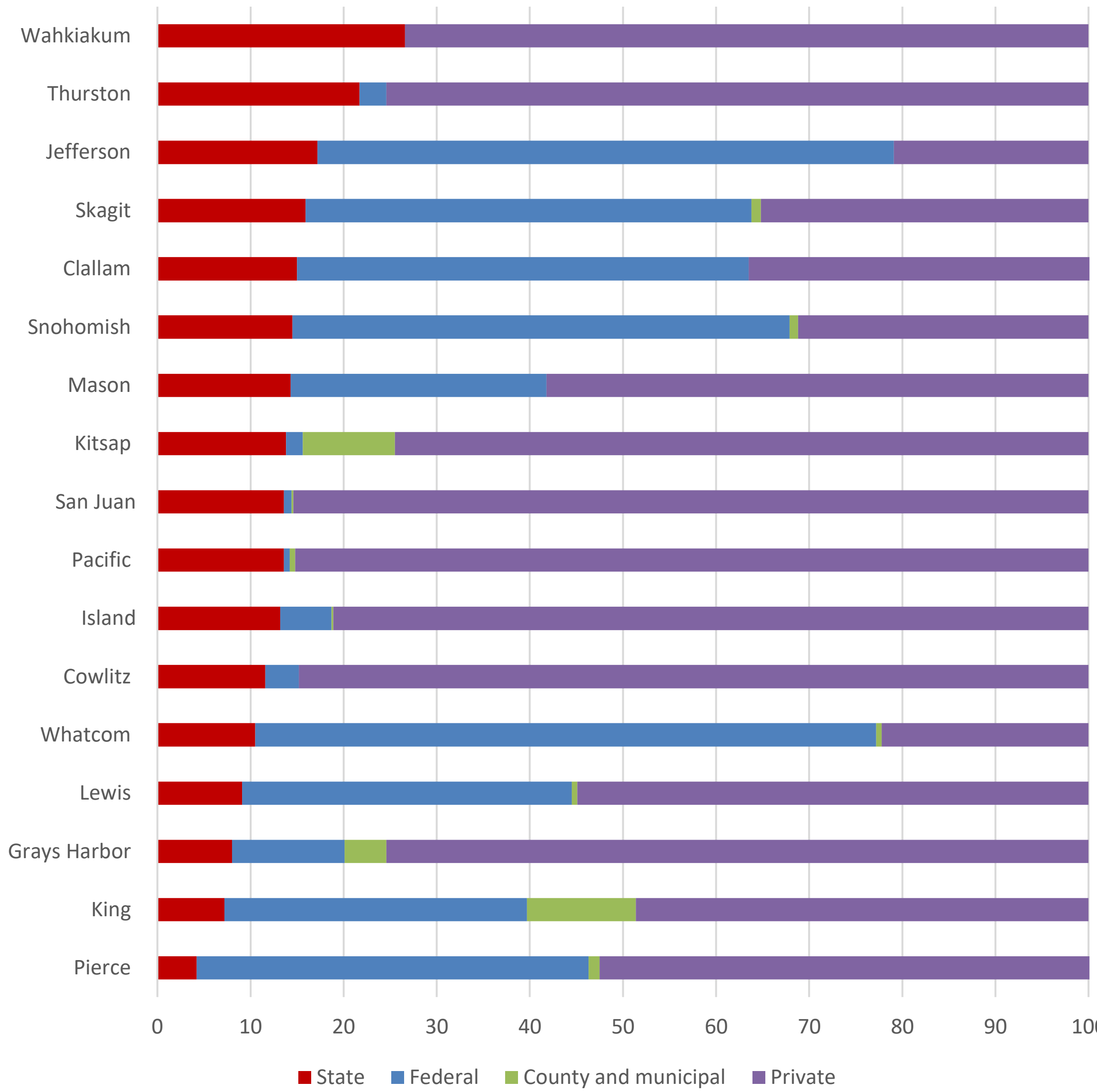
5.3 Forest Management in the Analysis Area: Past, Present, and Future Trends

■ Forestland Ownership Context

An important aspect of cumulative effects is the mix of land ownership within the landscapes upon which cumulative effects may occur. Within the approximately 13.5-million-acre analysis area (terrestrial lands within 55 miles of the marine waters), 31 percent of lands are federal (primarily National Forest and National Park), 9 percent are managed by DNR, and approximately 60 percent are in other non-federal ownership.

Based on acreages presented by Daniels (2004), private lands make up more than half of forestlands within Lewis, San Juan, Pacific, Cowlitz, Island, Grays Harbor, Kitsap, Wahkiakum, Mason, Thurston, and Pierce counties, and federal lands make up more than half of the forestlands within Whatcom, Jefferson, Columbia, Skamania, and Snohomish counties. Figure 5.1.1 breaks out the acres of land ownership by county (Daniels 2004).

Figure 5.1.1. Proportion of State Trust and Other Forestland Ownership Within Analysis Area, by County[a]



[a] Numeric percentages shown for state trust lands only. Portions evaluated based on entire county land base (not just within analysis area). Source: Daniels 2004.

■ Effects of Past Forest Management on the Marbled Murrelet[2]

Historically, habitat has been lost throughout the range of the marbled murrelet, largely due to timber harvest and some due to fire, windstorms, and other stochastic events. Section 4.6 described in detail the trends in population decline of the marbled murrelet in Washington and projects how the alternatives might affect that trend under different demographic scenarios. Regional trends and other impacts from outside the analysis area or the scope of the proposed action are summarized in this section.

Past Habitat Loss Throughout the Range of the Marbled Murrelet

The loss of nesting habitat was a major cause of marbled murrelet population declines over the past century. It is expected that habitat loss will remain a major contributing factor to the current decline in marbled murrelet populations (USFWS 2012). Throughout the range of the marbled murrelet, ongoing habitat loss rates are highest in Washington and this is also where the steepest declines in murrelet populations are currently being observed (Raphael and others 2016, Pearson and others 2018). Fires, logging, and wind storms all contribute to ongoing habitat loss (Falxa and Raphael 2016). The *Northwest Forest Plan* (U.S. Department of Agriculture and U.S. Department of the Interior 1994) effectiveness monitoring program identified and mapped murrelet habitat across California, Oregon, and Washington and estimated changes in habitat amount, distribution, and quality over time. At the start of the *Northwest Forest Plan* in 1993, the USFS model estimated 2.53 million acres of habitat across the *Northwest Forest Plan* area; approximately 59 percent of all habitat was on federal lands. The plan-wide habitat estimate was 2.23 million acres in 2012, representing a net loss of 12 percent (Raphael and others 2015a). Habitat loss was greater on non-federal lands, a net 27 percent loss over twenty years due to wildfire, timber harvest, windthrow, and landslides. A net habitat loss was observed on federal lands as well, approximately 2 percent overall, with most loss due to fire and other natural disturbances. Currently, only about 12 percent of the habitat-capable lands within the listed range of the marbled murrelet contain habitat (Falxa and Raphael 2016).

Murrelet population size and distribution is strongly correlated between stands of cohesive and higher suitability nesting habitat (Falxa and Raphael 2016). The largest marbled murrelet subpopulations now occur off the coast of Oregon and northern California, while subpopulations in Washington have experienced the greatest rates of decline. Rates of nesting habitat loss also have been highest in Washington due to wildfire, timber harvest, windthrow, and landslides on non-federal lands (Falxa and Raphael 2016), which suggests that the loss of nesting habitat continues to be an important limiting factor for the recovery of murrelets. The 20-year monitoring report for the *Northwest Forest Plan* notes that conservation of the marbled murrelet will not be possible if trends in habitat loss continue at the rates

[2] CEQ's cumulative effects guidance recommends "analysis and a concise description of the identifiable present effects of past actions to the extent that they are relevant and useful in analyzing whether the reasonably foreseeable effects of the [proposed action] and its alternatives may have a continuing, additive and significant relationship to those effects." (*Guidance on the Consideration of Past Actions in Cumulative Effects Analysis* (CEQ 2005)).

estimated over the past 20 years (Falxa and Raphael 2016). Even if continued nesting habitat loss were halted, the murrelet population likely would continue to decline for a time, as long as the population remained larger than the reduced amount of nesting habitat could support (Appendix C). It is uncertain the degree to which marine conditions are likely affecting murrelet population decline, but marine conditions that reduce the abundance and distribution of prey are expected to also be a factor in the continued population decline (USFWS 2012).

Past Forest Management on State Trust Lands

Throughout much of the 20th century, timber management on state trust lands was primarily focused on clearcut harvesting of structurally and biologically diverse stands and converting them into even-aged young stands dominated by Douglas fir. For some time, DNR policy was to harvest the oldest stands first (DNR 1979). In many cases, harvested stands were broadcast burned and planted to Douglas fir, which rapidly became densely stocked with little understory vegetation or structural complexity. As a result, most of the DNR-managed lands have been managed for timber production, resulting in the potential loss of marbled murrelet nesting habitat prior to the listing of the marbled murrelet as a threatened species in 1992 (57 FR 45328).

DNR-managed lands in the analysis area encompass over 1.38 million acres and represent about 9 percent of the total land area within the range of the marbled murrelet in Washington. While much of this area is conserved in long-term forest cover, only about 212,000 acres is currently classified as marbled murrelet nesting habitat, representing about 15.4 percent of DNR-managed lands and about 14 percent of the total estimated marbled murrelet habitat in Washington. The U.S. Fish and Wildlife Service (USFWS) recovery plan for marbled murrelet (USFWS 1997) considers nesting habitat on DNR-managed lands as essential for the conservation and recovery of murrelets, particularly in landscapes that have little or no federal lands.

The *State Trust Lands Habitat Conservation Plan* (1997 HCP) established landscape-level strategies to support endangered species conservation on state trust lands through a combination of active and passive habitat management. These HCP conservation strategies also increased protection of riparian and northern spotted owl habitat, which supports murrelet habitat. Since signing the 1997 HCP, DNR has also increased the acres of protected natural areas (natural area preserves and natural resources conservation areas) and increased protection of old-growth forests.

Management for marbled murrelets under the 1997 HCP has occurred under an interim strategy that focused on identifying marbled murrelet habitat and generally avoiding timber harvest in areas deemed likely to be occupied by marbled murrelets. Since signing the 1997 HCP, DNR also has established marbled murrelet habitat protection measures in the North and South Puget HCP planning units and restricted harvests in southwest Washington. In sum, DNR established protections of habitat across approximately 190,000 acres within the analysis area, which dramatically reduced the harvest-related loss of habitat on DNR-managed lands to only the lowest-quality habitat.

The interim strategy authorized the removal of low-quality ("marginal") marbled murrelet habitat that would be expected to contain a maximum of 5 percent of potential occupied sites (DNR 1997, p. IV.40, Step 3) and allowed for some harvest of habitat that was surveyed but determined to be unoccupied (DNR

1997, p. IV.40, Step 4). To date, approximately 28,300 acres of marginal habitat and 2,600 acres of surveyed unoccupied habitat have been harvested (approximately 46 percent of low-quality habitat on DNR-managed land).

Additionally, natural disturbance events, including the "Great Coastal Gale of 2007," resulted in a loss of marbled murrelet habitat, and salvage activities have occurred on approximately 1,200 acres of windthrow-damaged murrelet habitat throughout the analysis area. While most marbled murrelet nesting habitat has been retained on DNR-managed lands since 1997, timber management in interspersed areas of non-habitat may have fragmented remaining habitat patches and contributed to edge effects.

Past Forest Management of Federal Lands

Federal lands within the range of the marbled murrelet in Washington include National Parks and National Forests, as well as smaller areas associated with National Wildlife Refuges and Department of Defense military reservations. As with DNR-managed lands, much of the historic marbled murrelet habitat that existed on federal lands outside of the national parks was harvested prior to the listing of the marbled murrelet as a threatened species in 1992 (USFWS 1997). As a result, large areas of national forest lands now contain densely stocked tree plantations rather than naturally functioning forest, and much of the remaining old-forest habitat is highly fragmented (Falxa and Raphael 2016). Federal lands in the analysis area encompass over 4.2 million acres and represent about 31 percent of the total land area within the range of the marbled murrelet in Washington. Current estimates indicate over 887,000 acres of marbled murrelet habitat occur on federal lands, which represent about 66 percent of the total estimated marbled murrelet habitat remaining in Washington. Currently, about 26 percent of the habitat-capable area on federal lands contains murrelet habitat (Falxa and Raphael 2016).

The *Northwest Forest Plan* (USFS 1994) established a large network of late-successional reserves on national forest lands for the specific purpose of maintaining and recruiting late-successional and old-growth forests. These areas, along with national parks and designated wilderness areas, are all considered federal reserves. In Washington, nearly 90 percent of federal lands within the range of the marbled murrelet are in federal reserves. Federal reserves are expected to provide the primary role for the conservation and recovery of the marbled murrelet in most areas (USFWS 1997). Nesting habitat in conservation reserves on federal lands is expected to increase over the next 50 years as young forests transition to more mature forests and the quality of existing habitat increases through a reduction of past habitat fragmentation and edge effects.

Under the *Northwest Forest Plan*, the focus of forest management in national forests has shifted from regeneration timber harvest to ecological restoration. Examples of recently planned projects within the analysis area are the Queets Vegetation Management Project in Olympic National Forest (USFS 2015a) and the Hansen Creek Vegetation Project in Mount Baker-Snoqualmie National Forest (USFS 2015b). The Queets project is located adjacent to lands proposed for marbled murrelet conservation in DNR's long-term murrelet conservation strategy alternatives in the Upper Clearwater and Queets landscape units.

Past Management of Private Forestlands

Private industrial forestlands are intensively managed and typically have trees less than 60 years old. Very few late-successional forests are present on such lands. Private industrial forestlands are focused on timber production, with many areas being harvested on relatively short rotations (40 to 50 years) (Davies and others 2011). Private forestlands within the analysis area also are being converted to other uses, including industrial and residential developments.[3]

Private forestlands (industrial and non-industrial private lands) in the analysis area encompass over 6 million acres of habitat-capable lands within the range of the marbled murrelet in Washington. Current estimates indicate over 260,000 acres of marbled murrelet habitat occur on private lands, which represents about 20 percent of the total estimated marbled murrelet habitat remaining in Washington. Most habitat remaining on private lands is highly fragmented and occurs in small, scattered patches. Currently, only about 4 percent of the habitat-capable area on private lands contains marbled murrelet habitat (Falxa and Raphael 2016).

Private timber harvest in Washington must comply with the Washington Forest Practices Act (RCW 76.09) as well as the Washington forest practices rules (WAC 222), although the requirements could vary if the landowner has a federally approved HCP. Washington forest practices rules require murrelet surveys in habitat as defined in WAC-222-16-010 and provide protection for known occupied and presumed-to-be occupied marbled murrelet habitat until it is shown not to support murrelets.

Monitoring for the *Northwest Forest Plan* (USFS 1994) indicates that potential marbled murrelet nesting habitat on non-federal lands (state, private, tribal, and county ownerships) in Washington has declined over the past 20 years due to wildfire, timber harvest, and other natural disturbances (Falxa and Raphael 2016). It is important to note that estimates of potential marbled murrelet habitat identified through remote sensing models are not directly comparable to field-based habitat delineations required under the Washington forest practices rules. However, habitat models derived from remote-sensing data indicate that most of the potential marbled murrelet nesting habitat on private lands is now largely confined to areas associated with known occupied marbled murrelet sites, riparian corridors, potentially unstable slopes, and other areas deferred from harvest through existing HCPs or other deferrals under the Washington forest practices rules.

■ Present and Potential Future Actions and Threats to Marbled Murrelets

This section considers the present and reasonably foreseeable future actions that may influence the marbled murrelet population in Washington State. Based on a 2012 review of the species status by a USFWS recovery implementation team (USFWS 2012) and other recent USFWS analyses, known and

[3] Refer to http://file.dnr.wa.gov/publications/em_fwflanduse.pdf.

potential cumulative effects on marbled murrelets in addition to loss of nesting habitat and predation include the following:

- Changes in marine forage conditions, affecting the abundance, distribution, and quality of murrelet prey
- Post-fledging mortality from oil spills, fisheries bycatch, derelict fishing gear, and wind energy projects
- Cumulative and interactive effects of factors on individuals, populations, and the species (includes human development close to foraging areas that forces marbled murrelets to commute further to find suitable nesting habitat; in other words, urbanization in the Puget Sound lowlands)

In a 2010 finding regarding a petition to delist the marbled murrelet (USFWS 2010), USFWS determined that it was reasonable to expect that the species will continue to be exposed to a broad range of threats across its listed range. Although some threats have been reduced, most continue unabated and new threats now strain the ability of the murrelet to successfully reproduce. In the 2010 finding, USFWS concluded that reproductive success was too low to sustain the population and that manmade and natural threats were likely to continue at current or increased levels, resulting in the population continuing to decline.

This RDEIS does not determine whether the alternatives would “jeopardize the continued existence” of the Washington/Oregon/California distinct population segment of the marbled murrelet. Once DNR submits an application based on an alternative for an amendment to its incidental take permit, USFWS prepares a biological opinion to determine whether the final strategy would “cause jeopardy” to the species. Cumulative effects of the action alternative will be a factor that the USFWS considers when making determinations regarding jeopardy. Population viability analyses conducted for the proposed alternatives will be among the information sources considered for this determination (refer to Section 4.6 and Appendix C).

Changes in Long-Term Forest Cover

The no action alternative would continue to protect marbled murrelet habitat designated under the interim strategy, and more habitat would develop in long-term forest cover. The changes to long-term forest cover brought by the action alternatives are as follows:

- Alternative B would reduce long-term forest cover by approximately 24,000 acres (1.7 percent of total DNR-managed lands within the analysis area).
- Alternative C would increase long-term forest cover by approximately 17,000 acres (1.2 percent).
- Alternative D would increase long-term forest cover by approximately 18,000 acres (1.3 percent).
- Alternative E would increase long-term forest cover by approximately 22,000 acres (1.6 percent).
- Alternative F would increase long-term forest cover by approximately 142,000 acres (10.4 percent).
- Alternative G would increase long-term forest cover by approximately 43,000 acres (3.1 percent).
- Alternative H would increase long-term forest cover by approximately 10,000 acres (0.7 percent).

The cumulative amount of lands on which long-term forest cover would be designated would change from the current 45 percent under Alternative A to 43 percent under Alternative B; 46 percent under Alternatives C, D, E, and H; 54 percent under Alternative F; and 48 percent under Alternative G. The cumulative result of an increase in long-term forest cover over time would be an increase in structurally complex forest within these acres, a decrease in available timber volume for harvest in these areas, and a potential shift in other forestland uses (such as recreation, leases, and road building) to other areas of the forest. With Alternative B, the cumulative effect of a decrease in long-term forest cover would mean an increase in available timber volume and fewer impacts to other non-harvest land uses. These incremental changes can be analyzed in the context of other actions, trends, and activities affecting elements of the environment in the analysis area in order to determine their significance.

Future Forest Management Within the Analysis Area

On private forestlands in Washington, commercial forest management is expected to continue on a rotation schedule of 40 to 50 years. Forests managed on short rotations are not expected to grow into marbled murrelet habitat. Riparian zones are managed differently than the uplands, and over long periods of time, and in some cases habitat may develop in limited areas. However, due to their narrow width, riparian zones are not expected to develop extensive areas of habitat, nor is that habitat expected to provide secure areas for marbled murrelet nesting (refer to Section 4.6 and Appendix H for discussion of edge effects) due to the short rotation in the adjacent uplands.

National forests are expected to provide increasing amounts of habitat into the future. In Washington, nearly 90 percent of federal lands within the range of the marbled murrelet are in federal reserves. Federal reserves are expected to provide the primary role for the conservation and recovery of the marbled murrelet (USFWS 1997) in most areas. Nesting habitat in federal reserves is expected to increase over the next 50 years as young forests transition to more mature forests, and as the quality of existing habitat increases through a reduction of habitat fragmentation and edge effects. USFS is intentionally managing for older forests, which will benefit the marbled murrelet into the future. If management for late-successional and old-growth forests continues, there will be substantial increases in habitat amount and quality on federal lands. Current estimates indicate over 1.5 million acres on federal lands in Washington are young forests (43 percent) that are habitat capable (Falxa and Raphael 2016). Much of this forest is likely to transition into habitat over the next 50 to 100 years. National parks within the range of the murrelet are expected to continue providing high quality habitat for the species.

Forest Conversion

The Washington state population grew 1.78 percent in 2017 to 7,310,300 (https://www.ofm.wa.gov/sites/default/files/public/dataresearch/pop/april1/ofm_april1_poptrends.pdf) This population growth contributes to forestland conversion for homes and businesses. While these land conversions are probably not harvesting much habitat for marbled murrelets, in some landscapes, forest conversions are happening close to habitat, for example near Port Angeles. Conversions reduces the effectiveness of the existing habitat for murrelets, for example by providing enhanced habitat for corvids. Section 4.6 describes these types of effects. As the population of Washington continues to grow, so will forestland conversion, which can result in reduced habitat effectiveness.

Washington State Marbled Murrelet Listing

Following a periodic status review of the marbled murrelet in Washington by the Washington Department of Fish and Wildlife (Desimone 2016), the State Fish and Wildlife Commission changed the listing from state threatened to state endangered in February 2017. This may prompt a state recovery plan, which could provide guidance on recovery efforts at the state level.

Climate Change

Within the planning period of this RDEIS, it is unlikely that the conservation approaches proposed under the alternatives will exacerbate expected climate change impacts (refer to Section 4.2). However, climate change is expected to alter forest ecosystems throughout the range of the marbled murrelet (Kliejunas and others 2008), potentially negatively impacting habitat for many species, including the murrelet (USFWS 2011). Climate change is likely to increase threats to the marbled murrelet throughout its inland range, such as the projected drought-related fire, mortality, insects and disease, and increases in extreme flooding, landslides, and windthrow events in the next 50 years. While it appears likely that the marbled murrelet will be negatively affected by these changes, USFWS has determined that it lacks sufficient information to use climate change projections to quantify the magnitude of effects to the species.

Climate change also is expected to alter marine conditions in ways that could harm marbled murrelets' primary foraging habitat, including harmful algal blooms, reductions in dissolved oxygen, and reduced prey availability and quality. The ability of the species to respond to shifts in prey conditions is constrained by several factors. Nesting habitat distribution is limited, and nesting marbled murrelets in Washington already travel long distances between their nest sites and at-sea foraging areas, likely at a large energetic cost (Lorenz et al. 2017, p. 313). Shifts in productive foraging locations may make the nest-to-sea commute prohibitively difficult, limiting the ability of marbled murrelets to attempt breeding.

5.4 Incremental Impacts of the Alternatives

This section examines whether the alternatives, when added to other past, present, and reasonably foreseeable future actions, could result in collectively significant cumulative impacts to marbled murrelet habitat or other elements of the environment.

■ Incremental Impacts, Marbled Murrelets

Alternatives F, G, and H (DNR's preferred alternative) have no net short-term losses of existing habitat. Alternatives A through E result in both short-term losses of existing nesting habitat and long-term increases in habitat in areas conserved as long-term forest cover. Depending on the alternative, habitat losses balanced with habitat gains on DNR-managed lands are projected to result in a net increase from the current level of 212,000 acres (15.4 percent of DNR-managed lands in the analysis area) to between approximately 267,000 (Alternative B) and approximately 319,000 (Alternative F) acres of nesting habitat (26 percent to 51 percent) over the next 50 years.

Alternative B represents the greatest risk for negative cumulative effects to marbled murrelets because it would release for harvest the greatest amount of existing habitat (47,000 acres, including over 6,000 acres of higher-quality habitat). This amount represents approximately 3.6 percent of the total habitat in Washington State (Falxa and Raphael 2016). Alternative B does not buffer occupied sites, so the chance of sites persisting are likely to be reduced by edge effects. Alternative D does buffer occupied sites; however, neither Alternative B nor D recover the amount of raw acres of habitat harvested during the planning period and both take two decades to recover adjusted acres.

Alternatives C and E through H have the potential to provide positive cumulative effects by conserving existing habitat and recruiting additional habitat in key landscapes that are essential for the conservation and recovery of marbled murrelets. Alternative F has the greatest potential to contribute toward reversing or restricting the decline of the marbled murrelet population because it would remove the least amount of habitat outside long-term forest cover and provide the most acres of long-term forest cover, and is likely to result in substantial increases in habitat in strategic locations over the next five decades.

Once DNR updates its incidental take permit, all take would be considered incidental take. Incidental take would likely include take from harvest of murrelet habitat in areas outside long-term forest cover, take from some limited road construction and maintenance in certain occupied sites, and take from edge impacts, roads, and disturbance from forest management and land use within long-term forest cover. As described in section 4.6, road building in occupied sites or their buffers will be avoided if possible; however, it may occur. The amount and location of road building in occupied sites or their buffers is not known. The alternatives would minimize take through conservation of habitat in long-term forest cover and mitigate take by the growth of habitat, softening of edge effects over time, and conservation measures that reduce disturbance and road impacts. Provided that forest growth occurs as projected, the resulting impact and mitigation analysis shows that mitigation exceeds take for all alternatives except Alternatives B and D.

Because the murrelet population trend has been linked to trends in habitat, minimizing the loss of habitat and recruiting additional high-quality habitat are necessary to minimize future declines. All the alternatives include impacts to marbled murrelets, including removal of habitat and other actions. The alternatives have varying levels of conservation intended to minimize and mitigate timber harvest and other impacts. Considering the threats to the species (refer to preceding sections) there is increased risk to the species from the alternatives if the intended conservation does not perform as expected. For example, Alternative B has the most timber harvest and least conservation; thus, there is a higher risk of this alternative having cumulative impacts in comparison to the other alternatives.

Results of the population viability analysis show, under one scenario, a reduction or reversal in the rate of decline of the marbled murrelet population on DNR-managed lands (refer to Section 4.6). Alternatives with a greater loss of higher-quality habitat (Alternatives B, D, and H) have a greater potential negative impact to the marbled murrelet population. However, cumulative, ongoing impacts from stressors in the marine and terrestrial environments that are outside the scope or control of the proposed action also may be contributing to ongoing population decline.

■ Incremental Impacts, Non-Forest Land Uses

The existing, underlying policy and regulatory framework governing forest management remains largely unchanged under the action alternatives. Alternative B would increase land available for harvest compared to the no action alternative; all other alternatives decrease land available for harvest. Impacts of these existing state policies and regulations, including harvest impacts, have been previously analyzed.[4]

Alternatives C through H would increase lands conserved for marbled murrelet, and while this conservation of land largely has neutral or beneficial impacts to other elements of the environment, some minor to moderate adverse effects can be identified for road networks and associated recreational opportunities or development of other non-forestland uses (such as mineral extraction and telecommunications). Reductions in area available for non-forest land uses could shift demand to elsewhere within the range of the marbled murrelet; however, existing uses would remain unchanged. Future recreational or leasing demands for state trust lands would be managed at the tactical level through forest land plans and at the operational level for project-specific facilities and plans.

■ Incremental Impacts, Socioeconomic Effects on Private, State, and Federal Forestlands

An important question being considered in this RDEIS is whether the incremental effects of additional restrictions under any of the alternatives considered in this RDEIS would contribute to existing socioeconomic trends in declining timber harvest, resulting in significant adverse effects to local communities.

As described in Chapter 3, "Affected Environment," DNR state trust lands have undergone major shifts in policy and associated changes in on-the-ground management. Major policy and procedural changes include the following:

- 1997 HCP
- *Policy for Sustainable Forest* (DNR 2006)
- *Riparian Forest Restoration Strategy* (DNR 2006)

From 1997 to 2017, harvest volumes from state trust lands have fluctuated between 298 and 605 million board feet per year in counties in the analysis area. In the same period, harvest on all ownerships in counties in the analysis area have declined slightly, although harvest volumes were lowest during the economic downturn in 2009 (Figure 5.1.2). At the county level, harvest volumes from state trust lands have been relatively consistent in all counties. Total harvest volume has generally decreased since 1997 in

[4] Refer to *Final Environmental Impact Statement for the Alternatives for Sustainable Forest Management of State Trust Lands in Western Washington* (DNR 2004, 2007); *Final (Merged) Environmental Impact Statement for the Habitat Conservation Plan* (DNR 1998); *Forest Practices Habitat Conservation Plan Final Environmental Impact Statement* (DNR 2006); *Final Environmental Impact Statement of the Policy for Sustainable Forests* (DNR 2006).

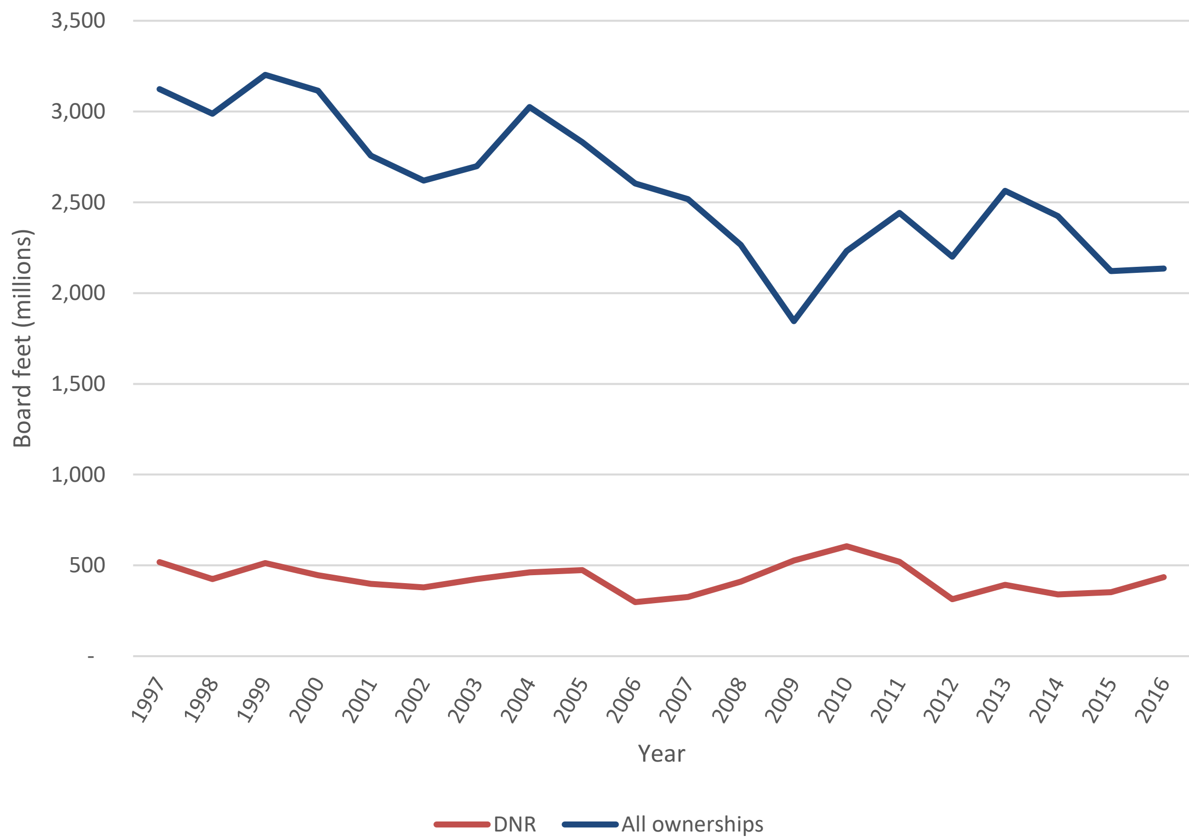
Grays Harbor, Mason, Pierce, and Skagit counties and has increased in Jefferson County. The harvest level in other counties has been relatively stable.

Based on the 1997 through 2016 *Washington Timber Harvest Report*, DNR-managed lands for counties located in the analysis area produced 17 percent of the total volume harvested in that period. The harvest volume ranged from 11 percent in 2006 to 29 percent in 2009 of the total volume. Harvest from private lands accounted for 81 percent of the total harvest volume from 1997 to 2017 and ranged from 87 percent in 2006 to 67 percent in 2009. Federal lands and other public lands produced between 1 and 2 percent of the total harvest volume.

Due to the abundance of private forestlands within the analysis area, private forestlands are expected to continue to provide the majority of timber products to industry into the future, regardless of actions on state trust lands.

Considered collectively, socioeconomic trends have contributed to a cumulative reduction of timber harvest, which has led to associated adverse socioeconomic effects on local communities. It is uncertain whether the effects of the proposed alternatives, when added to existing trends, would be significant at the statewide scale.

Figure 5.1.2. Timber Harvest Levels in the Analysis Area



Incremental Reductions in Available Timber

Alternatives C through H would reduce timber harvest within lands designated as long-term forest cover. The highest reduction in timber harvest is expected under Alternative F and the lowest under Alternative H. Pacific and Wahkiakum counties are projected to be impacted the most (refer to Section 4.11) by reductions in available timber volume under Alternatives C through H (refer to Table 4.11.5).

The cumulative economic effects related to regional forest policy decisions, regulatory strategies, and complex economic and social conditions have and will continue to occur at much larger scales than the effects that would occur due to amending the 1997 HCP. Even though up to 142,000 acres of additional long-term forest cover may sound like a large amount of land, the incremental effect of this change may not be significant within the context of more than 12 million acres of commercial forestlands in western Washington (Daniels 2004), with the exception of impacts to Pacific and Wahkiakum counties as noted in Section 4.11.

■ Summary of Incremental Impacts

Table 5.1.1 summarizes past, present, and future forest management and land use activities within the analysis area and whether the alternatives incrementally add to those impacts.

Table 5.1.1. Incremental Impacts of the Alternatives: Impacts Added to Past Effects and Future Trends Within the Range of the Marbled Murrelet in Washington

	Past	Present	Future actions and trends	Incremental additions of the alternatives
Marbled murrelets	Habitat loss, predation, and threats in the marine environment (for example, oil spills) contributed to population decline. Nesting habitat has been reduced to about 12 percent of the historic habitat-capable area in Washington.	Population decline continues in Washington (current rate is estimated at 4.4%). Habitat losses on federal and DNR-managed land have been substantially reduced, while habitat loss on private forestlands continues. Federal reserves provide the primary role for marbled murrelet conservation and recovery, but habitat on DNR-managed lands is essential for the conservation of murrelets in landscapes that have limited federal ownership (for example, southwest Washington).	Conservation of the marbled murrelet will be difficult to achieve if trends in habitat loss continue at the current rate. Habitat loss on private forestlands will continue and habitat will eventually be limited to known occupied marbled murrelet sites, some riparian zones, and some limited deferral areas under Washington forest practices rules. Nesting habitat in federal reserves is expected to increase over the next 50 years as young forests transition to more mature forests and the quality of existing habitat increases through a reduction of past habitat fragmentation and edge effects. Depending on the alternative, habitat losses balanced with habitat gains on DNR-managed lands are projected to result in a net increase from the current level of about 15.5% habitat area to 23% to 27% habitat area over the next 50 years. Because the amount and configuration of nesting habitat is the primary factor	All alternatives are projected to result in increased nesting habitat area on DNR-managed lands over the next 50 years. The increase in nesting habitat has the potential to slow or reverse the population decline by conserving habitat in long-term forest cover and mitigating the short-term impacts of habitat loss through the growth of new habitat, softening edge effects over time and imposing conservation measures that reduce disturbance and non-harvest impacts. Alternative B has the greatest potential to result in negative cumulative effects due to greater harvest of existing nesting habitat and lack of buffers on occupied sites. Alternative F has the highest potential to provide positive cumulative effects by conserving more existing habitat and recruiting additional habitat in key landscapes that are essential for conservation and recovery of marbled murrelets.

	Past	Present	Future actions and trends	Incremental additions of the alternatives
			associated with murrelet population trends, murrelet populations are likely to stabilize and eventually increase as habitat area and quality gradually increase over time on both federal and DNR-managed lands. However, cumulative, ongoing impacts from other stressors in the marine and terrestrial environments that are outside the scope or control of the proposed action may also be contributing to ongoing population declines. Depending on the alternative, murrelet conservation strategies on DNR-managed lands may reduce the impact of other stressors. For example, alternatives that distribute habitat gains throughout the strategic locations may reduce the impact of changes in productive foraging locations resulting from climate change.	Forestland conversions are expected to continue, which can remove habitat or reduce effectiveness of existing habitat. Climate change is expected to affect marine and terrestrial habitats.
Forest management	Historic timber harvest, clearing for agriculture and development, and reforestation over the past 100 years have created densely stocked stands with reduced	Ongoing timber harvest has the potential for local adverse effects on soils, water, wildlife habitat, and other elements of the environment. Significant effects are typically avoided or mitigated through the existing policy and	Ongoing use of thinning will continue to increase timber productivity and wildlife habitat values.	Only Alternative B results in more land available for harvest compared with the no action alternative. Other action alternatives include some local increases in land available for harvest but an overall increase in the amount of long-term forest cover. The existing regulatory framework is sufficient to address the incremental effects of

	Past	Present	Future actions and trends	Incremental additions of the alternatives
	timber productivity and wildlife habitat values. Wildlife habitat has been significantly reduced due to the loss and fragmentation of structurally complex forest stands.	regulatory framework. Active thinning improves timber production and wildlife habitat values. Much thinning is conducted as part of commercial harvest.		harvest. Thinning would decrease under some alternatives within some marbled murrelet conservation areas. Thinning may increase where needed to meet habitat objectives. Thinning may also increase due to certainty provided by the long-term strategy (clarity around what land is truly “off-base” for future harvest).
Non-forestland uses	Road building, mineral extraction, and clearing for other types of infrastructure and development occurred. Developed facilities, recreational trails, and off-road vehicles can disturb soils, water quality, and riparian and wildlife habitats and attract predators.	Policies and statewide regulations limit road density and protect soils, streams, and fish habitats. Recreation and non-timber land uses occur throughout public and private forestland. Current demand for communication facilities is high. Interest in energy developments is currently low. High levels of recreational use occur near urban areas, particularly in the South Puget HCP planning unit.	Road densities are expected to remain constant. Future demands for mineral or energy leases on state trust lands may increase based on future market conditions. Effects would be addressed in project-specific planning efforts. Increasing recreation demands on forestland are expected as populations increase.	No additive effects are expected from the alternatives. Conservation measures limit new development in marbled murrelet habitat. Shifting demands for recreational uses can be addressed through forestland plans and project-specific planning. Potential local road reductions are expected within long-term forest cover, which could impact access for other users. Overall, no net change to road density is expected.
Socio-economic	From 1997 to 2017, harvest volumes	DNR-managed forestland produces an average of 17%	Private forestlands are expected to continue to provide the majority of	Pacific and Wahkiakum counties may be significantly impacted by reductions in

	Past	Present	Future actions and trends	Incremental additions of the alternatives
effects (associated with timber volume)	have fluctuated on land in counties in the analysis area. Harvest in counties in the analysis area have declined slightly on all ownerships but remained more consistent on DNR-managed lands.	of total harvest volume for counties in the analysis area. Private forestland produces approximately 81%, and federal lands and other public lands produce an average of 2%.	timber products to industry into the future, regardless of actions on DNR-managed lands.	available timber volume under Alternatives C, D, E, F, or G. Pacific County may be significantly impacted by reductions in available timber volume under Alternative H(refer to Section 4.11).

Chapter 6

LITERATURE CITED

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Chapter 6

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Chapter 7

KEY DEFINITIONS

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Chapter 7

Key Definitions

A

Active management: Intervening in the development of a forest stand through planting, thinning, managing competing vegetation, harvesting, or other stand management activities. Also referred to as "active forest management."

Adjusted acres: A quantity of marbled murrelet habitat (in acres) that has been discounted or "adjusted" for factors that can reduce the benefit of that habitat to murrelets, for example whether the acres are close to a forest edge that can attract predators, whether the acres are near or far from occupied sites, and whether the habitat is subject to disturbance. Adjusted acres are used in the analytical framework to determine the balance of take to mitigation.

Analytical framework: A methodology agreed upon by DNR and the U.S. Fish and Wildlife Service (USFWS), also referred to as the "Joint Agencies," to provide objective, repeatable, science-based estimates of potential impacts and mitigation to marbled murrelet habitat from DNR's land management activities under the *State Trust Lands Habitat Conservation Plan* (1997 HCP). The analytical framework provides the means to assess how DNR's mitigation measures cover potential impacts. This quantification will enable the Joint Agencies to evaluate whether a proposed conservation strategy meets the issuance criteria for the Incidental Take Permit.

B

Bare land value: Bare land value assesses the present net worth of an infinite number of successive, identical timber harvest rotations.

Basal area: A measure of stand density. The cross-sectional area of all stems in a stand measured at breast height, expressed in square feet per acre.

Biodiversity: The full range of life in all its forms, as defined by the Washington Biodiversity Council.

Board foot: The amount of wood contained in an unfinished board 1 inch thick, 12 inches long, and 12 inches wide (2.54 x 30.5 x 30.5 centimeters), abbreviated bd. ft.; commonly, 1,000 bd. ft. is written as 1 MBF and 1,000,000 bd. ft. as 1 MMBF.

Board of Natural Resources (board): As defined and authorized in RCW 43.30.215, the board consists of six members: the governor or governor designee; the Superintendent of Public Instruction; the Commissioner of Public Lands; the director of the School of Environmental and Forest Sciences at the

University of Washington; the Dean of the College of Agriculture, Human, and Natural Resource Sciences at Washington State University; and a representative of those counties containing state forestlands acquired by the department. The board's duties include establishing department policy and setting appraisal value of lands and valuable materials including timber values offered for sale. See RCW 43.30.215 for more duties of the board.

Buffer: A forested strip left during timber harvest to conserve sensitive ecosystems or wildlife habitat. Active management may be allowed as long as it is consistent with the conservation objectives for the buffer.

C

Carrying capacity: The maximum population size of the species that the environment can sustain indefinitely, given the food, habitat, shelter, water, and other necessities available in the environment.

Commercial thinning: A thinning that generates revenue and is performed to meet a wide range of objectives, including improving the growth of the stand, enhancing stand health, reducing tree mortality, or accelerating the development of habitat.

Consultation: As used in this RDEIS, "consultation" does not mean an Endangered Species Act Section 7 consultation, but refers to DNR informally contacting USFWS about a particular project. DNR and USFWS may identify project-specific measures to avoid, minimize, or mitigate potential impacts to remain consistent with the 1997 HCP and incidental take permit.

Critical habitat (federal): Defined under the federal Endangered Species Act for threatened and endangered species as "(i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the [U.S.] Secretary [of Interior] that such areas are essential for the conservation of the species."

Cumulative impact: The incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can occur from individually minor but collectively significant actions taking place over time and space.

D

Deferral: As used in this RDEIS, the term "deferral" or "deferred lands" refers to forestland that will not be harvested during the planning period due to a long-term conservation commitment under the 1997 HCP, *Policy for Sustainable Forests*, or other DNR conservation objectives.

Dispersal habitat: Habitat used by juvenile northern spotted owls or at any age to disperse or move from one area designated for nesting-roosting-foraging habitat to another.

DNR-managed lands: Lands managed by the Washington Department of Natural Resources. Includes state trust lands, natural area preserves, and natural resources conservation areas. *See* state trust lands.

E

Endangered species: Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range and published in the Federal Register.

F

Forest health: Defined in RCW 76.06.020 as "the condition of a forest being sound in ecological function, sustainable, resilient, and resistant to insects, diseases, fire, and other disturbance, and having the capacity to meet landowner objectives." RCW 76.06.140 points to "overcrowded" conditions (i.e., overstocking) as causing forest health impediment and to well-managed forests as the first line of defense.

Forest edge: An abrupt transition or boundary between two habitat types. Forest edges are created by roads, harvests, changes in species composition, and physical changes in the landscape.

G

Gene pool reserve: A naturally regenerated, Douglas-fir stand that DNR has deferred from harvest to ensure that native genetic material, well-adapted to local conditions, will be available to DNR in the future.

Guy line: A cable stay used to hold up a logging tower, spar, or a tailhold tree.

H

Habitat carrying capacity: The maximum number of female murrelets expected to breed if habitat use continues as estimated in the population viability analysis.

Habitat conservation plan (HCP): A plan authorized under Section 10 of the Endangered Species Act that permits incidental take (in the course of an otherwise lawful activity) of a species protected under the Act.

HCP planning unit: A geographic area that is based on watersheds for the purpose of tying minimization and mitigation more closely to the natural systems and geographic variation in habitat, gaining economies of scale, and providing greater efficiency in planning and implementing the 1997 HCP.

High-quality spotted owl habitat: The most structurally complex habitat used by territorial northern spotted owls for nesting, roosting, and foraging. Refer to *DNR State Trust Lands Habitat Conservation Plan 2015 Annual Report* for a more complete definition.

High-quality habitat: Habitat with a P-stage score of 0.47 to 0.89.

I-K

Incidental take: Harm or harassment to individuals of a listed species when such take is incidental to, and not the purpose of, carrying out otherwise lawful activities such as timber harvests (DNR 1997).

Inland habitat: Marbled murrelet habitat on land; nesting habitat.

L

Landing: A widened area (often on or adjacent to a forest road) to which logs are yarded or skidded for loading onto trucks to be hauled to market.

Large data overlay: DNR's complex GIS model comprised of hundreds of individual data sources describing DNR-managed lands. Examples of such data include forest inventory information, riparian and hydrology data, roads and trails, and other biological and physical information.

Long-term forest cover (LTFC): DNR-managed forestlands with commitments to maintain permanent forest cover to provide long-term conservation benefits to the marbled murrelet. Areas of long-term forest cover have existing conservation commitments under the 1997 HCP, *Policy for Sustainable Forests*, Natural Heritage Program, forest practices rules, the OESF Forest Land Plan, and/or are identified as marbled murrelet conservation areas.

Low-quality habitat: Habitat with a P-stage score of 0.25 to 0.36.

M

Management area for northern spotted owls: Lands identified and designated in the 1997 HCP to be managed for specific types of habitat for the northern spotted owl.

Marbled murrelet conservation area (MMMA): A generic term for a discrete area designated for marbled murrelet habitat conservation under one or more of the alternatives analyzed in this RDEIS.

Marginal landscape: Landscape considered less valuable for marbled murrelet conservation because of distance from known occupied sites and murrelet critical habitat on federal lands, number of observations of murrelet nesting behavior, capability for developing future habitat, and other factors.

Metering Harvest: Delaying harvest of marbled murrelet habitat that DNR otherwise would be authorized to harvest upon amendment of its incidental take permit until the end of the first decade following implementation. Metering will maintain habitat capacity while additional habitat is developed under the long-term conservation strategy. These metered acres will become available for harvest at the beginning of the second decade.

N

National Environmental Policy Act (NEPA) of 1969: An act passed by the U.S. Congress to (1) declare a national policy which will encourage productive and enjoyable harmony between man and his environment; (2) promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; (3) enrich the understanding of the ecological systems and natural resources important to the Nation; and (4) establish a Council on Environmental Quality. In the state of Washington, NEPA's counterpart is the State Environmental Policy Act (SEPA).

Natural area preserve: Under authority of the state Natural Area Preserves Act of 1972 (codified in Chapter 79.70 RCW), an area established on public lands to protect the best remaining examples of many ecological communities, including rare plant and animal habitat. NAPs are managed by DNR under the Natural Areas Program.

Natural regeneration: Reforestation by natural seed-fall from existing stands and trees.

Natural resources conservation area: As codified in 1987 in Chapter 79.71 RCW, an area designated to protect outstanding examples of native ecosystems; habitat for endangered, threatened, and sensitive plants and animals; and scenic areas. The NRCA program represents a protection alternative to complement NAPs. NRCAs are managed by DNR under the Natural Heritage Program.

Nesting, roosting, and foraging management area: A discrete area to be managed for sub-mature or better norther spotted owl habitat and nest patches.

Nest patch: Designated 500-acre patches that include a 300-acre patch for nesting and a 200-acre buffer of sub-mature or better habitat.

O

Occupied site: Habitat patches of varying size in which murrelets are assumed to nest based on field observations.

Old-forest habitat or old forest: As used in this RDEIS, a type of northern spotted owl habitat in the OESF HCP planning unit (1997 HCP, p. IV.88).

Old growth (western Washington): DNR's *Policy for Sustainable Forests* defers old-growth stands from harvest, defined as stands, 5 acres or larger, in the most structurally complex stage of stand development, also referred to as fully functional (determined through a standard scoring method based on a scientist panel consensus). Old growth stands also refer to stands with a natural origin date prior to 1850, generally considered the start of European settlement in the Pacific Northwest.

Olympic Experimental State Forest (OESF): An HCP planning unit that includes about 264,000 acres of forested state trust lands on the western Olympic Peninsula in which foresters and scientists seek to intentionally learn how to integrate revenue production and ecological values in a working forest.

P

Peak flow: Periods of high stream flow, usually associated with storm events.

Platform: A large limb or structure at least 50 feet above the ground and at least 7 inches in diameter on which a marbled murrelet might nest.

Platform tree: Mature trees with large limbs or other structures at least 50 feet above the ground and at least 7 inches in diameter.

***Policy for Sustainable Forests*:** A policy document that provides broad direction for DNR, in the form of 23 policies, to effectively manage forested state trust lands. The *Policy for Sustainable Forests* was adopted by the Board of Natural Resources on July 11, 2006. The purpose of the *Policy for Sustainable Forests* is to conserve and enhance the natural systems and resources of forested trust lands managed by DNR to produce long-term, sustainable income and environmental and other benefits for the people of Washington.

Pre-commercial thinning: Thinning in which felled trees have little or no market value (usually because of insufficient size) and are therefore are left where felled.

P-stage: A habitat classification system used in the development of the marbled murrelet long-term conservation strategy. Assigns a numeric value to forest stands based on the probability of their use by marbled murrelets for nesting.

Procedure: An explicit department direction for implementing policies such as those contained in the *Policy for Sustainable Forests*.

Q

Quasi-extinction: The probability of the population dropping below a certain fraction of the starting population. A population that has reached quasi-extinction may have too few adults to assure persistence of the species.

R

Raw acres: Acres of marbled murrelet habitat that have not been adjusted for factors such as forest edges, location, disturbance, or when that habitat develops. *See* adjusted acres.

Reclassified habitat: Higher-quality marbled murrelet habitat types identified for surveys under the interim strategy to determine occupancy (DNR 1997, p. IV.40).

Reforestation: The reestablishment of forest cover either naturally (by natural seeding, coppice, or root suckers) or artificially (by direct seeding or planting). *Synonym:* regeneration.

Regeneration: The act of renewing tree cover by establishing young trees naturally or artificially.

Riparian management zone (RMZ): A protected band of vegetation adjacent to wetlands (called wetland management zone or WMZ), lakes, rivers, and streams that varies in width based on stream or wetland size and presumed ecological significance. The 1997 HCP designated RMZs and WMZs in order to protect salmonid and other aquatic and riparian obligate species.

Road maintenance and abandonment plan (RMAP): A plan that covers all forest roads on a landowner's property constructed or used for forest practices after 1974. It is based on a complete inventory that also shows streams and wetlands adjacent to or crossed by roads. The plan lays out a strategy for maintaining existing roads to meet state standards and shows areas of planned or potential road abandonment.

S

Salvage: Logging performed to sell blowdown, insect-infested, or otherwise damaged timber before natural processes cause deterioration in quality and value. Salvage harvest volume is not counted toward the sustainable harvest level set by the board.

Security forest: A closed-canopy forest stand over 80-feet tall that is located adjacent to marbled murrelet nesting habitat and provides security from windthrow, predation, and other disturbances.

SEPA: The State Environmental Policy Act, codified under Chapter 43.21C RCW.

Silviculture: The art and science of cultivating forests to achieve objectives. (This concept incorporates theory, planning, and practice at the stand through landscape/management area scales.)

Site preparation: Preparation of a final-harvested or intermediate-harvested forest management unit to increase the probability of successful regeneration by reducing slash and/or undesirable tree and brush species. Site preparation may be performed concurrent with logging (by, for example, pulling up and disposing of brush clumps), through piling and burning logging slash, through broadcast- or under-burning logging slash, by manually cutting undesirable vegetation, by applying herbicide (aerial or ground) to undesirable tree and brush species prior to planting, or other methods or combinations of methods. Compare to "vegetation management."

Southwest Washington: Defined for this planning effort as those portions of the Columbia and South Coast HCP planning units west of Interstate 5 and that portion of the South Coast planning unit south of Highway 8 and south of Highway 12 between the towns of Elma and Aberdeen.

Stand density: A quantitative measure of stocking expressed either absolutely in terms of number of trees, basal area, or volume per unit area or relative to some standard condition; a measure of the degree of crowding of trees within stocked areas commonly expressed by various growing space ratios (for example, height/spacing).

Stand development stages: The generally recognized stages of forest stand development that would occur as trees and other organisms populate a piece of ground, grow into a stand, evolve in form, and gradually die in the absence of stand-replacement disturbance.

State trust lands: Lands held as fiduciary trusts to provide revenue to specific trust beneficiaries. The majority of these lands were granted to the state by the federal Enabling Act (25 U.S. Statutes at large, c 180 p 676) as a means of financial support, primarily for public schools and universities. Other lands were acquired by Washington from the counties; those lands also are held and managed in trust the same as the federally granted lands (RCW 79.02.010(13)). The Washington State Department of Natural Resources generates revenue on forested state trust lands primarily through timber harvest.

Stochastic: Referring to patterns resulting from random effects.

Strategic location: A geographic areas within Washington considered to have a disproportionately high importance for murrelet conservation due to proximity to marine waters and marine hot spots (areas with higher-than-average murrelet density), proximity to known occupied sites, abundance of habitat, abundance and distribution of occupied sites, capacity for developing future habitat, protection from disturbance, and proximity to federal lands.

Stringer habitat: Stringer habitat is predominantly narrow riparian management zones (less than 656 feet [200 meters] wide) where adjacent uplands have not been designated as long-term forest cover. This habitat is not part of the calculation of impact or mitigation.

Structurally complex stand: A forest stand in the in the niche diversification or fully functional stand development stages.

Sub-mature habitat: A northern spotted owl habitat definition for stands with the structural characteristics necessary to provide roosting and foraging functions and, rarely, nesting functions.

Sustainable harvest calculation: A strategic analysis process that quantifies forestry goals, such as future forest conditions and trust revenue, against forecasted near- and long-term effects of alternative sets of policy. This process is also used to recommend to the board the next decade's sustainable timber harvest level. DNR is required by law (RCW 79.10.320) to periodically calculate and adjust the harvest level from forested state trust lands managed by DNR.

Swiss needle cast: A fungal disease specific to Douglas fir that can cause yellowing and loss of needles and reduced diameter and height growth.

T

Tailhold: A stump, tree, rock bolt, or other immovable object to which a skyline is tied off or tail block attached.

Take: Defined in the Endangered Species Act as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species. Harm may include significant habitat modification when such modification actually kills or injures a listed species through impairment of essential behavior (for example, nesting or reproduction).

Timber sale: A sale of timber from DNR-managed forested state trust land that is separate from the land.

U

Upland: Land above the ordinary high watermark of bodies of water. In everyday usage, the term refers to all lands above riparian management zones and aquatic lands, forested as well as not.

V

Variable-density thinning: A type of commercial thinning in which a mixture of small openings (gaps), un-thinned patches (skips), and varying stand densities are created to achieve specific objectives, such as accelerating development of a complex stand structure.

Variable retention harvest: A type of regeneration or stand-replacement harvest in which elements of the existing stand, such as down wood, snags, and leave trees (trees that are not harvested), are left for incorporation into the new stand. Variable retention harvest is different from a clearcut, in which all of the existing stand is removed.

Vegetation management: Weeding of undesirable competing vegetation, generally performed between planting and establishment, which may be performed through a variety of means such as hand-slashing or felling, mechanical means, herbicide applied from the ground, and herbicide applied by aircraft. Compare to “site preparation.”

W-X

Windthrow: Blowing over or breaking of trees in the wind.

Y

Yarding: The act of moving timber to a landing using a cable system.