Alternatives *for the* Establishment of a Sustainable Harvest Level

For Forested State Trust Lands in Western Washington

Final Environmental Impact Statement

October, 2019

WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

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October 2019

Dear Interested Party,

The Washington Department of Natural Resources (DNR) is establishing a sustainable harvest level for the fiscal year 2015 to 2024 planning decade for more than 1.4 million acres of forested state trust lands in western Washington. Once the level is set set by the Board of Natural Resources (Board), it will ensure the sustainable management of state trust lands consistent with the economic, ecological, and social objectives contained within the *Policy for Sustainable Forests*. Included in these objectives is meeting the commitments of the 1997 *State Trust Lands Habitat Conservation Plan*, and complying with all applicable state and federal laws.

The fiscal year 2015 to 2024 sustainable harvest level will address three key issues facing DNR uplands: marbled murrelet conservation, arrearage, and riparian area thinning. The marbled murrelet conservation strategy alternatives were analyzed by DNR in a separate final environmental impact statement released in September 2019. The strategies designate varying amounts of state trust lands for marbled murrelet conservation. Different amounts of state trust lands in conservation status shift the total of land available for harvesting and therefore have the potential to increase or decrease the decadal harvest level. In addition, DNR is required to address an arrearage that occurred during the previous decade (fiscal year 2005-2014). When and how the arrearage is addressed may also impact the sustainable harvest level. Finally, lower-than-expected levels of thinning in riparian areas contributed to the previous decade's arrearage. How much volume to expect from riparian areas will also impact the harvest level.

This Final Environmental Impact Statement evaluates five sustainable harvest level alternatives, along with a no-action alternative that reflects the previous level set by the Board in 2007. Each alternative combines a murrelet conservation strategy, arrearage approach, and riparian area thinning level as a basis for calculating a sustainable harvest level. The result is that the alternatives analyzed in this document provide a wide range of sustainable harvest levels for consideration by the Board.

Further information is posted at dnr.wa.gov/shc.

Thank you for your interest in the sustainable management of state trust lands.

Sincerely,

Hilary Franz
Commissioner of Public Lands

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FINAL

Environmental Impact Statement

on

Alternatives for the Establishment of a Sustainable Harvest Level for Forested State Trust Lands in Western Washington

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Fact Sheet

Title: Final Environmental Impact Statement (FEIS) on Alternatives for the Establishment of a Sustainable Harvest Level for Forested State Trust Lands in Western Washington

Description of Proposal: This proposal involves setting a sustainable harvest level for the fiscal year 2015–2024 planning decade for forested state trust lands in western Washington. Six alternatives, including a no action alternative, are analyzed. The alternatives propose a range of harvest levels for forested state trust lands in western Washington.

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Date of Issuance of FEIS

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Final Action

The final action is the adoption of a sustainable harvest level by the Board of Natural Resources.

Location, Availability, and Cost of Copies of This FEIS and Supporting Documents

This FEIS is posted online at: www.dnr.wa.gov/shc.

CD copies also are available to read at selected public libraries. These libraries are listed in Appendix K.

CD copies also are available at no charge. Requests for CDs may be mailed to the address listed under "Contact." Hard copies will be available for the cost of printing, per RCW 42.17.

This FEIS incorporates the following documents by reference:

- *Final (Merged) Environmental Impact Statement for the Habitat Conservation Plan*
- *Final Environmental Impact Statement on the Policy for Sustainable Forests*
- *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*
- *South Puget HCP Planning Unit Forest Land Plan Final Environmental Impact Statement*
- *Olympic Experimental State Forest HCP Planning Unit Forest Land Plan Final Environmental Impact Statement*
- *Final Environmental Impact Statement for the Marbled Murrelet Long-Term Conservation Strategy*

Copies of these documents and the following supporting documents—*Policy for Sustainable Forests*, *State Trust Lands Habitat Conservation Plan*, *Olympic Experimental State Forest HCP Planning Unit Forest Land Plan*, and Washington forest practices rules—are available for review at the DNR SEPA Center at 1111 Washington Street, Olympia. These documents can also be found online at www.dnr.wa.gov

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SUMMARY

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Summary

This FEIS document was produced by the Washington Department of Natural Resources (DNR). This document is intended to satisfy the requirements of the Washington State Environmental Policy Act (SEPA) for environmental review. The proposed action under review is the establishment of a sustainable harvest level for the fiscal year 2015 to 2024 planning decade for forested state trust land in western Washington.

Purpose, Need, and Objectives

Purpose: The purpose of the proposed action is to recalculate a sustainable harvest level consistent with DNR policies, including the *Policy for Sustainable Forests* (DNR 2006), the *State Trust Lands Habitat Conservation Plan* (1997 HCP; DNR 1997), and applicable local, state, and federal laws.

Need: The need to recalculate a sustainable harvest level arises from the following laws and policies:

- Revised Code of Washington (RCW) 79.10.320 requires DNR to "manage the state-owned lands under its jurisdiction which are primarily valuable for the purpose of growing forest crops on a sustained yield basis insofar as compatible with other statutory directives. To this end, the department shall periodically adjust the acreages designated for inclusion in the sustained yield management program and calculate a sustainable harvest level."

- RCW 79.10.330 states that "[i]f an arrearage exists at the end of any planning decade, the department shall conduct an analysis of alternatives to determine the course of action regarding the arrearage which provides the greatest return to the trusts based upon economic conditions then existing and forecast, as well as impacts on the environment of harvesting the additional timber. The department shall offer for sale the arrearage in addition to the sustainable harvest level adopted by the board of natural resources for the next planning decade if the analysis determined doing so will provide the greatest return to the trusts."

- The *Policy for Sustainable Forests* states that "[t]he department, with Board of Natural Resources approval, will recalculate the statewide sustainable harvest level, for Board of Natural Resources adoption no less frequently than every ten years."

The objectives for the sustainable harvest calculation are:

- **Objective #1:** Coordinate with the Marbled Murrelet (*Brachyramphus marmoratus*) Long-Term Conservation Strategy (LTCS) environmental analysis so that the Board of Natural Resources can integrate the effects of the range of marbled murrelet LTCS alternatives on the sustainable harvest level and arrearage.

- **Objective #2:** Incorporate new information into an updated model to calculate the sustainable harvest level. New information includes changes in the land base, changes in forest inventory, information

concerning the prior decadal arrearage and its causes, changes in technology, and any updates from the finalized forest land plans for the Olympic Experimental State Forest and South Puget HCP planning units.

- **Objective #3:** Consider climate change as part of the affected environment, analyze climate change impacts and benefits of the alternatives, and identify possible mitigation measures that will reduce or eliminate any identified adverse environmental climate change impacts of the proposal.
- **Objective #4:** Ensure alternatives analyzed are reasonable, feasible, and consistent with DNR's trust management obligations, existing DNR policies, and applicable state and federal laws.

The Alternatives

Six alternatives are analyzed in this final environmental impact statement (FEIS), including a no action alternative. DNR's preferred alternative in this FEIS is Alternative 6. The alternatives represent a range of harvest levels based on different combinations of marbled murrelet LTCS options (the impacts of which are analyzed in the marbled murrelet LTCS FEIS), options for how to best address arrearage volume from the fiscal year 2005–2014 planning decade, and options for riparian thinning in the five western Washington HCP planning units, excluding the Olympic Experimental State Forest (OESF; Table S.1).

Table S.1. Summary of the Alternatives

Component	Alternative 1 (no action)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Marbled murrelet LTCS alternative	Alternative A	Alternative B	Alternative D	Alternative E	Alternative F	HCP Amendment[1]
Arrearage	Assume no harvest of arrearage volume	Harvest 702 MMBF proportionally from sustainable harvest units with deficits over 5 years	Harvest 462 MMBF proportionally from sustainable harvest units with deficits over 10 years	Harvest 462 MMBF proportionally from sustainable harvest units with deficits in 1 year	Arrearage volume is incorporated into the inventory	Harvest 382 MMBF proportionally from sustainable harvest units with deficits over 10 years
Riparian thinning in the five west side planning units	Up to 10 percent of the riparian area	Up to 10 percent of the riparian area	Up to 1 percent of total upland harvest and thinning area in these planning units	Up to 1 percent of total upland harvest and thinning area in these planning units	Up to 1 percent of total upland harvest and thinning area in these planning units	Riparian volume not included when setting the sustainable harvest level

[1] The Amendment marbled murrelet LTCS presented in this FEIS differs from alternative H in the Long Term Conservation Strategy for the Marbled Murrelet FEIS (DNR 2019a). A description of the differences are provided in Chapter 1.

The alternatives result in differing harvest levels both in terms of harvest and thinning acres and volume (Table S.2.).

Table S.2. Average Annual Harvest and Thinning Area, and Volume

	Alternative 1 (no action)	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Average annual harvest acres	12,500	12,000	11,200	11,000	8,900	11,400
Average annual thinning acres	7,500	4,700	2,100	2,000	2,500	1,600
Average annual volume (including arrearage volume)	550	520	459	453	384	465

Summary of Potential Impacts to Elements of the Environment

Impacts evaluated in this FEIS relate primarily to the acres of harvest that occur under each alternative. The alternatives result in different timber harvest volumes for the decade.

■ Earth

Soil resources and areas subject to landslide hazards will continue to be protected by existing DNR regulations, policies, and procedures.

■ Climate

Climate change impacts are not expected to be exacerbated by any alternative within the planning decade. Carbon sequestration is expected to be greater than emissions under all alternatives.

■ Aquatic Resources

Reduced acres of thinning in alternatives 3 through 6 could delay some riparian areas meeting their restoration objectives. However, overall HCP objectives are expected to be met.

Vegetation

The proportion of structurally complex forest will increase under all alternatives. Protection of rare plants and ecosystems, old growth forests, and natural areas would not change under any alternative.

Wildlife

Wildlife would benefit from the development of structurally complex forest under all alternatives. All stand development stages will remain on DNR-managed land, providing habitat for a large number of species. Northern spotted owl will continue to be managed under the 1997 HCP (DNR 1997) and habitat will continue to increase in designated Spotted Owl Management Units (SOMUs). Consistent with the *Washington Environmental Council et al. v. Sutherland et al.*[2] settlement agreement that occurred during the previous decadal planning period (fiscal years 2005-2014), the action alternatives for the 2015-2024 planning decade include northern spotted owl conservation as defined in the HCP but not in the agreement. The no action alternative includes conservation measures defined in the agreement. No impacts to northern spotted owl are expected by this difference. Populations of other threatened and endangered species, and sensitive and regionally important wildlife will not be impacted by any of the alternatives.

Marbled Murrelet

This FEIS incorporates by reference the marbled murrelet LTCS FEIS (DNR 2019a). The lands included in this FEIS but outside the analysis area in the marbled murrelet LTCS FEIS are not expected to support marbled murrelets because they are beyond the range of the marbled murrelet.

The marbled murrelet LTCS FEIS analysis showed that for all alternatives, habitat losses in the short term (the first decade of the planning period, due to harvest of habitat outside of long-term forest cover) would be mitigated over time by the recruitment of additional habitat and an increase in interior habitat in strategic locations within long-term forest cover. When the acres of this habitat are adjusted for quality, the cumulative impacts expected on marbled murrelet habitat are exceeded by the mitigation expected under every proposed alternative except the marbled murrelet LTCS alternative (Alternative B) incorporated into Alternative 2 of this FEIS.

[2] Washington Environmental Council et al. v. Sutherland et al. Settlement Agreement (King County Superior Court No. 04-2-26461-8SEA, dismissed April 7, 2006).

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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 sustainable harvest calculation and state lands management, describes the analysis area, and highlights the environmental impact statement and approval process.

1.1 Proposed Action: Purpose, Need, and Objectives

The action proposed by the Washington Department of Natural Resources (DNR) is to establish a sustainable harvest level for the fiscal year 2015– 2024 planning decade for forested state trust lands in western Washington. The sustainable harvest level is the timber volume scheduled for harvest from state trust lands during a planning decade.[1,2]

The proposed western Washington sustainable harvest level will be based on current DNR policies including the *State Trust Lands Habitat Conservation Plan* (DNR 1997), referred to as the 1997 HCP, and *Policy for Sustainable Forests* (DNR 2006a) as well as all applicable local, state, and federal laws.[3]

■ Purpose of the Proposed Action

The purpose describes what DNR is trying to achieve. The purpose of the proposed action is to recalculate a sustainable harvest level consistent with DNR policies, including the *Policy for Sustainable Forests*, the 1997 HCP, and applicable local, state, and federal laws.

[1] RCW 79.10.300(5).
[2] The proposed action also includes adoption of an "End of Decade Analysis: Arrearage" policy and a revision to the Policy on Definition of Sustainability for the Sustainable Harvest Calculation. More information about these policy changes is in Chapter 2 and Appendix M and N of this FEIS.
[3] For the 1997 HCP, visit https://www.dnr.wa.gov/publications/lm_hcp_plan_1997.pdf?642gkr
For the *Policy for Sustainable Forests*, visit
https://www.dnr.wa.gov/publications/lm_psf_policy_sustainable_forests.pdf?oaq33g

Need for the Proposed Action

The need describes why DNR is seeking to accomplish the purpose:

- Revised Code of Washington (RCW) 79.10.320 requires DNR to "manage the state-owned lands under its jurisdiction which are primarily valuable for the purpose of growing forest crops on a sustained yield basis insofar as compatible with other statutory directives. To this end, the department shall periodically adjust the acreages designated for inclusion in the sustained yield management program and calculate a sustainable harvest level."

- RCW 79.10.330 states that "[i]f an arrearage exists at the end of any planning decade, the department shall conduct an analysis of alternatives to determine the course of action regarding the arrearage which provides the greatest return to the trusts based upon economic conditions then existing and forecast, as well as impacts on the environment of harvesting the additional timber. The department shall offer for sale the arrearage in addition to the sustainable harvest level adopted by the Board of Natural Resources for the next planning decade if the analysis determined doing so will provide the greatest return to the trusts."

- The *Policy for Sustainable Forests* states that "[t]he department, with Board of Natural Resources approval, will recalculate the statewide sustainable harvest level, for Board of Natural Resources adoption no less frequently than every ten years."

Objectives for the Proposed Action

DNR has four objectives for the sustainable harvest calculation. The objectives describe how the purpose and need are fulfilled. All of these objectives are based on DNR's trust mandate, the 1997 HCP, *Policy for Sustainable Forests* (described in the following section), other existing DNR policies, and applicable local, state, and federal laws.

- **Objective #1:** Coordinate with the marbled murrelet (*Brachyramphus marmoratus*) long-term conservation strategy environmental analysis so that the Board of Natural Resources can integrate the effects of the range of marbled murrelet conservation alternatives on the sustainable harvest level and arrearage.

- **Objective #2:** Incorporate new information into an updated model to calculate the sustainable harvest level. New information includes changes in the land base, changes in forest inventory, information concerning the prior decadal arrearage and its causes, changes in technology, and any updates from the finalized forest land plans for the Olympic Experimental State Forest and South Puget HCP planning units.

- **Objective #3:** Consider climate change as part of the affected environment, analyze climate change impacts and benefits of the alternatives, and identify possible mitigation measures that will reduce or eliminate any identified adverse environmental climate change impacts of the proposal.

- **Objective #4:** Ensure alternatives analyzed are reasonable, feasible, and consistent with DNR's trust management obligations, existing DNR policies, and applicable local, state, and federal laws.

What Is the Sustainable Harvest Level?

The sustainable harvest level is defined in RCW 79.10.300(5) as "the volume of timber scheduled for sale from state-owned lands during a planning decade as calculated by DNR and approved by the board." The *Policy for Sustainable Forests* establishes policies that govern the sustainable harvest calculation. DNR calculates the sustainable harvest level for each of the 20 sustainable harvest units in western Washington. DNR must calculate an estimated multi-decade level such that the mean annual timber volume for any decade should not vary up or down more than 25 percent from the level of the preceding decade for any sustainable harvest unit. The mean annual harvest level is calculated by dividing the decadal sustainable harvest level by 10. Annual variation in the harvest level is allowed so that DNR can take advantage of market opportunities. (Refer to p. 28–30 of the *Policy for Sustainable Forests* for policies guiding the sustainable harvest calculation.)

The sustainable harvest level is a non-project action and does not authorize any specific timber sales. Once adopted, the sustainable harvest level will be used by DNR to plan and offer for sale harvests within the analysis area, consistent with DNR policies and applicable local, state, and federal laws. DNR will still conduct environmental review of site-specific timber harvests subject to the State Environmental Policy Act (SEPA).

The department is also required by RCW 79.10.330 to conduct an analysis of any arrearage volume resulting from the previous planning decade (fiscal year 2005–2014) to determine the best course of action. For purposes of this analysis, arrearage volume is the difference between the planned sustainable harvest level and the actual harvest level in a planning decade.[4] The purpose, need, and objectives for this proposal combine the arrearage analysis with the calculation of a sustainable harvest level.

DNR's proposed sustainable harvest level does not govern the management of lands owned or managed by other landowners in western Washington. DNR's sustainable harvest level only applies to the management of state trust lands.

[4] The definition of arrearage in RCW 79.10.300(1) is a cumulative calculation dating back to 1979, while RCW 79.10.330 requires a decadal analysis.

1.2 Regulatory and Policy Framework

State trust lands in western Washington are subject to a variety of federal, state, and local laws, as well as policies adopted by the Board of Natural Resources (Board). All management activities, including timber harvests and road construction, must comply with these laws and policies.

1997 Habitat Conservation Plan

Forest management activities on DNR-managed lands in western Washington are subject to the 1997 HCP and associated incidental take permits.[5] The 1997 HCP is a long-term land management plan that is authorized under the Endangered Species Act (ESA) and prepared in partnership with the federal services.[6] The 1997 HCP describes how DNR meets ESA Section 10 criteria with a suite of habitat conservation strategies focused on northern spotted owl, marbled murrelet, salmon, and riparian obligate species, as well as other unlisted species, in conjunction with timber harvest and other forest management activities.[7] 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 1997 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.

Policy for Sustainable Forests

The *Policy for Sustainable Forests* is DNR's guiding set of policies for the management and stewardship of forested state trust lands. The policy describes DNR's obligations for managing forestlands on behalf of the state trusts and establishes specific policies around economic performance, forest ecosystem health and productivity, and social and cultural benefits. The *Policy for Sustainable Forests* works to support implementation of the 1997 HCP. The multiple benefits from 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, and social and cultural benefits (DNR 2006a, p. 25–50).

[5] In this document, the term "incidental take permit" refers to all of the following: DNR's original incidental take permit [PRT 812521] issued by USFWS in 1997, amendments to that permit in 1998 and 1999, and an incidental take permit [PRT 1168] issued by NOAA in 2009 for six types of salmon stocks.
[6] 16 U.S.C. 1531 *et seq*.
[7] ESA Section 10 (a)(2)(B); 16 U.S.C. §1539 (a)(2)(B).

State Forest Practices Act

In 1974, the Legislature passed the Forest Practices Act (Act), which regulates activities such as growing and harvesting timber on all non-federal forestlands in the state, including forested state trust lands.[8] The Forest Practices Board adopts forest practices rules that implement the Act.[9]

In 1999, the Legislature directed the Forest Practices Board to amend the rules to be consistent with the April 1999 Forests and Fish Report.[10] 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 (ESA).[11] In 2001, the Forest Practices Board amended the rules and, in 2006, the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) approved the programmatic *Forest Practices Habitat Conservation Plan* and associated incidental take permits to conserve fish and amphibian species. The Forest Practices HCP provides ESA incidental take coverage for all forest landowners through the state's Forest Practices program.

Specific forest practice rules apply to forest practices covered by an HCP like the 1997 State Trust Lands HCP.[12] DNR has obtained approval for substitution of certain 1997 HCP requirements.[13]

State Trust Lands

As a trust lands manager, DNR must follow the common law duties of a trustee. Two of these duties were defined 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 state's duty as trustee is to manage trust assets prudently (DNR 2006a, p. 15). Refer to the *Policy for Sustainable Forests*, p. 9–16, for a description of DNR's trust management duties.

This Final Environmental Impact Statement (FEIS) 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. The term "state trust lands" used in this FEIS 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 (25 U.S. Statutes at Large, c. 180 p. 676) to grant the

[8] RCW 76.09.
[9] RCW 76.09.030 and .040.
[10] RCW 77.85.180.
[11] RCW 77.85.190.
[12] WAC 222-16-080(6)(i)(Exempting forest practices consistent with HCP from Class IV-Special classification); WAC 222-12-041(3)(a) (Use of HCPs for aquatic resources).
[13] DNR Proprietary HCP Substitution Agreement for Aquatic Resources within the OESF Planning Unit, 2008; DNR Proprietary HCP Substitution Agreement for Aquatic Resources, Five West-side Planning Units, Excluding the OESF, 2008; DNR Proprietary HCP Implementation Agreement for the Northern Spotted Owl, 2008; and DNR Proprietary HCP Implementation Agreement for the Marbled Murrelet, 2014, Five West-side and the Olympic Experimental State Forest Planning Units.

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 2006a). 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 Forest Lands are used primarily for forestry, forever reserved from sale, and are managed similarly to federally granted trust lands.

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

- **Community College Forest Reserve** (RCW 79.02.420): In addition to the State Lands and State Forest Lands, DNR also manages more than 3,200 acres of forestlands for community colleges. The Community College Forest Reserve was established by the Legislature in 1996. Monies 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 the county's biosolids will be applied to these lands where soils and locations are appropriate.

■ Other Related Laws and Policies

DNR complies with all other applicable local, state, and federal laws. Some examples include the Shoreline Management Act,[14] which is intended to protect valuable shoreline resources, and the state and federal Clean Water Acts,[15] which establish the basic structure for regulating discharges of pollutants into the waters of the United States. The state and federal Clean Air Acts[16] and certain local laws also affect the management of state trust lands. Chapter 3 summarizes the applicable laws and policies for each element of the environment evaluated for impacts.

[14] RCW 90.58.
[15] 33 U.S.C. §1251 *et seq*. (1972); RCW 90.48.
[16] 42 U.S.C. §7401 *et seq*. (1970); RCW 70.94.

1.3 Analysis Area

The analysis area is all DNR-managed forestlands in western Washington. Western Washington is defined in this FEIS as lands in the Columbia, North Puget, Olympic Experimental State Forest, South Coast, South Puget, and Straits HCP planning units (Figure 1.3.1). This area includes about 1.4 million acres of forested (1.5 million acres, including forested and non-forested areas) state trust lands (Table 1.3.1).

The sustainable harvest level is set only for state trust lands in western Washington. However, other forestlands managed by DNR where harvest does not occur, such as Natural Area Preserves and Natural Resource Conservation Areas, are included in the analysis area because they contribute to meeting ecological objectives. For example, Natural Resource Conservation Areas contain northern spotted owl habitat that contributes to the conservation strategy for northern spotted owl defined in the 1997 HCP (p.1–38). This FEIS uses "DNR-managed lands" to refer to forested state trust lands as well as other forestlands managed by DNR.

Table 1.3.1. Land Ownership in Western Washington (Forested and Non-Forested)

Land within western Washington		Acres
Total land regardless of ownership		19,465,123
	Acres	Percent
US Forest Service, USFWS, and National Park Service land	5,647,041	29%
DNR-managed land	1,572,544	8%
Private and other	12,245,538	63%

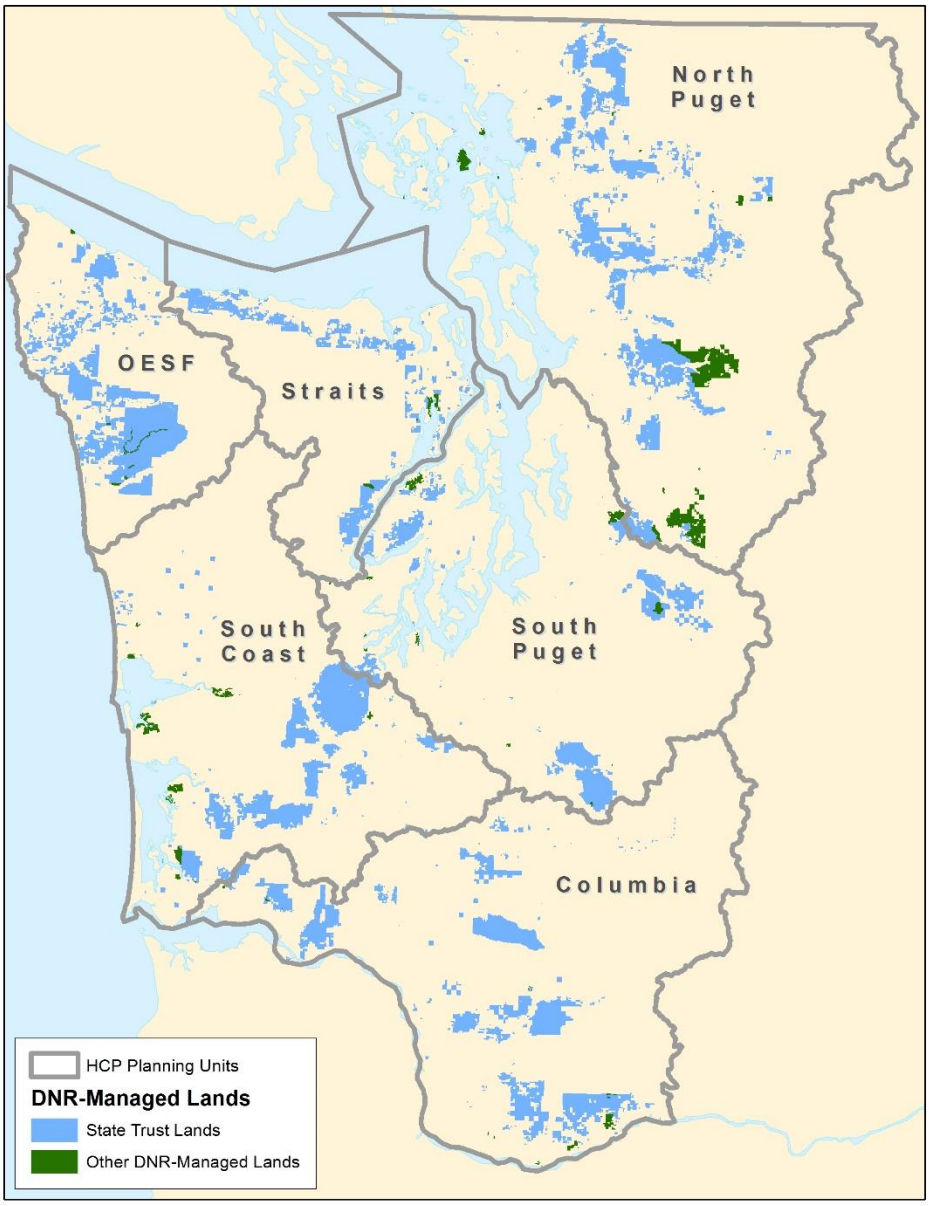
As a result of the regulatory and policy framework described in the preceding section, the analysis area is comprised of both areas managed for forest cover and areas where harvest may occur. Thinning may occur in some areas managed for forest cover but not others, depending on policy or law. Areas managed for forest cover are managed for wildlife habitat or other ecological values and include Natural Area Preserves, Natural Resource Conservation Areas, riparian areas, lands in stream and wetland buffers, areas managed for northern spotted owl or marbled murrelet habitat, certain potentially unstable slopes,[17] and areas with a range of operational difficulties. The alternatives differ in area in each category due to differences in the marbled murrelet long-term conservation strategy (Table 1.3.2).

[17] Management on or near potentially unstable slopes as determined by office and field assessments by a qualified expert. Refer to Chapter 3.1 for more information.

Table 1.3.2. Distribution of Lands by Management Category
(Refer to Chapter 2 for a detailed description of the alternatives; sums may not equal totals due to rounding)

	Lands where even-aged management may not occur (acres)	Lands where even-aged management may occur (acres)	Total (acres)
Alternative 1	685,000	779,000	1,465,000
Alternative 2	678,000	787,000	1,465,000
Alternative 3	709,000	756,000	1,465,000
Alternative 4	709,000	756,000	1,465,000
Alternative 5	818,000	646,000	1,465,000
Alternative 6	698,000	767,000	1,465,000

Figure 1.3.1. DNR-Managed Lands in Western Washington



What Are Sustainable Harvest Units?

Sustainable harvest units are smaller landscapes within the analysis area. Sustainable harvest levels are calculated for each of these sustainable harvest units. The *Policy for Sustainable Forests* (DNR 2006a, p. 29) divides western Washington into 20 sustainable harvest units (refer to Table 1.3.3, Table 1.3.4, and Figure 1.3.2). The units are:

- The Olympic Experimental State Forest (OESF), regardless of trust.
- The Capitol State Forest, regardless of trust.

- Each of the 17 county beneficiaries of State Forest Transfer Lands separately (excluding those lands in the OESF or Capitol State Forest).
- All of the federally granted trusts and State Forest Purchase Lands in western Washington together, with the exception of the OESF and Capitol State Forest.

Policies and laws apply in the same manner to each sustainable harvest unit.

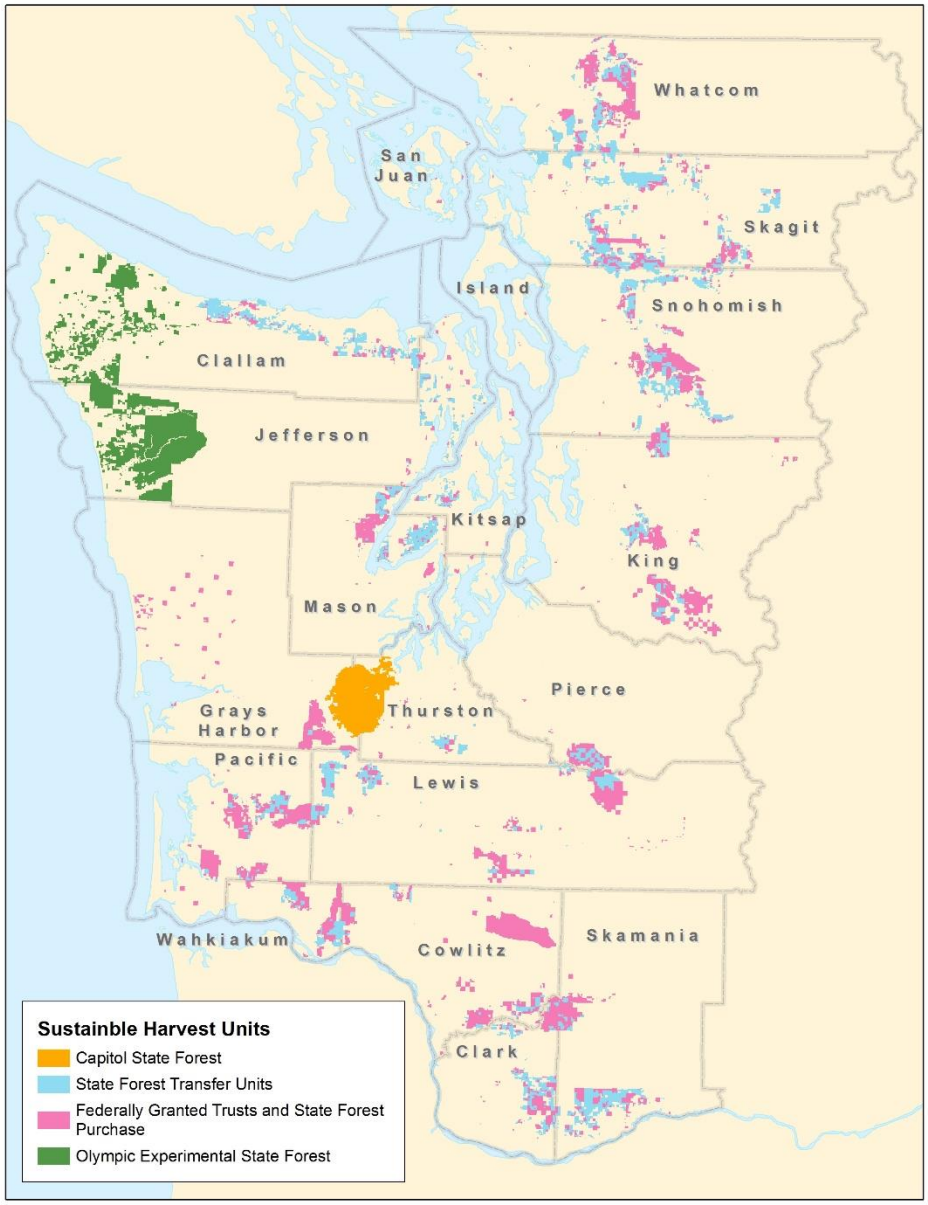
Table 1.3.3. Sustainable Harvest Units (Values may not sum to totals due to rounding)

Category	Sustainable harvest units	Forested acres	Percent of total forested acres
All trusts within these geographic areas	OESF	255,000	19%
	Capitol State Forest	90,000	7%
Federally granted trust and State Forest Purchase Lands	Federally granted trusts and State Forest Purchase Lands outside of the OESF and Capitol Forest	593,000	43%
State Forest Transfer Lands	Clallam County (outside of the OESF)	48,000	3%
	Clark County	25,000	2%
	Cowlitz County	10,000	1%
	Grays Harbor County (outside of Capitol Forest)	600	<1%
	Jefferson County (outside of the OESF)	14,000	1%
	King County	21,000	2%
	Kitsap County	7,000	1%
	Lewis County	38,000	3%
	Mason County	26,000	2%
	Pacific County	14,000	1%
	Pierce County	8,000	1%
	Skagit County	80,000	6%
	Skamania County	35,000	3%
	Snohomish County	59,000	4%
	Thurston County (outside of Capitol Forest)	7,000	0%
	Wahkiakum County	12,000	1%
	Whatcom County	28,000	2%
Total		1,372,000	100%

Table 1.3.4. DNR-Managed Lands in the Analysis Area

Category	Forested acres	Percent
All sustainable harvest units	1,372,000	94%
Other lands (including natural areas)	93,000	6%
Total	1,465,000	100%

Figure 1.3.2. Western Washington State Trust Lands Sustainable Harvest Units
(Individual units for State Forest Transfer Lands in each county are not shown separately)



1.4 EIS and Approval Process

The sustainable harvest calculation is a non-project action. Non-project actions include the adoption of plans, policies, programs, or regulations that contain standards controlling the use of the environment or that regulate or guide future on-the-ground actions (WAC 197-11-704(2)(b)).[18]

Project Scoping

On January 29, 2015, DNR issued a Determination of Significance and Public Scoping Notice for the proposal to establish a sustainable harvest level for the fiscal year 2015–2024 planning decade for forested state trust lands in western Washington, indicating that an environmental impact statement (EIS) would be prepared (Figure 1.4.1). This notice opened a scoping period that ran from January 29, 2015, to February 27, 2015. Scoping is the first formal step in preparing an EIS and initiates public comment.

In the scoping notice, DNR provided information during two webinars. One webinar was held live on February 12, 2015. A second webinar was recorded and made available for public viewing on DNR's website starting February 9, 2015. A webinar is a public meeting held over the internet. The webinar discussed four topics: the environmental review steps required by the State Environmental Policy Act (SEPA), background on the purpose of scoping, how to make effective comments to DNR during the scoping period, and sustainable harvest calculation proposal information. During the webinar, participants could make comments. DNR saved these comments. DNR also received and saved comments submitted in writing during the comment period. All the comments received were reviewed and considered in the development of the analyses in the Draft Environmental Impact Statement (DEIS). More information about the scoping period and comments received is in Appendix A.

Based on comments received in the scoping process, DNR determined the need to consider the following elements of the environment in the DEIS:

- Earth: Geology and Soils
- Climate
- Aquatic Resources
- Vegetation
- Wildlife

[18] Future management actions depend, in part, on the decisions made during this planning process, but no specific on-the-ground activities are designed as part of this process.

Development of the DEIS

Following scoping, DNR developed a set of management alternatives. The alternatives represent meaningful management options to decision makers and incorporate, where appropriate, the ideas and concerns expressed by oral and written comments from the public and stakeholders.

DNR then prepared the DEIS in 2016. In the DEIS, DNR analyzed a reasonable range of alternatives to identify potential environmental impacts under SEPA. The DEIS did not specify a preferred alternative for the sustainable harvest level.

Figure 1.4.1. EIS and Approval Process

On December 2, 2016, notice of availability of the DEIS was issued in compliance with SEPA, initiating a 90-day public comment period. DNR received over 1,300 comments during this comment period. Comments came in the form of individual letters, form letters, emails, and comment cards that were submitted during four public meetings. Some commenters supported one of the alternatives analyzed, some suggested new alternatives, and others suggested changes to what was analyzed in the DEIS and what should be included in subsequent analysis. Refer to Appendix L for summaries of comments received on the DEIS and DNR's responses to those comments.

Development of the FEIS

A considerable portion of the text from the DEIS was used in this FEIS. Some data changes were made as well (refer to "Changes between the DEIS and the FEIS" at the end of this chapter as well as Appendix F). Additionally, several appendices were updated and new appendices were added, including summaries of comments received on the DEIS and DNR's responses to those comments (see Appendix L).

DNR reviewed and considered all comments received on the DEIS to prepare this FEIS.

Who Is the Decision Maker?

DNR's decision maker for establishing the sustainable harvest level is the Board of Natural Resources. Board approval is required by RCW 79.10.300 and 79.10.330, as well as the *Policy for Sustainable Forests* (p. 29). 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 alternative in this FEIS, it will be within the range analyzed.

Approval Process

Once the FEIS is published, the Board will select a harvest level based on an alternative or combination of components of two or more alternatives. The Board will consider the potential environmental impacts of the alternatives; the ability of the alternatives to meet DNR's purpose, need, and objectives as described in the FEIS; and the potential financial impacts of the alternatives on the trusts. The adoption of a marbled murrelet long-term conservation strategy and a sustainable harvest level will occur concurrently since the harvest level is influenced by the long-term strategy. For more detail on the marbled murrelet conservation strategy process, refer to the *Final Environmental Impact Statement for a Long-Term Conservation Strategy for the Marbled Murrelet* (DNR 2019a).

Text Box 1.4.1

What Is the Board of Natural Resources?

The Board of Natural Resources (Board) was established when the 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 regarding these actions 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.

Will the Sustainable Harvest Level Affect Other DNR Planning Processes?

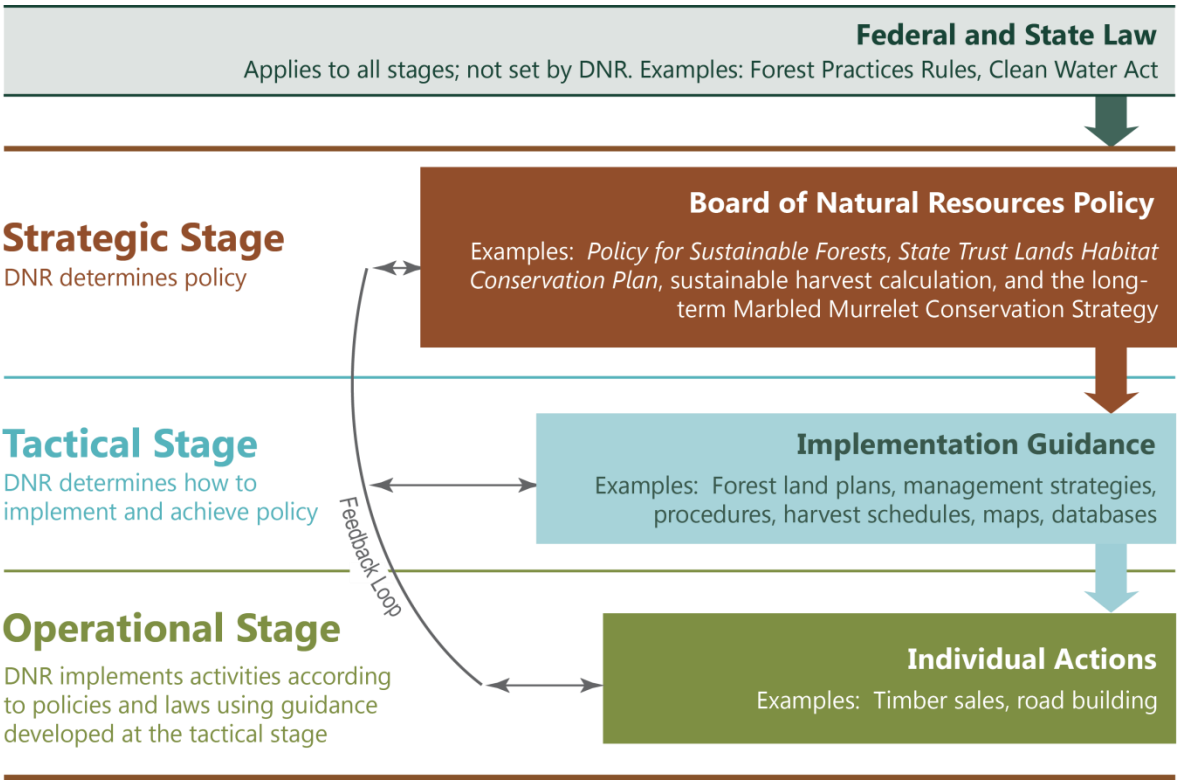
The sustainable harvest level will affect certain planning processes, but others will not be affected. To understand why and how, it is important to understand DNR's planning process. This process has three stages: strategic, tactical, and operational (Figure 1.4.2).

The first 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. Examples of policies include the 1997 HCP and the Policy for Sustainable Forests. Another

example of a policy is the sustainable harvest calculation. All of these policies require approval from the Board.

Consistent with Objective #1, the sustainable harvest calculation incorporates the marbled murrelet alternatives into the alternatives analyzed in this FEIS. The sustainable harvest calculation will not change the murrelet strategy. However, the marbled murrelet long-term conservation strategy may affect both harvest volumes and the placement of harvests on the landscape. Once the USFWS makes a final determination to approve DNR's application for amendment of the 1997 HCP (refer to Appendix Q of DNR 2019a), and issues an amended incidental take permit, the Board will decide whether to accept the permit terms and conditions (thus adopting the marbled murrelet long-term conservation strategy), and the associated sustainable harvest level. The Board will also consider adopting the End of Decade Analysis: Arrearage policy and revisions to the Policy on Definition of Sustainability for the Sustainable Harvest Calculation within the *Policy for Sustainable Forests*.

Figure 1.4.2. DNR's Planning Process



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 may also 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 planning unit. To date, DNR has completed forest land plans for the South Puget HCP planning unit (DNR 2010) and the OESF HCP planning unit (DNR 2016b). Consistent with Objective #2, the sustainable harvest alternatives will incorporate both forest land plans.

Text Box 1.4.2

After the Sustainable Harvest Level Is Adopted, Will Individual Projects in the Analysis Area Still be Reviewed Under SEPA, National Environmental Policy Act (NEPA), and Other Laws?

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

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.

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.[19]

Changes Between the DEIS and the FEIS

DNR made a number of changes to the FEIS based in part on comments received on the DEIS, comments received on the *Draft Environmental Impact Statement for the Long-Term Conservation Strategy for the Marbled Murrelet* (DNR 2016c) and the *Revised Draft Environmental Impact Statement for the Long-Term Conservation Strategy for the Marbled Murrelet* (DNR 2018), and direction from the Board.

- **DNR's Preferred Alternative (Alternative 6)**: DNR developed this alternative with direction from the Board and in response to comments received on the DEIS, as well as comments on the marbled murrelet DEIS and RDEIS. The marbled murrelet long term conservation strategy in this alternative reflects the strategy that DNR submitted to USFWS in the form of an HCP amendment (Amendment) in support of an amendment to DNR's incidental take permit (refer to Appendix Q of DNR 2019a). Alternative 6 is described in detail in Chapter 2 of this FEIS.

- **Data Updates**: DNR updated its data for this analysis. These data changes affect all of the alternatives in this FEIS. Refer to DNR 2019a Chapter 1 and Appendix O for more information.

- **Model Updates**: DNR updated several of the constraints used in the model that calculates the sustainable harvest level. These updates include updated inventory data, adjusted yields, and changes to northern spotted owl habitat development and management. These and other updates are described in detail in Appendix F of this FEIS.

- **Policy on Arrearage proposed addition to the *Policy for Sustainable Forests***: At the November 7th, 2017, Board of Natural Resources meeting, the Board directed staff to develop a policy on how to consistently calculate and address arrearage. The End of Decade Analysis: Arrearage policy proposed addition to the *Policy for Sustainable Forests* is based on the approach DNR used to develop the arrearage analysis presented to the Board. It has been incorporated into the sustainable harvest level arrearage options for the 2015-2024 planning decade. More information about this policy is in Chapter 2 and Appendix M of this FEIS.

- **Updates to the *Policy for Sustainable Forests***: Clarifications to the Policy on Definition of Sustainability for the Sustainable Harvest Calculation are proposed on how much the harvest level may fluctuate within and between decades. Specific language is in Appendix N of this FEIS.

[19] Some actions are exempt from SEPA review by statute or rule. Refer to RCW 43.21C.037 (Exempting Class I, II, or III forest practices defined in WAC 222-16-050—includes precommercial thinning and tree planting); WAC 332-41-833 (Exempting certain small timber sales); WAC 197-11-800, 830 (SEPA categorical exemptions for minor activities).

What Is in the Other Chapters of This FEIS?

- **Chapter 2**, "The Alternatives," describes the six alternatives in detail, with information about how the alternatives were developed and data comparing the alternatives to one another.
- **Chapter 3**, "Affected Environment," describes the affected environment. Elements of the natural and built environment likely to be affected by the alternatives are summarized, and the chapter provides baseline conditions against which the FEIS will evaluate potential impacts from the alternatives.
- **Chapter 4**, "Environmental Consequences," describes the environmental consequences and 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 FEIS.
- **Chapter 7**, "Key Definitions," defines terms used in this FEIS.

2

Chapter 2

THE ALTERNATIVES

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Chapter 2

The Alternatives

In this chapter, DNR describes six alternatives being considered for the sustainable harvest level for the fiscal year 2015– 2024 planning decade for forested state trust lands in western Washington.

2.1 Developing the Sustainable Harvest Alternatives

The sustainable harvest alternatives include three key components: 1) the marbled murrelet long-term conservation strategy (impacts of which are analyzed in the marbled murrelet long-term conservation strategy FEIS); 2) how to best address the arrearage volume from the fiscal year 2005–2014 planning decade; and, 3) how much riparian harvest will be considered as part of the sustainable harvest level.

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, method for incorporating arrearage, and riparian thinning level.

■ Marbled Murrelet Options

Incorporating the marbled murrelet long-term conservation strategy within the alternatives is consistent with the purpose, need, and objectives set by the Board for the sustainable harvest calculation. According to the first objective, the sustainable harvest calculation process will coordinate with the marbled murrelet long-term conservation strategy so that the Board can integrate the effects of the murrelet conservation strategy on the sustainable harvest level and arrearage. At their November 2015 meeting, the Board directed DNR to incorporate five marbled murrelet long-term conservation strategy options into the alternatives analyzed in the DEIS. This FEIS also includes DNR's marbled murrelet long-term conservation strategy as specified in DNR's Amendment (refer to Appendix Q of DNR 2019a).

The six conservation options cover a range of acres and configurations of long-term forest cover for marbled murrelet on DNR-managed lands. The options differ in the amount of land that is designated for marbled murrelet conservation, where conservation is located, and how conservation areas will be managed. These options are based on the eight alternatives analyzed in the marbled murrelet long-term conservation strategy FEIS. The options do not include marbled murrelet conservation strategy Alternative C because it is similar in long-term forest cover area (refer to Appendix B for an explanation of long-term forest cover) to Alternatives D and E, would result in harvest levels similar to those alternatives, and is within the range of harvest levels analyzed in this FEIS. Similarly, the options also do not include Alternative G which provides more acres of long-term forest cover than Alternatives A, B, C,

D, E, H and DNR's Amendment, but less than Alternative F. Alternative H in the *Final Environmental Impact Statement for the Long-Term Conservation Strategy for the Marbled Murrelet* (DNR 2019a) differs slightly from the long-term conservation strategy in DNR's Amendment, analyzed in this FEIS, in terms of area and location of long-term forest cover (refer to DNR 2019a Chapter 2, Appendix F, and Appendix Q for acres and location of forest cover for Alternative H and the Amendment). Thus, while not analyzed in this FEIS, Alternative H would have a similar harvest level to the Amendment and is within the range of harvest levels analyzed in this FEIS.

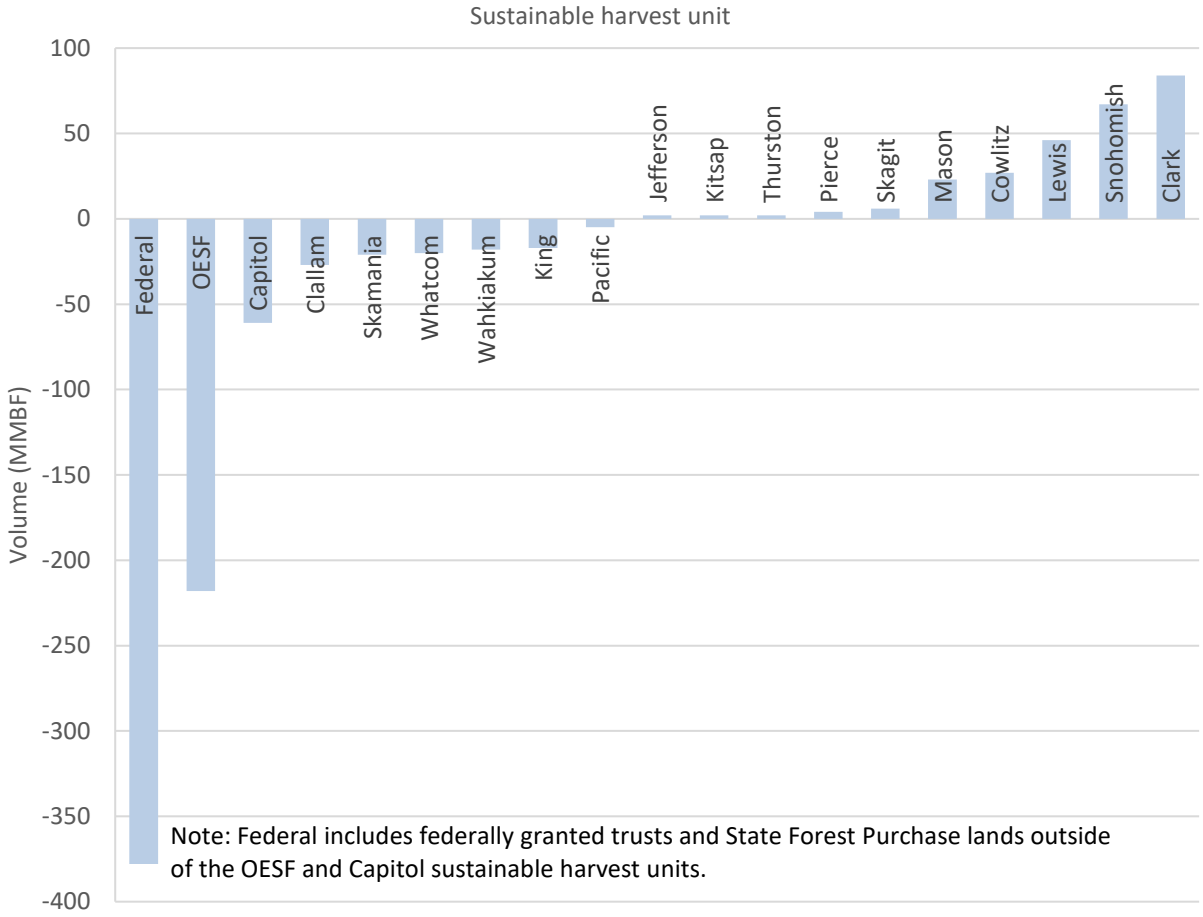
Arrearage Harvest Options

DNR is required to identify arrearage that exists at the end of any planning decade to analyze alternatives for addressing the arrearage to provide the greatest returns to the trusts and conduct an analysis on the environmental impacts of harvesting the additional timber (RCW 79.10.330). Arrearage occurs when the actual harvest volume is less than the sustainable harvest level set by the Board (refer to Appendix C for more information). The arrearage for the fiscal year 2005–2014 planning decade was 462 million board feet (MMBF). In March 2015, the Board formed a subcommittee to study arrearage further. After consideration of the subcommittee's recommendations, and to comply with RCW 79.10.330, the Board directed staff to incorporate four options for addressing arrearage into the sustainable harvest level alternatives for environmental analysis in this FEIS.

In the fiscal year 2005–2014 planning period, in some sustainable harvest units, the actual harvest exceeded the planned level while, in others, the harvest level was below the planned level. The Board directed DNR to consider the harvest of the volume from the sustainable harvest units where actual harvest levels were below planned harvest levels. This difference between the planned and actual harvest level is called a deficit (Figure 2.1.1). The sum of the deficits for these sustainable harvest units is 702 MMBF. The Board directed that this volume also be considered as arrearage volume.

At the November 7, 2017 meeting, the Board developed an arrearage harvest option that considered volume transacted though the Trust Land Transfer Program or though state forest lands reconveyance as harvest volume for the sustainable harvest units where these transactions occurred. This removed the entire deficit in the Whatcom sustainable harvest unit and 302 MMBF of the deficit in the Federal sustainable harvest unit. The resulting sum of the deficits is 382 MMBF.

Figure 2.1.1. Difference in Volume Between Fiscal Year 2005–2014 Sustainable Harvest Level and Actual Harvest



The Board had originally requested that DNR include an option for using "ecological catchup" to obtain arrearage by conducting thinning in places where DNR had not conducted thinning in the past decade so as to provide better habitat or other ecological function. The Board later determined that implementation of the recently completed *Olympic Experimental State Forest (OESF) HCP Planning Unit Forest Land Plan* (OESF Forest Land Plan) (DNR 2016b) addresses this concept, by providing for harvests that hasten the development of northern spotted owl habitat. The OESF Forest Land Plan is included in all of the sustainable harvest calculation alternatives, including the no action alternative.

The arrearage options in the sustainable harvest calculation are to:

- Harvest 702 MMBF proportionally from the sustainable harvest units with deficits over 5 years;
- Harvest 462 MMBF proportionally from the sustainable harvest units with deficits over 10 years;
- Harvest 462 MMBF proportionally from sustainable harvest units with deficits in 1 year, and then harvest the remaining sustainable harvest level volume for the decade over the next 9 years;

- Harvest 382 MMBF proportionally from sustainable harvest units with deficits over 10 years; or
- Set harvest levels without specifying arrearage quantity.

Updates to the Policy for Sustainable Forest

In developing the sustainable harvest calculation EIS and alternatives, DNR had to consider how existing laws, policies, and management practices would apply. DNR has identified two updates to the *Policy for Sustainable Forests* proposed for Board consideration.

The first is the addition of an End of Decade Analysis: Arrearage policy. As part of the sustainable harvest calculation process, RCW 79.10.330 requires an analysis of any arrearage volume resulting from the previous planning decade (fiscal years 2005–2014) to determine the best course of action. Consistent with Board direction in Objective #2 (described in Chapter 1), DNR conducted an end of decade analysis to determine the amount of and how to address arrearage volume from the fiscal year 2005-2014 planning decade. Following presentation of the analysis at the November 7, 2017 Board meeting, the Board directed DNR to develop a policy on arrearage to provide consistency in how arrearage is calculated and addressed. See Appendix M for the proposed *Policy for Sustainable Forests* End of Decade Analysis: Arrearage policy. The department also identified needed clarifications to the Definition of Sustainability for the Sustainable Harvest Calculation within the *Policy for Sustainable Forests* regarding mean annual timber volume fluctuations between and within decades. See Appendix N for the proposed changes to the *Policy for Sustainable Forests* Definition of Sustainability for the Sustainable Harvest Calculation.

Determining impacts of harvest level fluctuations within and between decades as well as impacts of arrearage harvest requirements are necessary to establish the sustainable harvest level. Upon adoption of a sustainable harvest level by the Board, these amendments to the *Policy for Sustainable Forests* will be considered for adoption.

Riparian Thinning Options

As a part of the process to establish the sustainable harvest level, the Board stated an intention to incorporate new information into an updated model, including information concerning the prior decadal arrearage and its causes. The Board identified low riparian harvest and thinning volumes as a factor that contributed to that arrearage. The 2007 sustainable harvest level assumed that 10 percent of the total riparian area available for thinning would be thinned in the decade. The resulting volume estimate was 394 MMBF, including the OESF HCP Planning Unit. However, only 39 MMBF was thinned from riparian areas during the fiscal year 2004–2015 period.[1] About 1 percent of the total area thinned or harvested by DNR in the fiscal year 2004–2015 period was in riparian areas.

[1] Some of the reasons for this deficit include that riparian thinning is more expensive than other thinning or harvests due to pre-sales costs, operability challenges, and regulatory uncertainty regarding the conservation of marbled murrelet.

The riparian thinning options differ only in the amount of riparian thinning that can occur in the five west-side planning units excluding the OESF HCP Planning Unit. The options are to:

- Thin in riparian areas in a decade an area up to 10 percent of the total riparian area in the five west-side planning units. Riparian areas cover 361,000 acres and are comprised of streams, wetlands, and associated buffers. The buffers range from 100 to over 190 feet wide depending on stream type or wetland area. This sustainable harvest calculation option would set the riparian thinning area maximum limit at 36,100 acres for the decade. Thinning levels in the alternatives (described in Chapter 2.3) are lower due to other considerations such as cost and potential revenue.

- Thin in riparian areas in a decade an area less than or equal to 1 percent of the acres thinned or harvested in non-riparian areas in a decade in the five west-side planning units. For example, if DNR expected to harvest or thin 100,000 acres outside of riparian areas in the five west-side planning units, this sustainable harvest calculation option would set the riparian thinning area maximum limit at 1,000 acres for the decade.

- Thin riparian areas consistent with the 1997 HCP and the *Riparian Forest Restoration Strategy* (RFRS) (DNR 2006c) but do not include riparian volume when setting the sustainable harvest level. During implementation, volume harvested from riparian areas will count toward attaining the sustainable harvest level. This option would give DNR the flexibility to thin within riparian areas on a case-by-case basis following the procedures for the RFRS or the OESF Forest Land Plan.

No difference in management of riparian areas is proposed for the OESF HCP Planning Unit. Thinning and limited harvest can occur in riparian areas in the OESF HCP Planning Unit under the OESF Forest Land Plan. The harvest levels are limited by the 1997 HCP, forest practice rules, the *Policy for Sustainable Forests*, and marbled murrelet long-term conservation strategy.

Settlement Agreement

The no action alternative retains the commitments in Washington Environmental Council et al. v. Sutherland et al. (Settlement Agreement) (King County Superior Court No. 04-2-26461-8SEA, dismissed April 7, 2006; refer to Appendix D for the Settlement Agreement). The Settlement Agreement requires short-term conservation of isolated patches of northern spotted owl habitat, mostly in the Columbia, Straits, and South Coast HCP planning units, and requires that acres of thinning equal the acres of harvest in the OESF HCP Planning Unit. The Settlement Agreement terminates when "the BNR approves a sustainable harvest calculation extending beyond FY 2014, but no earlier than June 30, 2014." Therefore, the Settlement Agreement is included as part of the no action alternative, but the action alternatives assume that the Settlement Agreement is terminated. Any environmental impacts that result from this termination are analyzed for each action alternative. The key change resulting from the termination of the Settlement Agreement is the reinstatement of harvest practices authorized under the 1997 HCP.

How Were the Alternatives Developed?

The alternatives were developed by pairing different management options for three areas of interest—marbled murrelet conservation, arrearage harvest, and riparian thinning level—**to create a range of harvest levels for the fiscal year 2015–2024 planning period**. Based on the options for murrelet conservation strategy approaches, arrearage harvest, and riparian harvest levels, there are 120 total possible combinations (eight marbled murrelet conservation approaches multiplied by five arrearage harvest options multiplied by three riparian thinning levels), not including the no action alternative. SEPA does not require DNR to evaluate every alternative iteration. Instead, based on Board input, DNR selected six alternatives to analyze in this FEIS, each of which includes a murrelet long-term conservation strategy, an arrearage harvest option, and a riparian thinning option. These alternatives represent the widest possible range of fiscal year 2015–2024 sustainable harvest level options for the Board to consider. The action alternatives along with the no action alternative, which assumes a sustainable harvest level consistent with the last Board resolution to set a sustainable harvest level, which was passed in 2007 (refer to Appendix E), are analyzed for their impacts on the affected environment as discussed in Chapter 3.

Management Approaches That Were Not Developed Into Alternatives

OTHER COMBINATIONS OF OPTIONS

Other combinations of marbled murrelet long-term strategy, arrearage harvest, and riparian thinning were considered but eliminated when their impacts were represented by the range of the alternatives and analysis in the DEIS and this FEIS. The alternatives analyzed encompass the full range of short-term and long-term harvest levels of different combinations of marbled murrelet long-term conservation strategy, arrearage harvest, and riparian thinning. The final action chosen by the Board need not be identical to any single alternative in the FEIS but must be within the range of the alternatives analyzed and discussed.

What if DNR Policies Change During the Planning Decade?

Future policy changes within the planning decade may result in the need to adjust the sustainable harvest level. If the need for this arises, DNR would evaluate the proposed change in the sustainable harvest level and then assess both the likely environmental impacts and the significance of those impacts.

The Sustainable Harvest Calculation Forest Estate Model

The forest estate model is a mathematical computer model of the forest. Capable of manipulating vast quantities of data, the model is used to solve problems that are too complex for other tools.

The model is built with information on current conditions, management objectives, and management activities and an understanding of natural growth processes and how forests respond to management

activities. The model stratifies DNR's forested land base into areas that have similar geographic attributes (refer to Appendix F). These similar areas are known as development types. By simultaneously considering all of this information, the model develops an optimal solution of which development types to harvest (when, where, and by what harvest method) and which not to harvest across forested state trust lands over time to meet both revenue production and ecological value objectives as effectively and efficiently as possible. To make these decisions, the model considers numerous interrelated factors, such as when the development type will be mature enough to harvest, whether or not it is deferred from harvest, how it may contribute to the objectives of DNR's conservation strategies, and how it may contribute to revenue production. Refer to Appendix F for an explanation of how the model works and changes made to the model between the DEIS and FEIS.

2.2 Elements Common to All Alternatives

All six alternatives continue DNR operations as authorized under the 1997 HCP, forest practices rules, department policy, and the *Policy for Sustainable Forests*. The alternatives also include the 1997 HCP for species other than marbled murrelet, for which multiple options are considered. All alternatives also include implementation of the OESF Forest Land Plan and the *South Puget HCP Planning Unit Forest Plan*. All alternatives contain riparian thinning rules based on the 1997 HCP and RFRS, forest practices rules, the *Policy for Sustainable Forests*, and marbled murrelet long-term conservation strategy. In addition, all six alternatives include the same assumptions of discount rate and management fund balance. DNR set the forest estate model to discount net present value by 3 percent to reflect assumptions about inflation and risk. The model also sets a budget constraint for all alternatives that requires management activities to generate at least $1.5 million more than the costs of the management activities per decade.

The data used in the forest estate model, including but not limited to forest inventory, northern spotted owl habitat classification, marbled murrelet long-term forest cover, and land ownership, are current as of January 12, 2018.

Establishing a sustainable harvest level does not authorize any project-specific timber sales but rather establishes the level of timber volume scheduled for harvest from state trust lands during a planning decade. All commercial harvests are reviewed by a Forest Practices program forester to ensure compliance with forest practices rules. Forest practices applications can be reviewed through the Forest Practices Application Review System.[2]

All alternatives would result in a continuation of DNR's timber sale program and associated forest management activities. Under all alternatives, DNR would continue to sell timber from state trust lands as allowed by existing regulations, policies, and procedures. Existing regulations and policies are designed to minimize the impacts of timber harvests and associated road construction.

[2] Refer to Forest Practices Application Review System at https://www.dnr.wa.gov/programs-and-services/forest-practices/forest-practices-application-review-system-fpars.

2.3 Profiles of the Alternatives

Alternative 1

Alternative 1 is the "no action" alternative. In this alternative, the sustainable harvest level is set at 5.5 billion board feet for the new planning decade, an average of 550 MMBF per year. This level was approved by the Board in 2007 for the fiscal year 2005–2014 planning decade. Without a new Board resolution, the annual target of 550 MMBF would remain in place. This alternative assumes that the Settlement Agreement remains in place.

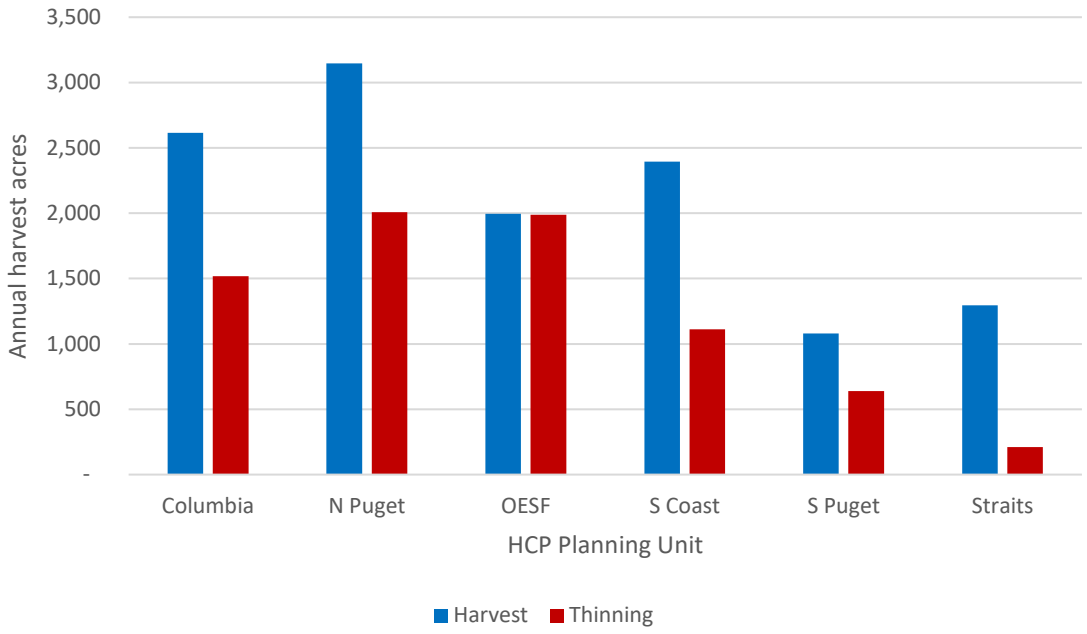
Alternative 1 does not assume harvest of volume from arrearage in the last planning decade. This alternative assumes no decision regarding arrearage volume has been made. This alternative includes the riparian thinning assumption from 2004 for the five western Washington HCP planning units to schedule an area up to 10 percent of the riparian area for thinning. Finally, the alternative assumes a continuation of DNR operations as authorized under the 1997 HCP and incidental take permits for all of west-side planning units (Table 2.3.1; refer to the marbled murrelet long-term conservation strategy Alternative A, DNR 2019a).

The average annual harvest volume for Alternative 1 is 550 MMBF. Harvest activities are expected to take place on an average of 12,529 acres and thinning on 7,478 acres per year (Figure 2.3.1). In the five west-side planning units, riparian thinning will occur on 3,300 acres per year.

Table 2.3.1. Alternative 1 Key Components

Key component	Description
Marbled murrelet	Continue with the interim marbled murrelet conservation strategy (Alternative A in the marbled murrelet long-term conservation strategy FEIS).
Arrearage	Assume no harvest of arrearage volume.
Riparian thinning in the five west-side planning units	Thin in the west-side planning units, excluding the OESF HCP Planning Unit, up to 10 percent of the riparian area.

Figure 2.3.1. Average Annual Harvest Activity Acres in Each HCP Planning Unit Expected in the Planning Decade Under Alternative 1



Alternative 2

Alternative 2 presents the highest volume of harvest under the proposed action alternatives. The alternative incorporates an arrearage volume of 702 MMBF to be harvested over 5 years, the high riparian thinning level in the five west-side planning units (up to 10 percent of the riparian area per decade), and a murrelet conservation strategy that conserves occupied sites (marbled murrelet long-term conservation strategy Alternative B; Table 2.3.2.).

The average annual harvest volume for Alternative 2 is 520 MMBF. Harvest activities are expected to take place on an average of 11,981 acres and thinning on 4,672 acres per year (Figure 2.3.2). In the five west-side planning units, riparian thinning will occur on 2,634 acres per year.

Table 2.3.2. Alternative 2 Key Components

Key component	Description
Marbled murrelet	Protect occupied sites (Alternative B in the marbled murrelet long-term conservation strategy FEIS).
Arrearage	Harvest 702 MMBF proportionally from sustainable harvest units with deficits over 5 years.
Riparian thinning in the five west-side planning units	Thin in the west-side planning units, excluding the OESF HCP Planning Unit, up to 10 percent of the riparian area.

Figure 2.3.2. Average Annual Harvest Activity Acres in Each HCP Planning Unit Expected in the Planning Decade Under Alternative 2

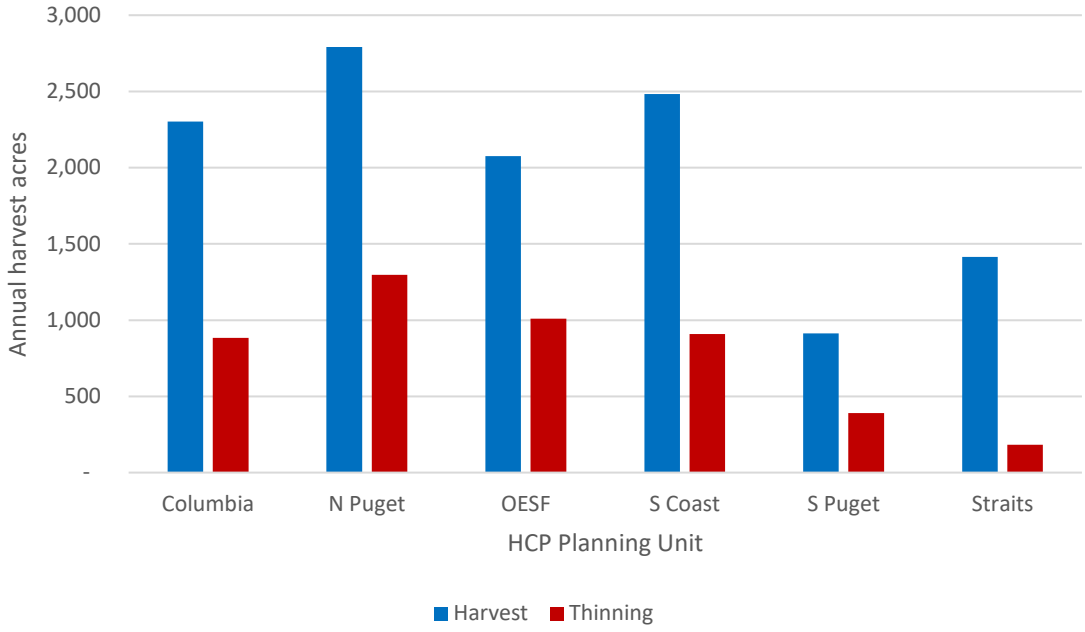
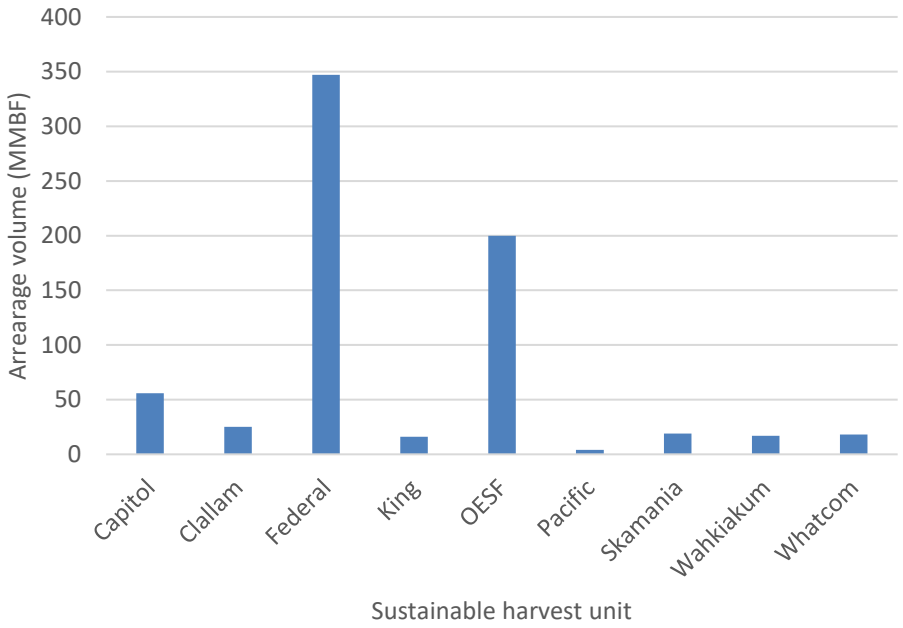


Figure 2.3.3. Arrearage Harvest by Sustainable Harvest Unit Under Alternative 2



Alternative 3

Alternative 3 combines the harvest of 462 MMBF of arrearage volume over a 10-year period with a low level of riparian thinning in the five west-side planning units (1 percent of upland harvest and thinning area) and the murrelet conservation strategy with conservation in special habitat areas (marbled murrelet long-term conservation strategy Alternative D; Table 2.3.3).

The average annual harvest volume for Alternative 3 is 459 MMBF. Harvest activities are expected to take place on an average of 11,155 acres and thinning on 2,060 acres per year (Figure 2.3.4). In the five west-side planning units, riparian thinning will occur on 104 acres per year.

Table 2.3.3. Alternative 3 Key Components

Key component	Description
Marbled murrelet	Protect occupied sites and special habitat areas (Alternative D in the marbled murrelet long-term conservation strategy FEIS).
Arrearage	Harvest 462 MMBF proportionally from sustainable harvest units with deficits over 10 years.
Riparian thinning in the five west-side planning units	Thin in the five west-side planning units, excluding the OESF HCP Planning Unit, an area up to 1 percent of total upland harvest and thinning area.

Figure 2.3.4. Average Annual Harvest Activity Acres in Each HCP Planning Unit Expected in the Planning Decade Under Alternative 3

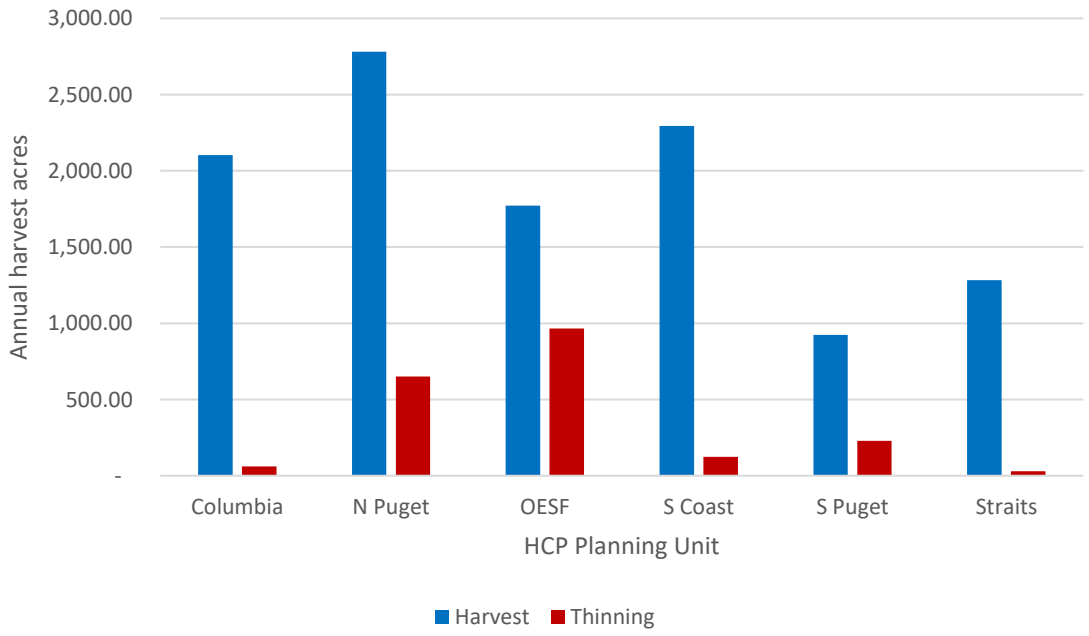
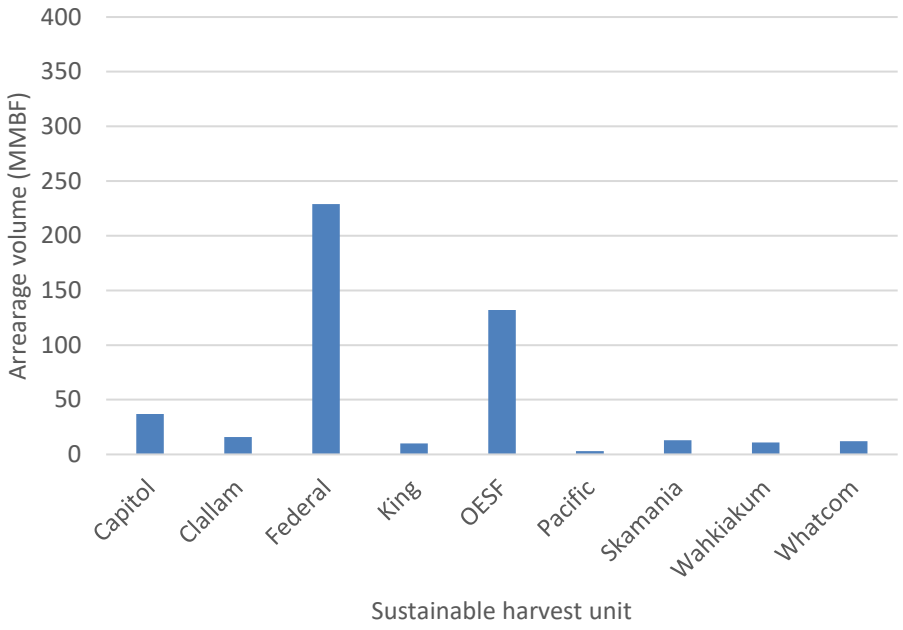


Figure 2.3.5. Arrearage Harvest by Sustainable Harvest Unit Under Alternative 3



Alternative 4

Alternative 4 combines the harvest of 462 MMBF of arrearage volume in 1 year with a low level of riparian thinning in the five west-side planning units (1 percent of upland harvest and thinning area) and the murrelet conservation strategy with conservation in special habitat areas, emphasis areas, and isolated P-stage (P-stage values ≥0.47) habitat (marbled murrelet long-term conservation strategy Alternative E; Table 2.3.4).

The average annual harvest volume for Alternative 4 is 453 MMBF. Harvest activities are expected to take place on an average of 11,015 acres and thinning on 1,990 acres per year (Figure 2.3.6). In the five west-side planning units, riparian thinning will occur on 102 acres per year.

Table 2.3.4. Alternative 4 Key Components

Key component	Description
Marbled murrelet	Protect occupied sites and a combination of emphasis areas, special habitat areas, and high-quality murrelet habitat throughout the analysis area (Alternative E in the marbled murrelet long-term conservation strategy FEIS).
Arrearage	Harvest 462 MMBF proportionally from sustainable harvest units with deficits in 1 year.
Riparian thinning in the five west-side planning units	Thin in the five west-side planning units, excluding the OESF HCP Planning Unit, an area up to 1 percent of total upland harvest and thinning area.

Figure 2.3.6. Average Annual Harvest Activity Acres in Each HCP Planning Unit Expected in the Planning Decade Under Alternative 4

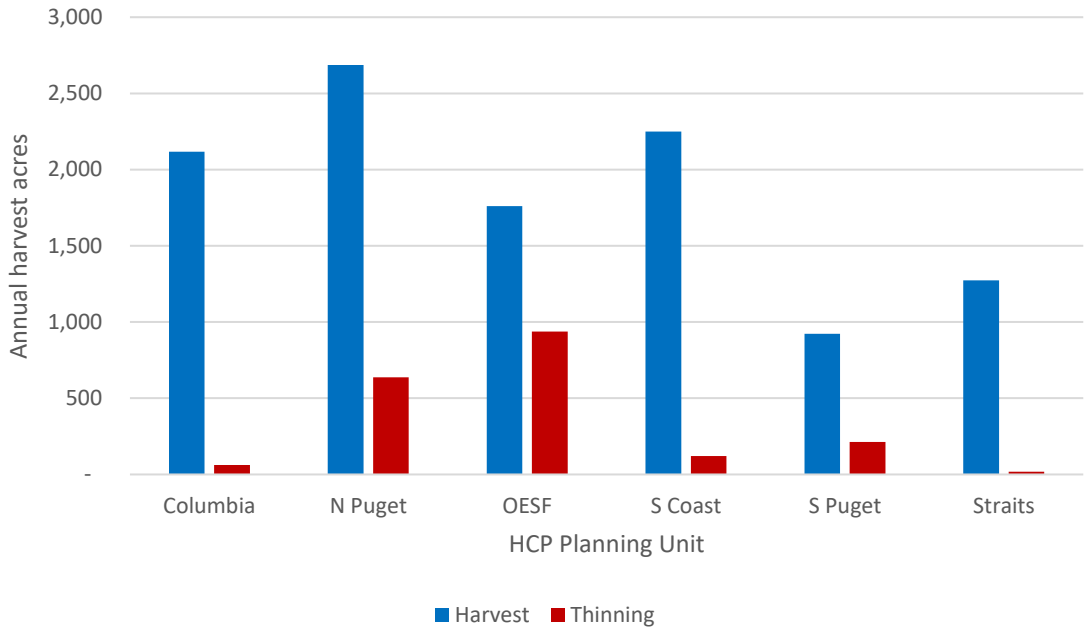
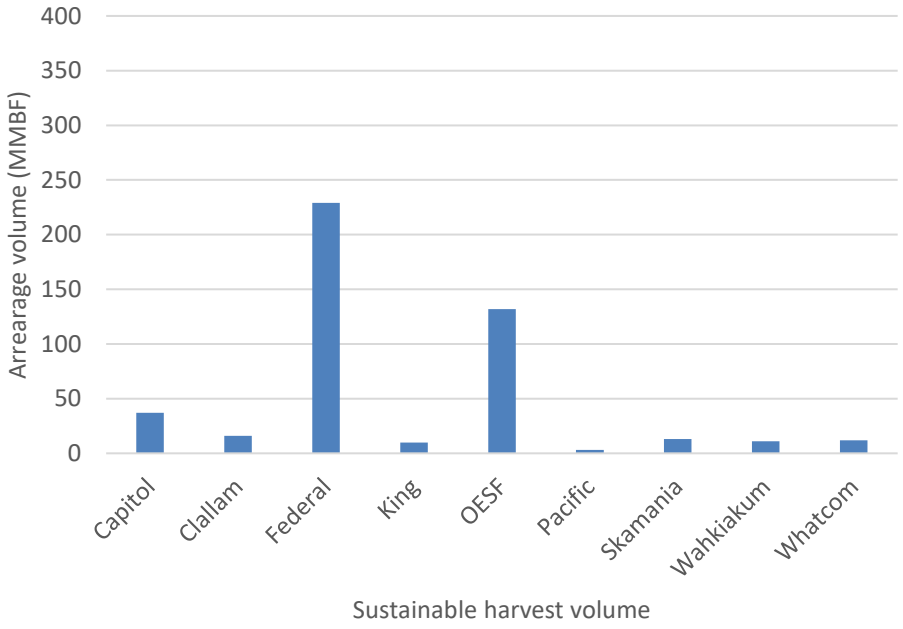


Figure 2.3.7. Arrearage Harvest by Sustainable Harvest Unit Under Alternative 4



Alternative 5

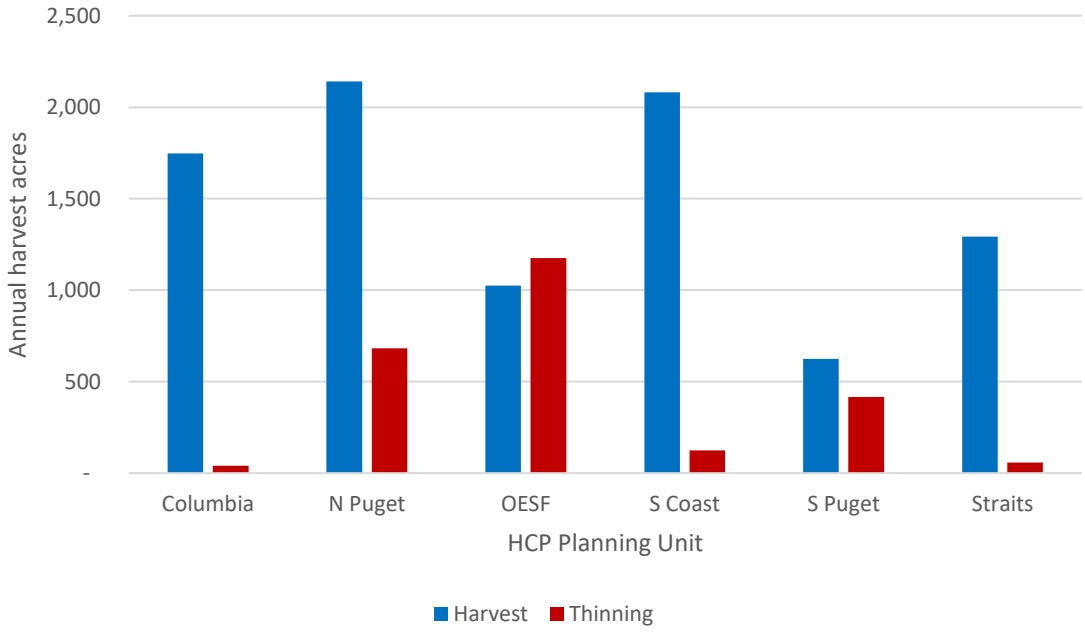
Alternative 5 produces the lowest harvest level by assuming the arrearage volume is included in the inventory and by incorporating a low level of riparian thinning in the five west-side planning units (1 percent of upland harvest and thinning area) and the murrelet conservation strategy with conservation in marbled murrelet management areas (MMMAs) similar to those in the Science Team Report (Raphael and others 2008) that also includes conservation in the North Puget HCP Planning Unit (marbled murrelet long-term conservation strategy Alternative F; Table 2.3.5).

The average annual harvest volume for Alternative 5 is 384 MMBF. Harvest activities are expected to take place on an average of 8,911 acres and thinning on 2,497 acres per year (Figure 2.3.8). In the five west-side planning units, riparian thinning will occur on 91 acres per year.

Table 2.3.5. Alternative 5 Key Components

Key component	Description
Marbled murrelet	Protect occupied sites and marbled murrelet management areas, similar to the strategy described in the Science Team Report (Raphael and others 2008) (Alternative F in the marbled murrelet long-term conservation strategy FEIS).
Arrearage	Arrearage volume is incorporated into the inventory.
Riparian thinning in the five west-side planning units	Thin in the five west-side planning units, excluding the OESF HCP planning unit, an area up to 1 percent of total upland harvest and thinning area.

Figure 2.3.8. Average Annual Harvest Activity Acres in Each HCP Planning Unit Expected in the Planning Decade Under Alternative 5



Alternative 6

Alternatives 6 is DNR's preferred alternative. This alternative combines the harvest of 382 MMBF of arrearage volume over ten years period with DNR's Amendment for the marbled murrelet long-term conservation strategy (refer to Marbled Murrelet Options of this Chapter). In this alternative, projected riparian volume is not included in the sustainable harvest level, but if harvested, would count toward the harvest calculation.

The average annual harvest volume for Alternative 6 is 465 MMBF. Harvest activities are expected to take place on an average of 11,447 acres and thinning on 1,592 acres per year (Figure 2.3.9).

Table 2.3.6. Alternative 6 Key Components

Key component	Description
Marbled murrelet	Protect occupied sites and special habitat areas (See DNR 2019a Appendix Q for DNR's application for amendment to the 1997 HCP incidental take permit).
Arrearage	Harvest 382 MMBF proportionally from sustainable harvest units with deficits over 10 years.
Riparian thinning in the five west-side planning units	Riparian volume not included when setting the sustainable harvest level.

Figure 2.3.9. Average Annual Harvest Activity Acres in Each HCP Planning Unit Expected in the Planning Decade Under Alternative 6

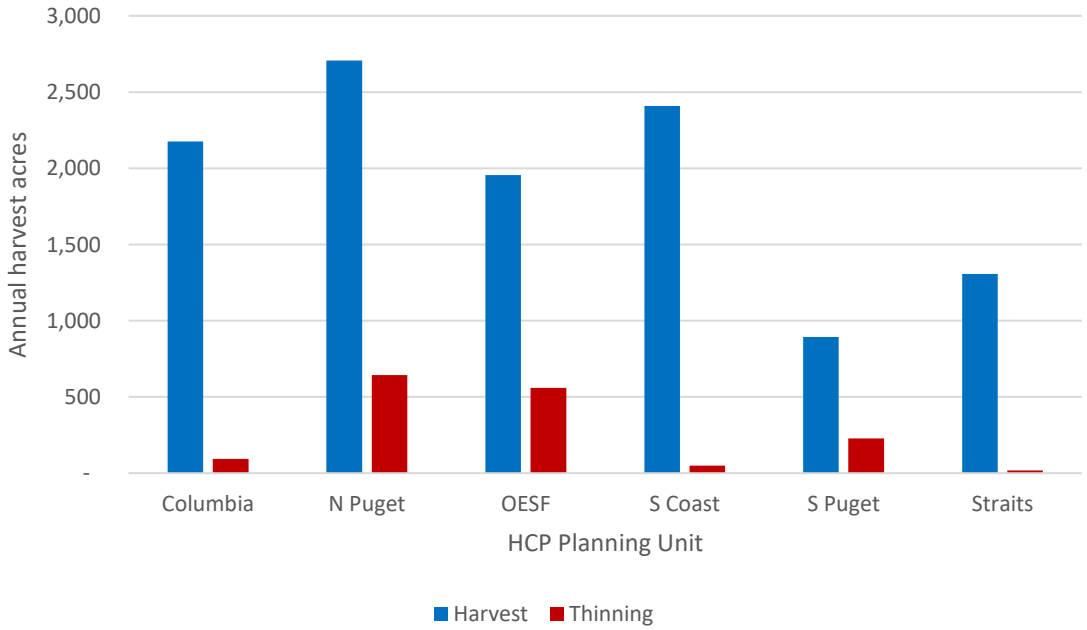
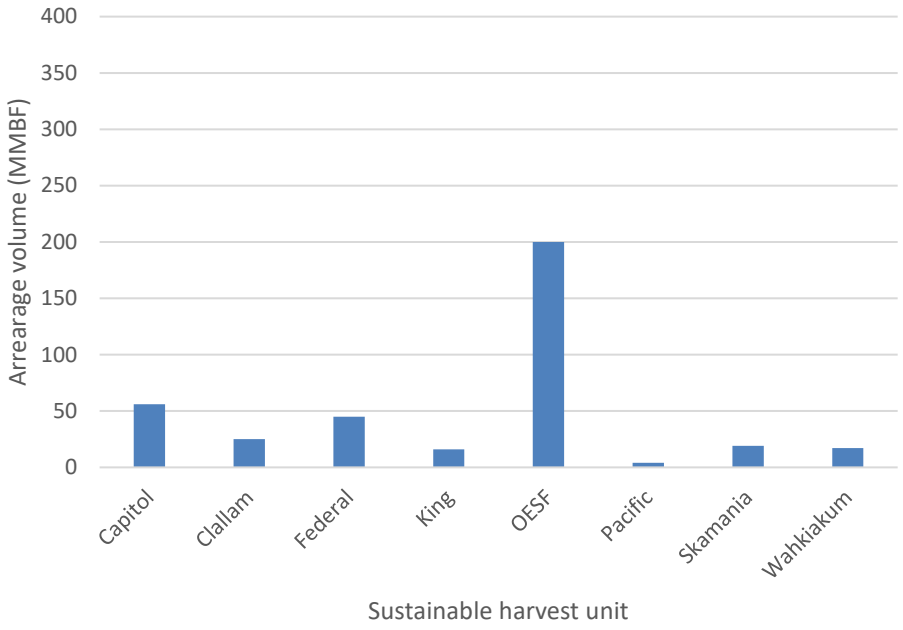


Figure 2.3.10. Arrearage Harvest by Sustainable Harvest Unit Under Alternative 6



2.4 Comparing the Alternatives

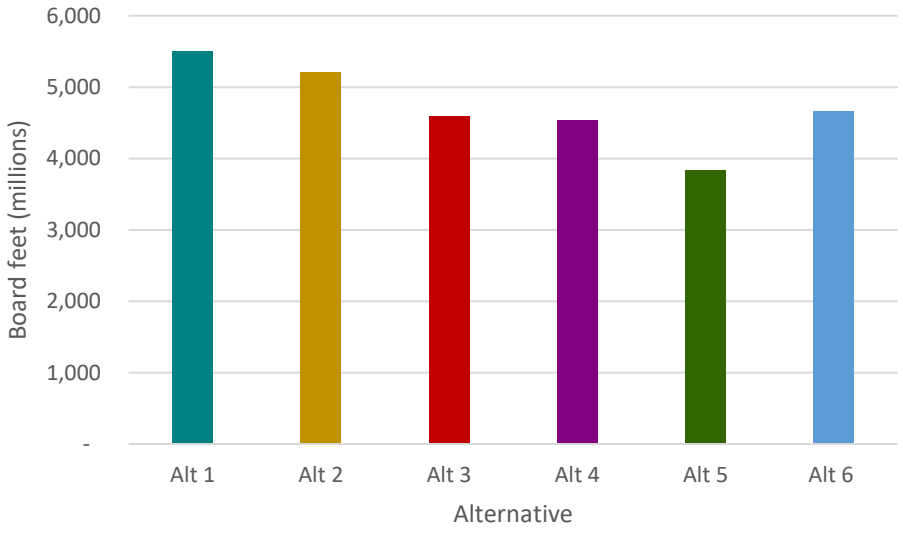
This section provides a comparison of the area of harvest and thinning and resulting timber volumes produced under each alternative (Table 2.4.1).

Table 2.4.1. Change in Volume of Harvest and Thinning in the Planning Decade Under the Action Alternatives

	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
	Acres	Percent change in harvest volume compared to Alternative 1				
Harvest	125,293	0%	-7%	-8%	-25%	-5%
Thinning	74,783	-34%	-63%	-64%	-55%	-68%

The total volume harvested in the planning decade under each alternative ranges from 5,500 MMBF under the no action alternative to 3,840 MMBF under Alternative 5 (Figure 2.4.1).

Figure 2.4.1. Total Harvest Volume for the Planning Decade Under Each Alternative



Harvest volume is typically lower in each sustainable harvest unit under the action alternatives than under the no action alternative. However, Capitol, Clallam, Grays Harbor, Jefferson, King, Pacific, Wahkiakum, and Whatcom have increases in harvest volume under one or more action alternative (Tables 2.4.2 and 2.4.3). For annual harvest volumes within the planning decade, refer to Appendix G.

Table 2.4.2. Total Harvest Volume by Sustainable Harvest Unit for the Planning Decade Under Each Alternative (Millions of board feet, rounded to nearest million)

Sustainable harvest unit	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Capitol	538	567	519	519	496	529
Clallam	185	242	203	201	209	210
Clark	74	54	48	48	48	48
Cowlitz	30	25	23	23	23	23
Federal	2,380	2,165	1,859	1,827	1,540	1,876
Grays Harbor	4	5	5	5	3	5
Jefferson	67	70	65	65	65	65
King	80	81	80	80	59	80
Kitsap	19	13	12	12	12	12
Lewis	208	203	192	190	154	191
Mason	99	98	95	95	95	95
OESF	948	835	730	720	508	739
Pacific	48	59	38	40	33	41
Pierce	36	29	29	29	9	29
Skagit	302	264	263	257	223	259
Skamania	118	107	97	97	89	101
Snohomish	224	212	199	198	179	203
Thurston	27	25	23	23	23	23
Wahkiakum	41	74	38	38	23	59
Whatcom	73	77	71	65	46	67
Total	5,500	5,202	4,590	4,533	3,837	4,654

Table 2.4.3. Change in Total Harvest Volume Between the Action Alternatives and the No Action Alternative by Sustainable Harvest Unit for the Planning Decade

Sustainable harvest unit	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
	MMBF (rounded to nearest million)	% change in harvest volume compared to Alternative 1				
Capitol	538	5%	-3%	-3%	-8%	-2%
Clallam	185	31%	10%	9%	13%	14%
Clark	74	-28%	-36%	-36%	-36%	-36%
Cowlitz	30	-19%	-23%	-23%	-25%	-23%
Federal	2,380	-9%	-22%	-23%	-35%	-21%
Grays Harbor	4	25%	25%	25%	-25%	22%
Jefferson	67	5%	-2.3%	-2.4%	-2%	-2.2%
King	80	2%	1%	0%	-26%	1%
Kitsap	19	-32%	-36%	-36%	-36%	-36%
Lewis	208	-2%	-7%	-8%	-26%	-8%
Mason	99	-2%	-4%	-5%	-4%	-4%
OESF	948	-12%	-23%	-24%	-46%	-22%
Pacific	48	24%	-20%	-17%	-30%	-15%
Pierce	36	-20%	-20%	-20%	-75%	-20%
Skagit	302	-13%	-13%	-15%	-26%	-14%
Skamania	118	-9%	-18%	-18%	-25%	-15%
Snohomish	224	-6%	-11%	-12%	-20%	-10%
Thurston	27	-5%	-13%	-13%	-14%	-13%
Wahkiakum	41	79%	-8%	-6%	-44%	43%
Whatcom	73	5%	-4%	-12%	-37%	-9%
Total	5,500	-5%	-17%	-18%	-30%	-15%

All alternatives harvest the arrearage volume specified in the alternative profiles (Chapter 2.3). The timing of harvest of arrearage volume differs between alternatives, resulting in different annual harvest levels within the planning decade (Figures 2.4.2. through 2.4.6).

Figure 2.4.2. Annual Harvest in the Planning Decade Under Alternative 1 (Assumes no decision regarding arrearage volume has been made)

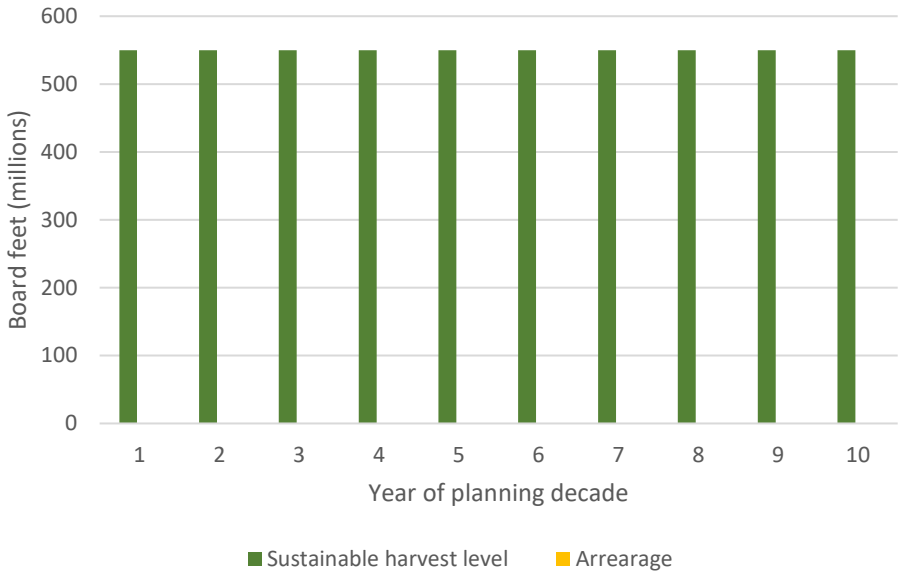


Figure 2.4.3. Annual Harvest in the Planning Decade Under Alternative 2 (702 million board feet of arrearage volume harvested in 5 years)

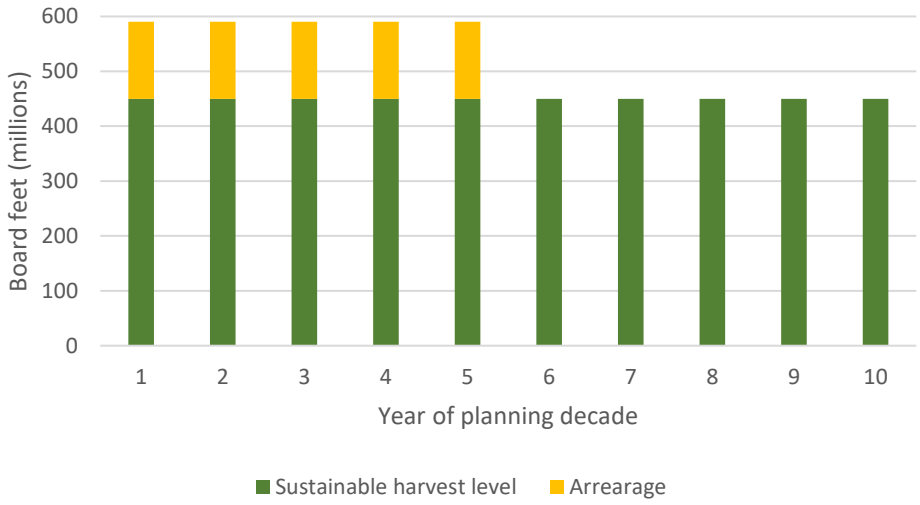


Figure 2.4.4. Annual Harvest in the Planning Decade Under Alternative 3 (462 million board feet of arrearage volume harvested in 10 years)

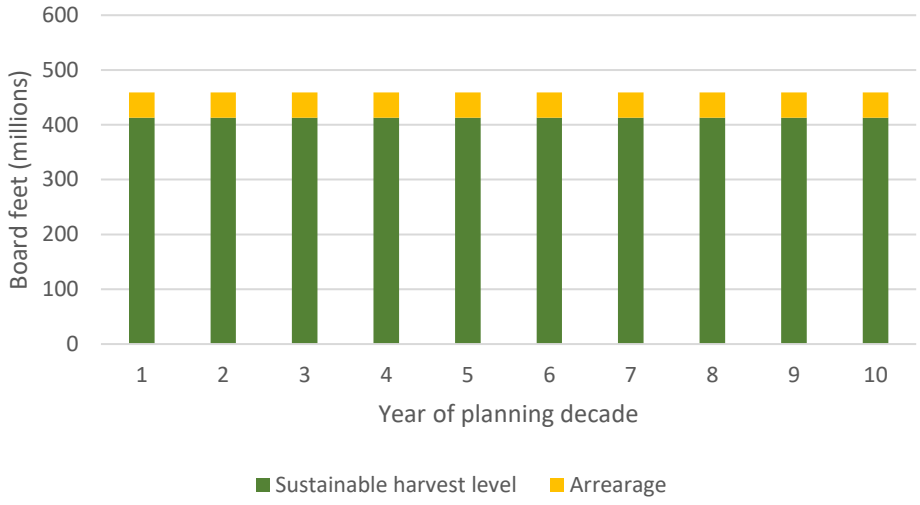


Figure 2.4.5. Annual Harvest in the Planning Decade Under Alternative 4 (462 million board feet of arrearage volume harvested in 1 year, and the sustainable harvest calculation volume is harvested in the remaining 9 years)

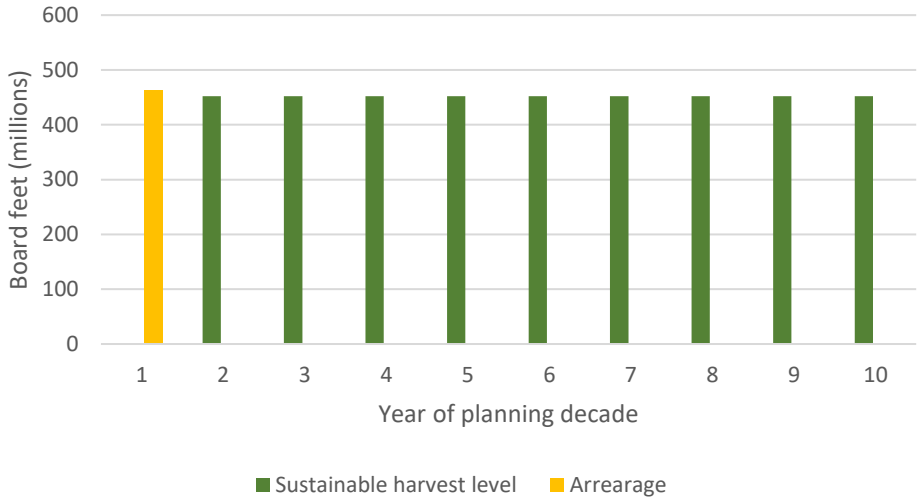


Figure 2.4.6. Annual Harvest in the Planning Decade Under Alternative 5 (Arrearage is incorporated into the inventory)

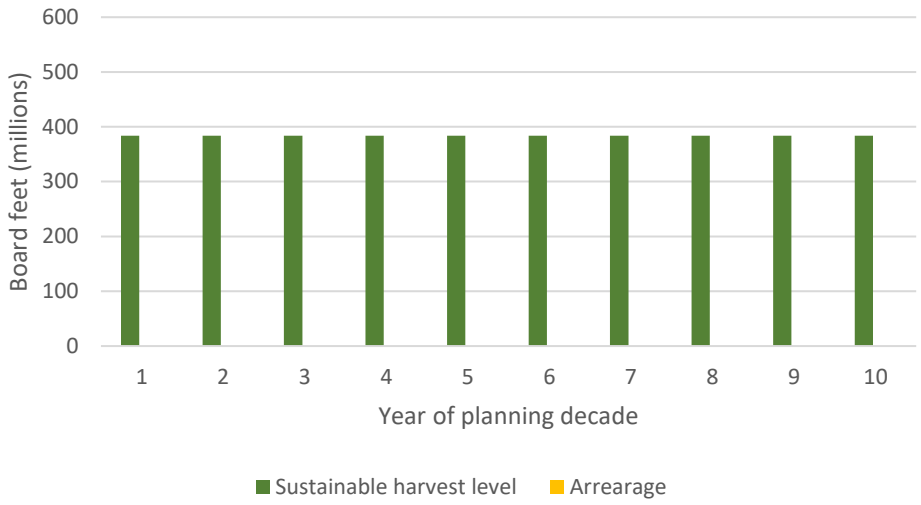
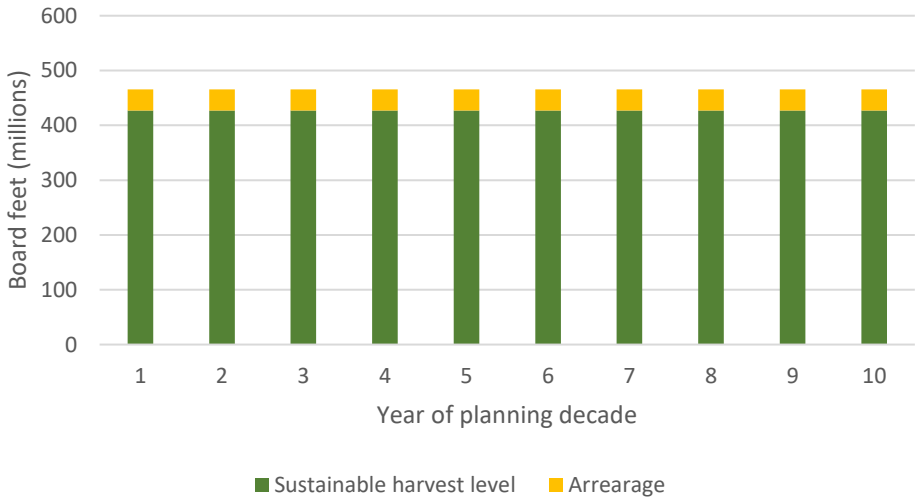


Figure 2.4.7. Annual Harvest in the Planning Decade Under Alternative 6 (382 million board feet of arrearage volume harvested in 10 years)



The alternatives include different options for riparian thinning levels in the five west-side planning units and result in different levels of riparian thinning in these planning units (Table 2.4.4). Differences in long-term forest cover in the marbled murrelet long-term conservation strategies result in differences in the amount of riparian thinning in the OESF HCP Planning Unit.

Table 2.4.4. Change from Alternative 1 in Average Annual Acres Thinned in Riparian Areas

HCP Planning Unit	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
	Acres	Percent change in acres of riparian thinning compared to Alternative 1				
Five west-side HCP planning units	3,300	-20%	-97%	-97%	-97%	-100%
OESF HCP Planning Unit	500	-22%	-26%	-27%	-23%	-100%
Total	3,800	-20%	-87%	-87%	-87%	-100%

The sustainable harvest calculation model does not include an estimate of the road-building needed to access the modeled harvest volumes. Road-building will be planned at the operational level. SEPA review of road-building activities will occur when those activities are planned. All road-building is done in compliance with forest practices rules and the 1997 HCP. In areas where harvest or thinning occurs, road density is expected to be similar under the action alternatives to the no action alternative.

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

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

Objective #1: Coordinate with the marbled murrelet (*Brachyramphus marmoratus*) long-term conservation strategy environmental analysis so that the Board of Natural Resources can integrate the effects of the range of marbled murrelet long-term conservation strategy alternatives on the sustainable harvest level and arrearage.

Alternatives 1 through 5 incorporate one of the marbled murrelet long-term conservation strategies and Alternative 6 incorporates DNR's Amendment, which is very similar to Alternative H in the *Final Environmental Impact Statement for the Long-Term Conservation Strategy for the Marbled Murrelet* (DNR 2019a) in terms of area and location of long-term forest cover. These options cover a range of acres and configurations of long-term forest cover for marbled murrelet on DNR-managed lands. Each alternative also includes an option for harvesting arrearage and an option for riparian thinning. The combinations of marbled murrelet conservation, arrearage, and riparian thinning options create a range of harvest volumes and acres that can be analyzed for their impacts on elements of the environment.

Objective #2: Incorporate new information into an updated model to calculate the sustainable harvest level. New information includes changes in the land base, changes in forest inventory, information concerning the prior decadal arrearage and its causes, changes in technology, and any updates from the finalized forest land plans for the Olympic Experimental State Forest and South Puget HCP planning units.

All alternatives include the same information sources. All incorporate updated land base and forest inventory information as of January 12, 2018. The alternatives that identify arrearage volume for sale in the first decade include the final arrearage volumes presented to the Board. The model used in the calculation uses the latest addition of the modeling software and newly developed yield tables that better match actual growth found on DNR-managed lands than older yield tables. Assumptions in the model, including cost of management and prices of DNR timber, were developed using data from recent fiscal years. All alternatives incorporate the finalized OESF and South Puget HCP planning units' forest land plans.

For all the action alternatives, this information is used to calculate a new sustainable harvest level. For the no action alternative, a new sustainable harvest level is not calculated. Instead, the level set in Board Resolution 1239 is retained. As a result, the no action alternative does not meet this objective. The no action alternative, however, must be analyzed under SEPA even if it does not meet objectives.

Objective #3: Consider climate change as part of the affected environment, analyze climate change impacts and benefits of the alternatives, and identify possible mitigation measures that will reduce or eliminate any identified adverse environmental climate change impacts of the proposal.

Climate change is considered as part of the affected environment in this FEIS. Current conditions are described in Chapter 3.2, and impacts of each alternative are described in Chapter 4.2. Chapter 4.2 includes an analysis of carbon sequestered on DNR-managed lands in western Washington and in timber harvest from these lands under each alternative.

Objective #4: Ensure alternatives analyzed are reasonable, feasible, and consistent with DNR's trust management obligations, existing DNR policies, and applicable state and federal laws.

All the action alternatives comply with existing DNR policies and state and federal law. The no action alternative complies with state and federal law but not all existing DNR policies since the no action alternative assumes that no new sustainable harvest level is calculated.

The alternatives result in different harvest volumes in the following order from most to least volume: Alternative 1, Alternative 2, Alternative 6, Alternative 3, Alternative 4, and Alternative 5. A revised financial analysis of the alternatives has been prepared (refer to the October 14, 2019 Revised Financial Analysis, Addendum to the *Long-term Conservation Strategy for the Marbled Murrelet FEIS*[3]) for the Board to consider in their decision making process.

■ Summary of Potential Impacts to the Environment

Chapter 4 includes an analysis of the alternatives for potential impacts to six different elements of the environment. A summary is provided in this section. Specific impacts are described in detail in Chapter 4. Chapter 5 describes potential cumulative effects.

Across DNR managed-lands in western Washington, the area of structurally complex forest is expected to increase with time. Elements of the natural environment are not expected to be adversely affected by

[3] https://www.dnr.wa.gov/mmltcs

these changes. Soil resources and areas subject to landslide hazards would continue to be protected by existing laws and DNR policies and procedures. Climate change impacts are not expected to exacerbate impacts from the alternatives to any element of the environment, and carbon sequestration is expected to be greater than emissions under all alternatives. No alternative is expected to reduce climate-related forest resistance and resilience to a changing climate. Existing riparian protection implementation strategies remain in place under all the alternatives, and aquatic functions are expected to be maintained or enhanced under all alternatives. Alternative 2 has less riparian treatments compared to Alternative 1 but significantly more than the other action alternatives, which will accelerate restoration of some riparian objectives compared to the other action alternatives. Alternatives 3, 4, 5, and 6 allow for less active management and result in slower progress toward riparian objectives.

Many wildlife and plant species would benefit from an increase in structurally complex forest that will develop. Wildlife diversity is likely to increase over time with all alternatives. Some local changes in habitat conditions may temporarily affect some species. Commitments in the 1997 HCP to maintain habitat for threatened or endangered species are maintained under all alternatives.

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Chapter 3

AFFECTED ENVIRONMENT

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Chapter 3

Affected Environment

This chapter describes the current conditions for the elements of the natural environment most likely to be affected 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

The purpose of this chapter is to describe the elements of the natural environment within the analysis area, which is defined as all DNR-managed forestlands in western Washington (refer to Figure 1.3.1) that could be affected by the proposed alternatives. Each section will describe a different element of the environment, its current condition, 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).

SEPA provides guidance on which elements to consider in environmental impact statements.[1] Only those elements of the environment most likely to be affected 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, riparian habitats, and fish)
- Wildlife and biodiversity
- Marbled murrelet

[1] WAC 197-11-444.

DNR determined that the following elements of the environment would not be analyzed in this FEIS because of the low likelihood of impacts:

Element of the environment	Findings
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	No change to DNR policy guiding management of visual impacts.
Water: Runoff/absorption/flooding/groundwater and public water supplies	Stream peak flows and water quality impacts are addressed in the Aquatic Resources section. No public water supply sources will be affected by the proposal or any alternatives.
Traffic and transportation	No change in management of forest roads under forest practices rules or the 1997 HCP. The proposal will not impact traffic or transportation on public roadways.
Noise	No change in management of noise.
Urban land uses (including population and housing impacts), sewer, and solid waste	Harvest and thinning activities occur in non-urban environments. No urban land uses will be affected.
Cultural and historic resources	No change in management of cultural or historic resources.
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. Additional databases maintained separately by DNR were also used as appropriate. Previously adopted plans, policies, and regulations are also sources of data for describing each element of the environment. Expert knowledge from DNR staff is also a source of information for describing the policy and regulatory context for each element of the environment.

Scope and Scale of Analysis

Current conditions are described for the DNR-managed forestlands in western Washington as a whole. Analyses in Chapter 4 are conducted at the same scale.

SEPA analysis is for the purpose of establishing a sustainable harvest level for the fiscal year 2015–2024 planning decade for forested state trust lands in western Washington.

Other than the changes described in Chapter 2 to the *Policy for Sustainable Forests*, there are no changes proposed to DNR policies or the 1997 HCP conservation strategies or how their objectives are to be accomplished. Impacts associated with marbled murrelet conservation are the subject of the marbled murrelet long-term conservation strategy DEIS (DNR 2016c), RDEIS (DNR 2018), and FEIS (DNR 2019a).

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?

Long-term forest management consistent with the *Policy for Sustainable Forests* and the 1997 HCP depends on healthy forests. Healthy soils are the 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 previously been described in several DNR documents, including the *South Puget HCP Planning Unit Forest Land Plan Final Environmental Impact Statement* (DNR 2010), *Final Environmental Impact Statement on Alternatives for Sustainable Forest Management of State Trust Lands in Western Washington (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* (NMFS and USFWS 2006), and Appendix B of the *Washington State Forest Practices Board Manual*, Section 16 (Washington Forest Practices Board 2016). 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 from glaciation, which are in turn underlain by very weak sedimentary and volcanic rocks. Large landslide complexes are widespread along Hood Canal and the lower reaches of the major river valleys. Landslides also are abundant in the very weak marine sedimentary rocks in western and northwestern portions of the Olympic Peninsula.

In southwest Washington, which largely was 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 the 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.

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 areas more susceptible to landslides.[2] 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 land 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 knowledge from a variety of screening tools to estimate the occurrence of potentially unstable landforms. Screening tools include Forest Practices GIS data, DNR State Uplands GIS data, LiDAR, and other mapping tools. The features identified using these tools reflect where DNR suspects there could be potentially unstable slopes.

The availability and accuracy of available screening tools varies across DNR-managed lands and represents an estimate intended to trigger field verification at the time of harvest planning. Field verification may find that no potentially unstable slope is actually present, may find new areas of potential instability, or may change the extent of the mapped hazard. According to DNR screening tools, approximately 12 percent of DNR-managed lands within the analysis area are mapped as potentially unstable.[3] These potentially unstable areas are present throughout the analysis area. The majority of the

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

[3] Percentages derived from the "UNSTABSLPS" field in DNR's large data overlay created on January 12, 2018. 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.

land identified as potentially unstable is already in a long-term deferral or conservation status. Unstable slopes continue to be identified as screening tools are updated through remote sensing and field assessment.

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 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.

■ 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 forest management activities, including those 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.

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 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 at the location.

[4] Refer to Section 3, Guidelines for Forest Roads, and Section 16, Guidelines for Evaluating Potentially Unstable Slopes and Landforms at https://www.dnr.wa.gov/about/boards-and-councils/forest-practices-board/rules-and-guidelines/forest-practices-board-manual.

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.

Regulating Activities That Can Damage Soils

Timber harvest, road-building and maintenance, and recreational activities 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 will be carefully considered in regard to the impacts to the environment. SEPA may require additional review of projects with potential operational effects on soil and water quality.

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 in conjunction with climate change.

Why Is Climate Change Important?

A key requirement in calculating DNR's harvest level is sustainability. Since forest resources are vulnerable to climate change, it is necessary to examine how potential changes to the climate could affect DNR's sustainable harvest projections, and other values and resources associated with DNR-managed lands. It is also important to understand how a change in DNR management activities proposed under the alternatives may or may not exacerbate any potential effects from climate change.

Current Conditions

Natural drivers alone cannot explain recently observed warming at the global scale (Gillett and others 2012). Multiple lines of evidence indicate 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 emissions from human activities have originated from the burning of fossil fuels. Deforestation (both the replacement of older forest with younger forests and forest conversion to non-forest) also has 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).[5] Unless otherwise noted, this FEIS 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).[6]

The RCPs represent different greenhouse gas scenarios, which, in turn, were used as input into general circulation models. These models incorporate our 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 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

[5] 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).

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

of RCPs where 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 dynamical 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 output from statistically downscaled general circulation models. Although RCP and global circulation model outputs are produced for 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 FEIS uses in the analysis. This analysis also focuses on trends through approximately 2070, encapsulating the life of the 1997 HCP.

The 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 throughout the year with warmest temperatures occurring during the summer months under (Mote and others 2013). For the 2040–2069 period, the 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 1970-1999 timeframe (Mauger and others 2015).

Annual precipitation projections are much less consistent than temperature projections. Precipitation projections for 2041 through 2070 vary from a 4.5 percent decrease to a 13.5 percent increase (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 other months (Mote and others 2013, Mauger and others 2015). Along with these annual and seasonal trends, temperature and precipitation extreme events are also projected to increase by mid-century (Mote and others 2013). These trends in precipitation and temperature likely will have environmental and ecological consequences for many of the elements of the environment analyzed in this FEIS. These consequences are discussed in Section 4.2.

Effects of Climate Change on DNR-Managed Resources

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

VEGETATION

Forest Conditions

Climate plays a key role in driving vegetation dynamics and constraining vegetation presence at broad spatial scales. Vegetation in Washington can be broadly classified 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 exceed available atmospheric and soil moisture (Littell and others 2010). In energy-limited systems, light or temperature constrain vegetation growth. Examples in western Washington are productive forests where cloud cover or competition limit available light for individuals, and higher elevation forests where 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 Pacific Northwest to examine trends in individual species (Littell and others 2010, Rehfeldt and others 2006) and broader vegetation types (Rogers and others 2011, Sheehan and others 2015, Halofsky and others 2018a). All modeling efforts project drying in the Puget Sound lowlands and Olympic Peninsula rain shadow, but the degree of projected changes in species composition and/or structure varies by modeling approach, assumptions in how vegetation types may respond to changes in precipitation and temperature, and climate projections.

Studies that cover all vegetation types in western Washington also project a decline in subalpine parkland[7] area due to increased 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 locations that become more water-limited. The timing of such changes is uncertain and will, at least partially, relate to annual and seasonal trends in temperature and moisture, and the timing and frequency of stand-replacing disturbances and disturbance interactions (Vose and others 2018) (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 and interactions.

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 (Allen and others 2015, Littell and others 2016, Vose and others 2016, Vose and others 2018). 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. Future precipitation patterns are more consistent when examined seasonally; typical projections are for 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 potential events is unknown (for example, days, months or longer); thus, the magnitude of effects on western Washington forests are uncertain.

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, Sheehan and others 2015, Halofsky and others 2018a). Most studies project at least a doubling in area burned, 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,

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

given the fuel density found west of the Cascade Range (Halofsky and others 2018b) and examples from the past in the paleo-record (Henderson and others 1989).

While wildfire is the primary mechanism of broad-scale forest renewal in western Washington, historically and currently, many coastal, west-side forests are more frequently disturbed by wind than wildfire. There is little scientific literature that examines 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 our 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 and others 2017, Agne and others 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 indicate 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 streamflows (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 also increase the conditions that trigger landslides (Salathé and others 2014, Mauger and others 2015).

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 Lettenmaier 2007, Mote and others 2003, Mote and others 2005). Such trends are likely to continue with increasing 21st century temperatures.

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/winter months largely reflecting the precipitation falling as rain, and one in late spring/early summer mostly reflecting snowmelt.

With projected increases in winter precipitation, little change is expected 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 Mountains and northeast portion of the Olympic Peninsula, are projected to become rain dominant by the 2080s under moderate warming.[8] Similar to rain-dominant basins, 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. In addition to timing changes, flooding magnitude and frequency are also 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). As rivers adjust to new hydrologic patterns, new sediment loads, and new peak flow magnitudes, changes in the physical environment adjacent to rivers could occur, potentially affecting adjacent riparian vegetation and in-stream habitat.

Wetlands are expected to be sensitive to changes in climate given the relationship between wetland hydrology, structure, and function with 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 affected with changes in precipitation intensity, changes in flow regime, and stream temperatures. Warmer stream temperatures and lower summer flows will increase the thermal stress experienced by salmon and possibly increase the difficulty 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 and mean flows could create 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).

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 as a whole 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 condition), among other reasons (Lawler and others 2014).

[8] 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.

Recent work by Case and others in 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,[9] 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 that 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 northern spotted owl. Using data from Case and others (2015), as well as other data sources and opinions, 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.

Carbon Sequestration on DNR-Managed Lands

There are currently 145,911,000 tonnes of carbon stored on DNR-managed lands in western Washington.[10] As further discussed in Chapter 4, this estimate includes carbon found in both live and dead trees as well as forest soil.

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 FEIS 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 management 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 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.

[9] Refer to http://climatechangesensitivity.org.
[10] A tonne is equivalent to 1,000 kilograms or 2,205 pounds. Tonnes of carbon is a common metric unit of measure for carbon sequestration or release.
[11] Refer to https://www.epa.gov/ghgemissions/global-greenhouse-gas-emissions-data

Existing Policies and Regulations

The Council on Environmental Quality maintains greenhouse gas tools that agencies can use in their environmental assessments.[12] For example, the Forest Vegetation Simulator can be used to estimate changes in carbon stocks over time due to succession and both anthropogenic (human caused) and natural disturbances.[13] DNR used a complementary approach in the analysis of environmental consequences in Chapter 4. Although DNR does have broad climate and carbon strategies, DNR does not currently have a policy that specifically addresses climate change. Nonetheless, existing language in the Policy for Sustainable Forests (DNR 2006a) provides silvicultural flexibility and both forest health and natural disturbance-response guidance that should facilitate an adaptive agency response to a changing climate.

[12] https://ceq.doe.gov/guidance/ghg-accounting-tools.html
[13] https://www.fs.fed.us/fvs/

3.3 Vegetation

This section of the FEIS describes the current conditions of vegetation on DNR-managed land in western Washington, 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 (refer to Sections 3.2, 3.4 and 3.5, respectively).

Forest in South Puget Sound

■ Why Is Vegetation Important?

Healthy and productive forests provide many values and benefits, including wildlife habitat, clean water and air, carbon storage, and recreational opportunities, as well as forest products that DNR sells to provide a sustainable flow of revenue to schools and other beneficiaries.

■ Current Conditions

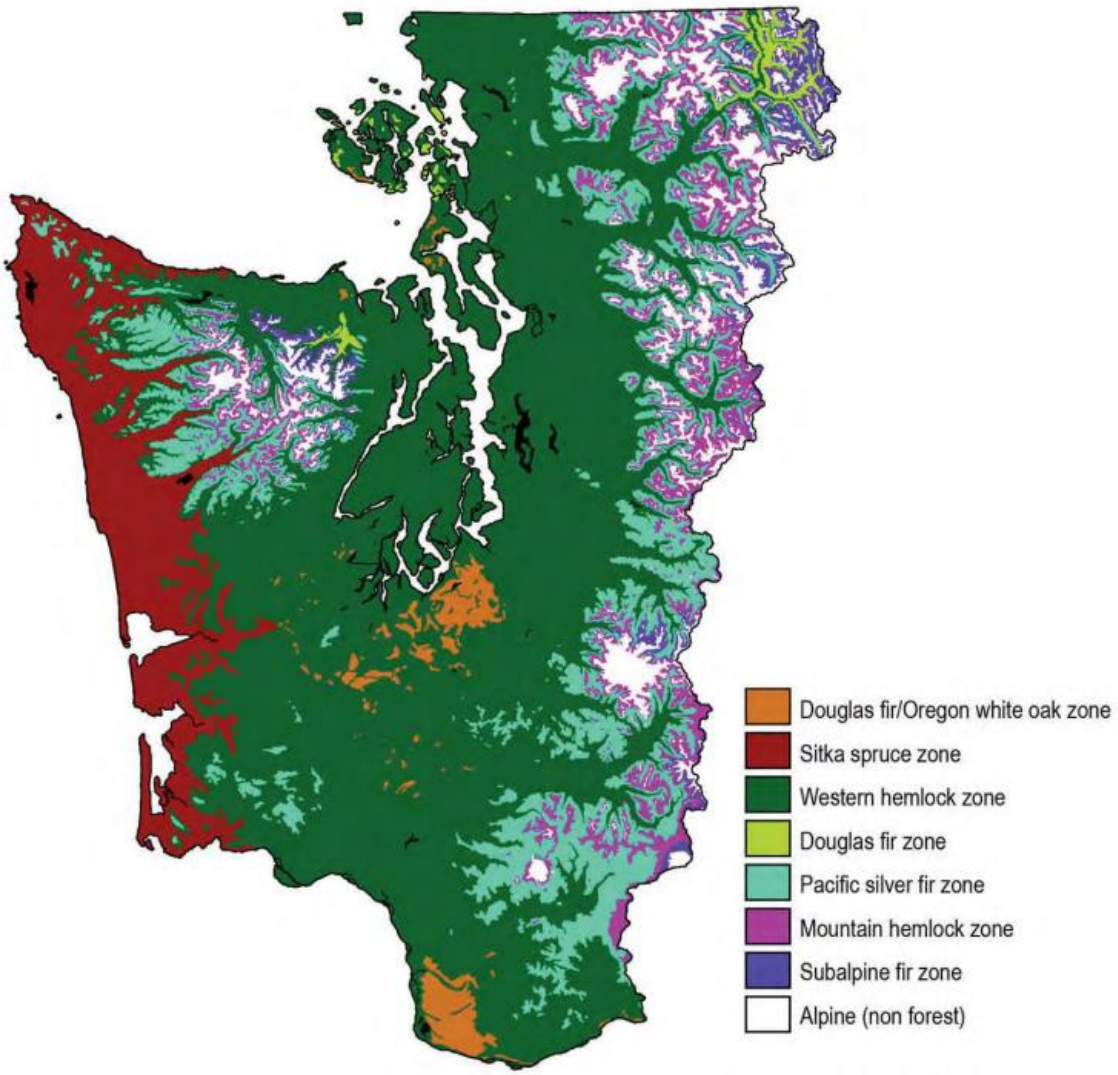
DNR maintains data from various sources on forest conditions in the analysis area. This section summarizes the existing conditions of forestlands in the analysis area in order to understand potential impacts from the alternatives.

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 (Table 3.3.1). In *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 forest vegetation zones (Figure 3.3.1). For more description of the vegetation zones occurring on DNR-managed lands, refer to the 2004 sustainable harvest calculation (DNR 2004, p. 4–6).

Table 3.3.1. Current Distribution of Acres by Dominant Species Type for DNR-Managed Lands in the Analysis Area (Acres and percentages do not sum to totals due to rounding)

Dominant species	Acres	Percent of DNR-managed lands
Douglas fir	841,000	57%
Red alder and other hardwoods	123,000	8%
Sitka spruce	9,000	1%
True fir	59,000	4%
Western hemlock	412,000	28%
Western redcedar	20,000	1%
Total	1,465,000	100%

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



General Forest Conditions

Forest stands are dynamic and diverse systems that constantly change through tree and other plant growth and ecological succession. To account for such change and diversity, DNR classifies forest stands into "stand development stages" that represent the general progression of growth and structural development that any particular stand of trees goes through over time. As trees grow from seedlings after a harvest or natural disturbance, forest stands move through stand development stages. Each stand development stage is characterized by a set of measurable physical attributes. The forest classification system for state trust lands is based on many scientific publications (Van Pelt 2007, Franklin and others 2002, Oliver and Larson 1996, DNR 2004). For this analysis, five stand development stages are used as shown in Table 3.3.2.

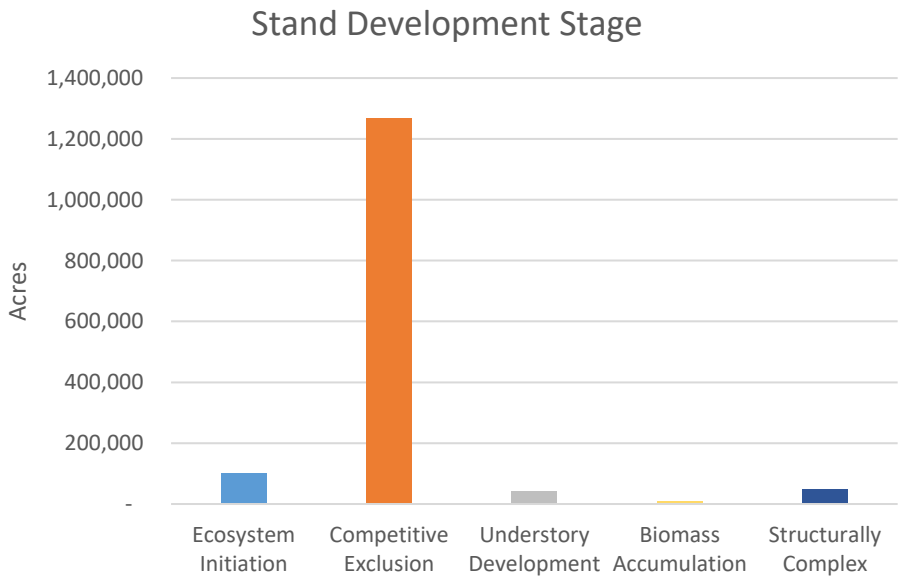
Table 3.3.2. Stand Development Stages and Current Distribution of Acres of DNR-Managed Lands in Western Washington by Stand Development Stage (Rounded to nearest 1,000)

Stand development stage		Acres
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.		101,000
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.		1,266,000
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.		42,000
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.		9,000
Structurally Complex Approaching conditions of natural older forests with multiple tree and shrub canopy layers, dead and downed logs, and well-developed understory. Multiple tree canopies are present, supporting diverse vertebrate and invertebrate species.		46,000

All stands generally progress through these development stages, beginning with Ecosystem Initiation and moving through Competitive Exclusion, Understory Development, and Biomass Accumulation to eventually reach the Structurally Complex stand development stage. However, stand development stages are not equal in terms of the duration stands typically spend in them. For example, stands progress through the Ecosystem Initiation stand development stage in one or a few decades but may spend

centuries in the Structurally Complex stand development stage. Currently, most stands on DNR-managed lands are in the Competitive Exclusion stand development stage (Figure 3.3.2).

Figure 3.3.2. Acres by Current Stand Development Stage



FOREST HEALTH AND DISTURBANCE

Based on annual aerial forest damage surveys conducted by DNR in conjunction with the U.S. Forest Service (U.S. Forest Service and DNR 2016), state trust forests in western Washington appear healthy, with relatively small areas of damage caused by bears, insects, and fungal infections (Tables 3.3.3 and 3.3.4). DNR's strategy to manage forest health is outlined in DNR's policies on forest health and catastrophic loss prevention, which includes actively managing stands to improve forest health. These polices will not change as a result of any of the alternatives.

Windthrow and wildfire also impact DNR-managed forests in western Washington. Large scale windthrow occurs periodically. In 2007, over 1,100 acres of DNR-managed forests in southwest Washington were damaged in a strong winter windstorm. Wildfire has affected less area than windthrow in recent years. Since 2006, 829 acres of DNR-managed forests have burned in western Washington in a total of ten fires. Nearly all DNR-managed forests in western Washington are categorized as low on the fire threat index, an index that considers the probability of ignition and the expected fire size in a range of weather conditions.[14]

Section 3.2 describes current knowledge about how climate change may increase disturbance events and the risk of catastrophic loss.

[14] For more information, refer to the West Wide Risk Assessment at http://forestryandfire.az.gov/sites/default/files/WWA-Detailed-Process.pdf.

Table 3.3.3. Sources of Forest Damage on DNR-Managed Lands in Western Washington, From the Results of the 2018 Aerial Forest Health Survey (U.S. Forest Service and DNR 2019)

Source of forest damage detected	Area
Douglas fir beetle (*Dendroctonus pseudotsugae*)	1,550 acres
Black bears (*Ursus americanus*)	Variable trees per acre over 2,3890 acres
Douglas fir engraver (*Scolytus unispinosus*)	120 acres
Fir engraver (*Scolytus ventralis*)	580 acres
Silver fir beetles (*Pseudohylesinus grandis*)	2 acres
Swiss needle cast (*Phaeocryptopus gaeumannii*)	760 acres severe, 6,640 acres moderate
Pacific madrone decline	10 acres
Lodgepole needle cast (*Elytroderma deformans*)	50 acres
Bigleaf maple dieback and decline (unknown agent)	230 acres

Table 3.3.4. Common Root Diseases in Western Washington (U.S. Forest Service and DNR 2016)

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

Disturbances due to wind, ice, and fire occur in western Washington at varying frequencies. Many of these disturbances are outside of DNR's management control, although the department does conduct forest health treatments to increase wind firmness and resilience to wildfire in some stands. The impact of disturbances on the sustainable harvest calculation depend on the location and severity of the disturbance. Extremely large-scale disturbances may require a recalculation of the harvest level. DNR incorporates strategies to prevent catastrophic losses into its management of forested state trust lands, such as development of fire-resistant stands. In addition, when it is in the best interest of the trust, forest stands that have been materially damaged by fire, wind, insects or disease will be salvaged. Such salvage will be conducted in compliance with state and federal law, contractual obligations, and policy (DNR 2006a, p. 32–33). However, none of the alternatives would change DNR's policy on catastrophic loss prevention.

Vegetation in Special Management or Conservation Status

DNR-managed forestlands within western Washington also include vegetation that is managed for conservation purposes pursuant to the 1997 HCP and DNR's *Policy for Sustainable Forests*. 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 individual very large diameter, structurally unique trees. DNR must notify the Board about any operations that will remove these trees (DNR 2006a, p. 34). According to DNR inventory information, there are approximately 88,000 acres of potential old growth on DNR-

managed lands in western Washington, with 60 percent of those acres demonstrating a high potential to be old growth (DNR 2005a). The *Policy for Sustainable Forests* and the department's old-growth timber harvest deferral and protection (west-side) procedure[15] summarizes DNR's management approach to old growth.

GENETIC RESOURCES

DNR protects the genetic resources of its native tree populations by maintaining a system of gene pool reserves (refer to Chapter 7, Key Definitions). These reserves are generally located in forestlands that are protected for other reasons (for example, as unstable slopes, old growth, or riparian areas). Gene pool reserves are deferred from harvest under the *Policy for Sustainable Forests* (DNR 2006a, p. 40). There are approximately 3,050 acres of gene pool reserves in western Washington.

NATURAL AREAS

DNR manages two types of natural areas defined by state law: Natural Area Preserves and Natural Resource Conservation Areas. These areas protect native ecosystems, rare plant and animal species, and unique natural features. Both types of natural areas are covered under the 1997 HCP. Natural Area Preserves are managed under the *State of Washington Natural Heritage Plan* (DNR 2007b, updated in DNR 2018), and some Natural Area Preserves also have site-based management plans. The Natural Resource Conservation Areas are managed under the *Natural Resource Conservation Areas Statewide Management Plan* or individual management plans. There are approximately 92,000 acres of forested natural areas in western Washington.

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 mature forests. 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 State Trust Lands HCP 2018 Annual Report (DNR 2019b).

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

The *Policy for Sustainable Forests* states that DNR will identify forested state trust lands with "special ecological features" of regional or statewide significance. This task is informed by the *State of Washington Natural Heritage Plan* (DNR 2007b, updated in 2018), 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 and 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. As listed in Appendix H, 50 species of rare plants are currently known to occur on forested DNR-managed state lands in western Washington.

[15] DNR PR 14-004-045.

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. These measures specifically protect features such as talus, caves, cliffs, balds, oak woodlands, large snags, and large, structurally unique trees. These uncommon wildlife habitats 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. 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.

■ Existing Policies and Regulations

Management of vegetation resources are consistent with the *Policy for Sustainable Forests*. The alternatives do not change any of these policies.

3.4 Aquatic Resources

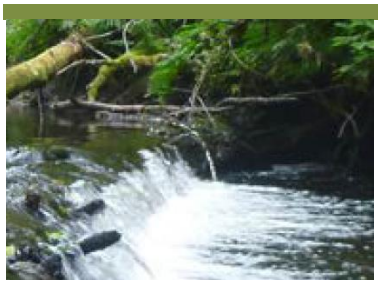
This section describes the existing conditions of riparian habitat, wetlands, rivers and streams, water quality and quantity, and fish populations and habitat, collectively referred to as *aquatic resources*.

DNR sometimes considers these elements of the environment individually when reviewing proposed actions. This FEIS considers these elements collectively because they would all 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 that improve water quality and provide fish and wildlife habitat. DNR's management philosophies are based largely on the underlying approach 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 2006a, p. 36–38).

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 Habitat and Wetlands

Approximately one-third of all DNR-managed land in the analysis area is forested riparian habitat. Of this, approximately half is available for commercial thinning, while the other half is deferred from any activities due to the 1997 HCP, *Policy for Sustainable Forests*, or known operational constraints. Areas deferred include wildlife habitat (for example, northern spotted owl or marbled murrelet habitats), old-growth stands, and potentially unstable slopes.

As of 2006, more than half (56 percent) of riparian stands on DNR-managed lands have been in the Competitive Exclusion stand development stage (DNR 2006c, p. 4). As described in Section 3.3, Competitive Exclusion stand development stages are characterized by densely stocked stands with few or no shrubs or groundcover and little benefit to wildlife. These stands also lack the large trees and multiple canopy layers found in the later stages of stand development and are usually deficient of large snags or substantial amounts of downed wood.

Waters

RIVERS AND STREAMS

The *Policy for Sustainable Forests* (DNR 2006a) and the 1997 HCP (DNR 1997) provide protection for Type 1 to 5 streams.[16] The level of protection is based on the characteristics of the stream channel and its position relative to fish-bearing stream habitat. Type 1 through 4 streams have buffers ranging in width from 100 feet to over 190 feet[17] from the edge of the 100-year floodplain. Type 5 streams are protected by forest practices rules[18] limiting disturbance of the stream channel and use of chemicals near water.

As of 2006, at least 50 percent of Type 5 streams associated with variable retention harvests are located in the buffer of a larger stream, a leave tree area, or other unharvested area (DNR unpublished data). In addition, streams of all types are located in areas where harvests and, in some cases, thinning will not occur including Natural Resources Conservation Areas or Natural Areas Preserves, old-growth stands, designated northern spotted owl nest patches, and marbled murrelet occupied sites, among other areas.

WATER QUALITY

Washington Department of Ecology's Water Quality Assessment lists the water quality conditions for water bodies in the state, as required under Sections 303(d) of the Clean Water Act (Washington Department of Ecology 2019). Not all streams have been assessed for this list, and forest streams are generally 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, 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 2016a).

WATER QUANTITY

Timber harvest and associated roads can increase stormwater runoff that is delivered to rivers, streams, and wetlands. Peak flows are of greatest concern; these have historically occurred within the analysis areas primarily during late fall through early spring (October through March)[19] 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. Detectable increases are defined as a 10 percent or greater increase in peak flows. Currently, 162 out of 213 basins managed for hydrologic maturity have more than the required amount of hydrologically mature forest as defined by the 1997 HCP. Harvests in the basins

[16] DNR types streams based on Washington Forest Practices Board Emergency Rules (stream typing) from November 1996, reproduced in PR-14-004-150.
[17] The 100-year site potential tree height.
[18] For example, WAC 222-30-021(2)(a) regarding equipment limitation zones.
[19] https://water.oregonstate.edu/sites/water.oregonstate.edu/files/water_and_climate_in_the_pacific_northwest_v3.pdf

below the required amount of hydrologically mature forest will not occur until an adequate amount of hydrologically mature forest exists in the basin.

Fish

At least nine native species of resident and anadromous trout and salmon inhabit rivers and streams on state trust lands in the analysis area (NMFS and USFWS 2006, Table 3–21). In addition, several trout and salmon species in the analysis area are currently listed as threatened under the Endangered Species Act. Numerous other native fish species are also distributed in water bodies throughout the analysis area, including minnows, suckers, sculpins, and three species of lampreys (NMFS and USFWS 2006). Appendix I contains a list of these species and their general distribution within the analysis area. All of these species are covered by DNR's 1997 HCP.

Operations

Harvest activities in OESF HCP Planning Unit riparian areas are conducted following the OESF Forest Land Plan (DNR 2016b). The RFRS is followed in the other HCP planning units (DNR 2006c).

In the 2005–2014 planning period, DNR completed riparian thinning activities on about 2,000 acres in all HCP planning units, fewer acres than the 35,000 acres anticipated in the 2007 sustainable harvest calculation for this period (DNR 2007a). DNR harvested on fewer acres than anticipated due to financial constraints, operational difficulties such as safety concerns and equipment limitations, and a cautious approach to harvesting in riparian areas. This approach is reflected in the percentage of DNR timber sales that implemented thinning activities following the RFRS.

In fiscal years 2015–2018, DNR completed approximately 1,750 acres of riparian thinning, and implemented thinning activities on about 17-30 percent of timber sales annually (DNR 2016d, p. 5; DNR 2019b, p. 6), consistent with the RFRS.

■ Existing Policies and Regulations

Forest Practices Rules

All forest management activities on non-federal lands in Washington State 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, fertilization, and forest chemical application. Many of these standards serve to protect aquatic resources.

In 2006, the *Forest Practices Habitat Conservation Plan* (DNR 2005b) and the associated incidental take permit were approved by the USFWS and NOAA Fisheries under the ESA to conserve listed and unlisted fish and amphibian species and habitat.[20] The *Forest Practices Habitat Conservation Plan* is a

[20] ESA section 10 (a)(2)(B); 16 U.S.C. §1539 (a)(2)(B).

"programmatic" plan that applies to all landowners that follow forest practices rules. It should not be confused with the state lands *Final Habitat Conservation Plan* (DNR 1997) that applies to DNR-managed lands in western Washington.[21]

The Forest Practice rules allow landowners with an HCP to obtain approval for substitution of forest practices HCP requirements that meet or exceed the level of protection provided by the rules.[22] DNR has obtained approval to apply its 1997 HCP riparian conservation strategies, described in the following section, for several activities, including delineating riparian management zones and harvest in riparian areas. Other forest practices rules designed to protect aquatic resources apply, including rules that regulate road construction, maintenance standards, and stream crossing design.

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

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 five remaining west-side HCP planning units ("west-side strategy").

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 accomplish riparian restoration objectives. Some limited harvest can be permitted in riparian zones, depending on this watershed analysis. The west-side strategy is supported by the RFRS, which provides direction on how to develop site-specific riparian forest prescriptions to achieve desired future conditions on stream reaches. The RFRS also provides guidelines for mitigating impacts from road-building in riparian areas and stream crossings (DNR 2006c, p. 34–35). The 1997 HCP prohibits variable retention harvesting in forested wetlands, but thinning is permitted in the wetlands and buffer.

DNR Procedures

DNR has established formal procedures for specific aspects of timber harvest in and around streams and wetlands to implement the riparian conservation strategies, including:

- *PR-14-004-060 Assessing Hydrologic Maturity*

[21] The northern spotted owl conservation strategy in the HCP applies to certain lands in eastern Washington as well.

[22] WAC 222-16-080(6)(i) (Exempting forest practices consistent with HCP from Class IV-Special classification); WAC 222-12-041(3)(a) (Use of HCPs for aquatic resources).

- *PR 14-004-150 Identifying and Protecting Riparian and Wetland Management Zones in The West-side HCP Planning Units, Excluding The OESF (August 1999)*
- *PR 14-004-160 Riparian Management in the OESF HCP Planning Unit*
- *PR 14-004-500 Wetlands Management in the OESF HCP Planning Unit*

3.5 Wildlife and Biodiversity

This section describes wildlife species and the overall wildlife diversity in the analysis area. Marbled murrelet are described separately in Section 3.6.

■ Why Is Wildlife and Biodiversity Important?

DNR-managed lands provide habitat for species listed under the ESA as well as species that are more common. Both rare and common species are important for recreational, economic, cultural, and ecological values.

The conservation of wildlife species and their habitats is an important policy objective (DNR 2006a, p 35). 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*).

■ Current Conditions

Wildlife Habitat

As described in Section 3.3. Vegetation, DNR classifies forested stands into "stand development stages" that represent the general progression of growth and structural development that any particular stand of trees goes through over time. All stands generally progress through these development stages, beginning with Ecosystem Initiation and moving through Competitive Exclusion, Understory Development, and Biomass Accumulation to eventually reach the Structurally Complex stand development stage.

The greatest diversity and abundance of wildlife occurs in the early Ecosystem Initiation stage and in the later Structurally Complex stage, while the middle stages provide the least favorable conditions for wildlife and the lowest biodiversity (Johnson and O'Neil 2001, Carey 2003).

Approximately 86 percent (1,266,000 acres) of state trust lands within the analysis area are within the relatively low-value Competitive Exclusion stage, while approximately 10 percent are within the relatively high-valued Ecosystem Initiation (7 percent) and Structurally Complex (3 percent) stages.

Wildlife Species

This FEIS 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 using 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. This section also describes wildlife species that are important to consider because of their sensitivity to disturbance, low population levels, and recreational, commercial, cultural, and ecological values.

WILDLIFE GUILDS

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

- *Early successional guild* is composed of species that forage primarily in very young forest stands, including deer, elk, several species of bats, other small mammals, and migratory songbirds. These species are directly associated with the Ecosystem Initiation stand development stage.
- *Late successional guild* is composed of species that require Structurally Complex forest stands. Representative species include northern goshawk, northern pygmy owl, brown creeper, Vaux's swift, Townsend's warbler, red tree vole, northern flying squirrel, and black bear (for denning).
- *Edge guild* is composed of species that use the edges between early stages, such as Competitive Exclusion, and later stages. Representative species include red-tailed hawk, great horned owl, Cascades fox, and mountain lion.
- *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 mink and beaver.

STATE-LISTED, CANDIDATE, SENSITIVE, AND REGIONALLY IMPORTANT SPECIES

Appendix J provides a list of state-listed, candidate, and sensitive species present within the analysis area and their primary forest habitat associations. Appendix J also provides a table of species of regional importance, including those species that are important for recreational, commercial, cultural, or ecological values. This FEIS 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 3.5.1 occur, or may occur, on 1997 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 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 3.5.1. Terrestrial Wildlife in Western Washington Listed as Threatened or Endangered Under the Endangered Species Act

Category	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 multi-species conservation strategy. DNR's current incidental take permit covers several listed species. Within the six west-side HCP planning units, species that are newly listed under ESA can be added to DNR's incidental take permit (DNR 1997, p. B.12).

NORTHERN SPOTTED OWL

The northern spotted owl ("spotted owl" hereafter) is federally listed as threatened under the Endangered Species Act (Buchanan 2016) and is a major management focus of the 1997 HCP (DNR 1997). As described in the 2007 Addendum to the 2004 sustainable harvest calculation (DNR 2007a, p. 6–7), spotted owl populations have continued to decline throughout their range in Washington even though extensive conservation efforts are occurring on federal, state, and private timber lands. This trend continues (Buchanan 2016, Dugger and others 2016, Lesmeister and others 2018). The USFWS is currently evaluating whether to change the species' status to endangered.

As reported in the 2007 Addendum, as well as in more recent literature (Buchanan 2016, Dugger and others 2016, Lesmeister and others 2018), competition with barred owls may be a primary cause of decline in spotted owl populations in western Washington. While habitat conservation is still assumed to be meaningful to spotted owl conservation efforts, competition and predation by barred owls are sufficiently severe that habitat protection alone may not be sufficient.

The 1997 HCP provides for landscape-level protection of spotted owls. This landscape-level strategy establishes specific habitat thresholds within designated areas called spotted owl management units, or in the OESF and South Puget HCP planning units, "landscapes." These landscape level habitat thresholds apply to an area of 557,000 acres in western Washington on which at least 252,000 acres of spotted owl habitat will be provided. Currently, most spotted owl management units or landscapes are below threshold (DNR 2019b).

■ Existing Policies and Regulations

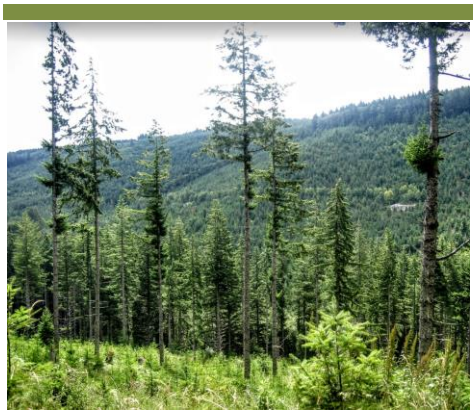
1997 HCP

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). The 1997 HCP also includes a multispecies conservation strategy for 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 long-term conservation of habitat supporting multiple species.

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 2006a, p. 6).

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.

The *Policy for Sustainable Forests* also defines DNR's general silvicultural strategy (DNR 2006a, p. 46), which is to use "biodiversity pathways" (refer to Text Box 3.5.1 and Chapter 7, Key Definitions) 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, and
- Improving habitat by creating snags and felling trees to create structure.

3.6 Marbled Murrelet

Current conditions for marbled murrelet in western Washington are described in Section 3.6 of the marbled murrelet long-term conservation strategy FEIS (DNR 2019a). This FEIS incorporates the description in the marbled murrelet long-term conservation strategy FEIS by reference.

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4

Chapter 4

ENVIRONMENTAL CONSEQUENCES

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Chapter 4

Environmental Consequences

This chapter identifies potential impacts under each alternative on the affected elements of the environment described in Chapter 3.

Identifying Impacts

The analyses in this section consider impacts from different sustainable harvest levels. The alternatives do not propose changing DNR policies or changing how DNR complies with state or federal law. This chapter, along with Chapter 5, considers potential direct, indirect, and cumulative impacts that could occur to natural resources due to the alternatives. The intent of this chapter is to assess and disclose what impacts might occur to elements of the 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 potentially affected 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 alternative, including the no-action alternative, affects the current conditions.

Evaluation criteria rely on the existing conservation or management objectives, policies, or rules that are being 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 FEIS is designed to meet the requirements of SEPA. SEPA requires the FEIS to evaluate potentially significant adverse impacts.

CONSIDERING SCALE AND CONTEXT

The analysis area covers over 1.4 million acres of DNR-managed land. The evaluation of impacts must consider whether identified potential impacts are significant relative to scale and context. The impact of an alternative to a single forest stand, for example, may not be significant when looked at in the context of DNR-managed lands in western Washington. The alternatives are evaluated at the analysis-area scale with consideration given to smaller scale impacts.

CONSIDERING INTENSITY

The term "intensity" refers to the severity of the impact. Intensity considers the duration and level of the impact. Some impacts can be relatively short in duration, and others may have longer-term consequences for the element of the environment. Indirect and cumulative impacts are also considered when determining the overall intensity of an impact to an element of the environment.

■ Existing Documents

Existing documents contain analyses relevant to the current proposal. The following analyses in existing documents are incorporated by reference as part of this final environmental impact statement (FEIS):

- *Final (Merged) Environmental Impact Statement for the Habitat Conservation Plan* (DNR 1998)

  This document analyzed the impacts of implementing the 1997 HCP. Sections incorporated by reference are the analyses of impacts to northern spotted owl (Section 4.2.1), riparian ecosystems (Section 4.2.3) in the five west-side planning units, the analyses of other species and habitats (Sections 4.5.1 through 4.5.4), and water quality (Section 4.8.2) in all western Washington planning units.

- *Final Environmental Impact Statement on the Policy for Sustainable Forests* (DNR 2006b)

  This document analyzed the impacts of implementing the *Policy for Sustainable Forests*. The analyses in this document are incorporated by reference in their entirety.

- *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* (NMFS and USFWS 2006)

This document analyzed the impacts of implementing forest practices rules. Analyses incorporated by reference are the analyses of impacts to water resources and riparian and wetland processes due to implementation of the forest practices rules regarding roads in western Washington.

- *South Puget HCP Planning Unit Forest Land Plan Final Environmental Impact Statement* (DNR 2010)

  This document analyzed the impacts of implementing the South Puget HCP Planning Unit Forest Land Plan. This forest land plan helps DNR meet policy objectives. The analyses in this document are incorporated by reference in their entirety.

- *Olympic Experimental State Forest HCP Planning Unit Forest Land Plan Final Environmental Impact Statement* (DNR 2016a)

  This document analyzed the impacts of implementing the OESF Forest Land Plan. This forest land plan helps DNR meet policy objectives and manage the OESF on a day-to-day basis. The analyses in this document are incorporated by reference in their entirety.

- *Final Environmental Impact Statement for the Marbled Murrelet Long-Term Conservation Strategy* (DNR 2019a).

  This document analyzed the impacts of eight alternatives for a long-term conservation strategy for the marbled murrelet. Five of the eight alternatives are incorporated into the sustainable harvest calculation alternatives analyzed in this FEIS. The description of the affected environment and the environmental consequences from the *Final Environmental Impact Statement on a Long-Term Conservation Strategy for the Marbled Murrelet* are incorporated by reference into this FEIS.

4.1 Earth: Geology and Soils

Analysis Question

- *Would the 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 1997 HCP.

Scale of Analysis

As described in Chapter 1, this FEIS considers DNR activities at the strategic level. Therefore, the scale of analysis for negative impacts to soils and landslide hazards is the analysis area.

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

Risk of Landslides

Lands identified as potentially unstable would continue to be managed as provided for under current regulations, policies, and procedures, which are designed to minimize landslide risks. For these reasons, there is no expected increased landslide risk compared with current conditions.

Under any alternative, additional lands could be designated as potentially unstable slopes in the future or lands currently designated as potentially unstable slopes could be removed from that designation. No changes in the management of these areas are anticipated as a result of the proposed action.

Effects on Soil Productivity

Timber harvest activities are implemented with best management practices defined by the forest practices rules and the 1997 HCP. By implementing these practices, adverse impacts to soil productivity due to erosion, compaction, or landslides are not expected to occur under any alternative.

Standard best management practices to minimize erosion include placing crushed surface rock on roads

Conclusions

Under all alternatives, including the no action alternative, DNR would continue to minimize the potential for landslides and damaging impacts to soils through the existing regulatory framework and through best management practices formally established in the forest practices rules. Table 4.1.1 summarizes these conclusions.

Table 4.1.1. Summary of Potential Impacts to Geology and Soils

Key questions	Criteria	Measure	Potential impacts
Do the alternatives affect the potential for landslides or increase soil erosion or compaction within the analysis area?	Whether the alternatives reduce DNR's ability to protect soils. Whether the alternatives are consistent with Washington state forest practices rules and other best management practices to protect potentially unstable slopes. Whether the alternatives increase potential for soil damage from forest management activities.	Acres of potentially unstable slopes.	No alternative increases landslide potential or increases risks to soil productivity. All alternatives retain the existing regulatory framework for managing potentially unstable slopes and for minimizing soil impacts and retain procedures for evaluating slope stability. The existing regulatory framework was designed to minimize impacts from activities.

4.2 Climate

This section evaluates possible relationships between sustainable harvest calculation alternatives and climate change. The evaluation examines DNR-managed lands through different lenses. The section first examines how the alternatives may potentially contribute to climate change through a carbon assessment. Following that, the analysis examines any effects climate change may have on the alternatives or their impacts and whether the alternatives exacerbate the impacts of climate change on elements of the environment.

Analysis Questions

- *Do any alternatives cause more greenhouse gases to be emitted than are 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 the 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 2016b). The carbon method implemented herein 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 here 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 and whether the loss is significant.

Scale of Analysis

Carbon sequestration is analyzed at the scale of DNR-managed lands in western Washington. This scale is appropriate because a determination of net carbon emissions for each alternative must consider both the carbon sequestered in the analysis area and the emissions from managing the same area.

The analysis to determine whether the alternatives exacerbate the impacts of climate change on the environment is analyzed at the same scale. While climate will influence the future forests of Washington, including 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 (Lenoir and others 2017) and broad adaptation strategies in forest types like those found in western Washington have been proposed (Halofsky and others 2018a, Halofsky and others 2011).

■ Summary of Direct, Indirect, and Cumulative Impacts

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 pools analyzed in this chapter are described in Table 4.2.1. Each pool was calculated separately based on the unharvested tree volume estimated from DNR's sustainable harvest model projected over time, and all forest-related carbon pools were summed together in this analysis.

Table 4.2.1. Pools of Stored Carbon 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 that 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 later in the chapter.

Table 4.2.2. Pools of Stored Carbon 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 carbon emissions from a tree begin the same year the tree is harvested. For example, Smith and others (2006) assumes 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. Carbon emitted from that harvested tree only 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 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 all DNR-managed state lands, we used 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. DNR applied this emission value to the total area harvested and thinned per decade (Figure 4.2.1).

COMPARISON OF THE ALTERNATIVES

Under each alternative, more carbon was sequestered than emitted in both the 2015–2024 period and over a five-decade period. Compared to each other, differences in net amount of carbon sequestered across all alternatives is small. In the planning decade, the action alternatives all sequester more carbon than the no action alternative. Over 50 years, Alternative 5 sequesters 5.1 percent more carbon than the no action alternative, while alternatives 2, 3, 4, and 6 sequester 0.4, 2.2, 2.3, and 2.1 percent more carbon than the no action alternative, respectively. All alternatives result in more sequestered carbon relative to current conditions (Figure 4.2.2).

Figure 4.2.1. Change in Carbon Sequestered and Emitted From Current Conditions Under Each Alternative in the Planning Decade (A) and Through the End of Five Decades (B)

Figure 4.2.2. Total Sequestered Carbon (with Emissions Deducted) at the End of the Planning Decade (A) and Decade 5 (B)

Impacts to Elements of the Environment Critical to Sustainable Forest Management

VEGETATION

Forest Composition

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 in other locations where warming temperatures extend the growing season (Halofsky and others 2018b). 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. Increases or decreases in productivity could result in reaching habitat goals, such as attainment of northern spotted owl habitat thresholds, sooner or later in different portions of DNR-managed lands. Overall, it is not yet possible to conclude when climate-related influences to forest productivity on DNR-managed lands within the analysis area will be positive, negative, or neutral through the life of the HCP. No productivity differences are expected between the no action alternative and the action alternatives, nor between action alternatives.

Forest conditions can be changed through management. Thinning to accelerate late-successional conditions in younger second-growth forests could increase forest resilience because it may reduce drought-related stress in younger and more moisture-sensitive trees and foster 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 at the stand scale (since older forests have the broadest range of tree sizes and species) (Halofsky and others 2018a). Thinning will occur in both areas managed for forest cover and areas that are harvested. Alternative 2 would result in approximately 10,000 fewer acres thinned than the no action alternative. Alternatives 3, 4, 5, and 6 would result in approximately 82,000–146,000 fewer acres thinned than the no action alternative (Table 4.2.4). However, this is a small difference when considering that DNR manages approximately 1.46 million acres in western Washington and that some of these areas will be harvested before attaining late-successional conditions. Forest resilience to a changing climate is therefore expected to be similar across the action alternatives and under the action alternatives compared to the no action alternative and will not result in any likely significant adverse impacts to forest conditions.

With a changing climate, future regeneration success using the same species and genetic material as presently used may decrease. While it is probable that current seedling stock will be unsuitable for

planting at some point in the future, it is also possible different genotypes[1] of the same species from either current or different seed zones will be better adapted. This possibility is greater for western Washington than many other locations because the primary commercial species currently planted are not yet at the southern edge of their range. In addition, DNR already uses a broad number of genotypes that have been selected because they perform well across a wide range of environments, and the *Policy for Sustainable Forests* (DNR 2006a) allows for continued species adaptation with climate. Furthermore, given current understanding of seed zones, available methods to inform modified seed zones under future climates (Ying and Yanchuck 2006), and gradual understanding of individual species characteristics (also known as phenology) and genetics (Gould and others 2011, Harrington and Gould 2015, Ford and others 2016), it is possible many planting-related issues can be mitigated in the forthcoming decades. Similarly, silvicultural techniques can be modified to account for changing tree-growing conditions. The potential to dampen climate change effects through planting and silviculture nonetheless requires identifying and filling gaps in scientific understanding. For example, the duration over which current seed sources used in planting will be a reasonable match to future climates is uncertain, nor is it known if the performance of other genotypes from other seed zones will be positive, negative, or neutral relative to past tree growth under the historical climate. It is therefore speculative to infer climatic effects on seedling regeneration success and growth to DNR-managed stands that will be replanted during the life of the HCP. Since planting strategies do not differ across alternatives, any changes to seedling regeneration success and growth are expected to be similar under each alternative.

Table 4.2.4. Acres Thinned Under Each Alternative for Decade 1 and Through Decade 5

Alternative	Thinning acres in Decade 1	Total thinning acres through Decade 5
Alternative 1	75,000	206,000
Alternative 2	47,000	196,000
Alternative 3	21,000	79,000
Alternative 4	20,000	78,000
Alternative 5	25,000	124,000
Alternative 6	16,000	60,000

Alternatives can also be examined more broadly by looking at the area managed for forest cover (Table 4.2.5). From a climate change resistance perspective, there might be an advantage to retaining more lands that will eventually become more structurally complex given HCP habitat goals, uncertainty of disturbance and vegetation trends in specific locations, and the potential loss to forest cover from large stand-replacing wildfires. However, the action alternatives are similar to the no action alternative and similar to each other in the Ecosystem Initiation, Competitive Exclusion, and Structurally Complex stand development stages.

[1] A genotype is defined as the entire genetic constitution (expressed or latent) of one individual (Society of American Foresters 1971).

Table 4.2.5. The Total Number of Acres Under Each Alternative Managed for Forest Cover (percent change based on raw values)

Alternative	Acres	Difference from Alternative 1 Acres	Percent change from Alternative 1 Acres
Alternative 1	685,000	-	-
Alternative 2	678,000	-8,000	-1%
Alternative 3	709,000	24,000	3%
Alternative 4	709,000	24,000	3%
Alternative 5	818,000	133,000	19%
Alternative 6	698,000	12,000	2%

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 Complex of 1902 burned approximately 239,000 acres of forest in Clark, Cowlitz, and Skamania counties in less than a week. Importantly, wildfires in western Washington are rarely limited by available fuel; the mild maritime climate largely limits wildfire occurrence in these forests. As such, these forests are therefore both adapted and resilient to stand-replacing disturbance regimes (Halofsky and others 2018a), although future resilience to such disturbances becomes less certain with time as the climate changes. Specifically, stand-replacing disturbances will increase exposure of tree seedlings to warmer climates. Because tree seedlings are highly sensitive to temperature and moisture regimes, novel climates could result in regeneration failure of species that have done well in the past and thereby foster unique species assemblages. Mature individuals of long-lived tree species can tolerate unfavorable climate conditions for up to several centuries (Brubaker 1986, Noss 2001). In the absence of stand-replacing wildfire, climate-induced shifts in the composition and distribution of existing forests will, therefore, likely be muted or substantially lagged (Franklin and others 1991, Halofsky and others 2018b).

Based on the long-term relationship between stand-replacing disturbances and western Washington forests described in the preceding section, 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 2018a). 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. As shown in Table 4.2.6, relative to the no action alternative, there is little difference in total number of acres designated as structurally complex forest (that is, older forest) currently and through the life of the HCP (Decade 5). For example, Alternative 5 increases area of structurally complex forest by 8 percent (an additional 9,000 acres), while there is a 3 percent decline (4,000 acre loss) in this forest condition under Alternative 2 through Decade 5 relative to the no action

alternative. Forest resistance to a changing climate is therefore likely to be similar both between the action and no action alternatives and between the action alternatives because acres of structurally complex forest are similar across alternatives in Decade 1 or through Decade 5. Thus, there are no likely significant adverse impacts anticipated due to the effects of any of the alternatives.

Table 4.2.6. Acres of Structurally Complex Forest Under Each Alternative Currently and at the End of Decade 5

Alternative	Current conditions (acres)	Decade 5 (acres)	Decade 5 percent change in acres from Alternative 1
Alternative 1	46,000	118,000	
Alternative 2	46,000	114,000	-3%
Alternative 3	46,000	117,000	-1%
Alternative 4	46,000	120,000	1%
Alternative 5	46,000	127,000	8%
Alternative 6	46,000	118,000	-0.3%

In addition, promoting well-distributed habitat patches rather than a 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 marbled 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 2018a).

Considering the similarities in total acreage of structurally complex forest, total acres of thinning, and total acres managed for forest cover, minimal differences in impacts to vegetation are expected between the action alternatives and the no action alternative. There is also little difference between action alternatives.

This conclusion does not mean climate will not impact lands managed for long-term forest cover; only that the differences across all alternatives is sufficiently small that climatic effects will be similar. Furthermore, while this analysis uses the concept of resistance in western Washington forests, it is recognized that a resistance strategy will eventually fail once a natural stand-replacing disturbance occurs. Without post-disturbance management, species compositions will reflect available seed sources and climate-related seed viability, which may or may not reflect historic composition. In contrast, because managers can select specific species compositions and seed stock, planting following a disturbance (natural or human-caused) can have a greater likelihood to result in stands that resemble past composition.

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 and will be minimized under current policy.

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. 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 uses 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 listed wildlife is expected between the action alternatives and the no action alternative, nor between action alternatives outside of Alternative 5. Alternative 5 is likely to have the lowest climate change impact on older-forest-associated species because of the substantial increase in total long-term forest cover acres (a 133,000-acre increase relative to Alternative 1). 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 discussed more specifically in Chapter 5 of the *Final Environmental Impact Statement for the Marbled Murrelet Long-Term Conservation Strategy*.

Potential Climate-Related Impacts on Projected Harvest Levels

Possible changes to forest productivity and composition are described in Section 3.2. The effects of these changes on the projected volume estimates are not known and may be positive, negative, or neutral through the life of the HCP. The proposal analyzed in this FEIS is to establish a harvest level for a 10-year period, fiscal year 2015–2024. For the fiscal year 2015–2024 period, climate-related impacts are likely to be low and similar across all alternatives. Projections presented for subsequent decades are less certain due both to uncertainty in any model and due to climate-related changes in growing conditions and disturbances. The risk that projected harvest volumes are incorrect increases as the projections look farther into the future. However, sustainable harvest levels for decades beyond 2024 will be calculated at least once per decade using the best available information at that time.

Based on our current scientific understanding, over the first decade and for the duration of the HCP, the greatest climate-change-related threat to harvest projections is likely from natural disturbances. Natural

disturbances may both affect the ability to harvest a projected level directly by reducing harvestable volumes in stands where harvests are planned, and indirectly by potentially delaying achievement of a conservation objective that must be met before certain areas can be harvested.

Little difference in the impacts of possible changes to productivity, composition, and disturbance on the harvest level projections is expected between the no action alternative and action alternatives, nor between action alternatives since similar harvest acres are expected in all alternatives.

Table 4.2.7. Summary of Potential Impacts to and From Climate Change

Key questions	Criteria	Measure	Potential impacts
Do any alternatives cause more carbon to be emitted than are sequestered?	Net carbon emissions do not exceed net sequestration.	Whether there is a net increase in carbon through time relative to current conditions.	All alternatives are projected to sequester more carbon than is emitted in the next decade and through the life of the HCP.
What effects will climate change have on the action alternatives or their expected environmental impacts?	An increase in risk to elements of the environment key to sustainable forest management.	Whether management approaches reduce climate-related forest resistance and resilience.	Due to relatively small differences in area of structurally complex forest and in area available for harvest, no alternative is likely to reduce climate-related forest resistance and resilience under a changing climate. Therefore, none of the alternatives are expected to increase climate change related impacts to forest resistance and resiliency.

4.3 Vegetation

This section describes the potential effect of the alternatives on general forest conditions, forest health, and vegetation under special management or conservation status.

Analysis Questions

- *Do any alternatives negatively impact forest composition and structure?*
- *Do the alternatives impact gene pool reserves, old-growth forests, rare plants, and rare plant communities?*

Evaluation Criteria

Scale of Analysis

Vegetation changes, tracked as changes in stand development stage, forest composition, and structure, are analyzed at the planning unit scale. Impacts to rare plants, gene pool reserves, and old-growth forests are discussed across all of western Washington.

How Impacts Are Measured

Data on forest conditions are used to qualitatively assess composition and structural development on DNR-managed lands in western Washington. A shift toward less complex stand development stages, such as an increase in the Competitive Exclusion stage, is considered a potential high impact though DNR intends to provide a range of forest condition on trust lands (DNR 2006a, p. 47). The impacts of the alternatives on disturbances are assessed qualitatively with increased risk of disturbance considered a potential high impact. The analysis also looks at whether the alternatives would impact rare plants, old-growth stands, natural areas, vegetation on uncommon habitats, and genetic resources. Any impact to these resources is considered a potential high impact.

Summary of Direct, Indirect, and Cumulative Impacts

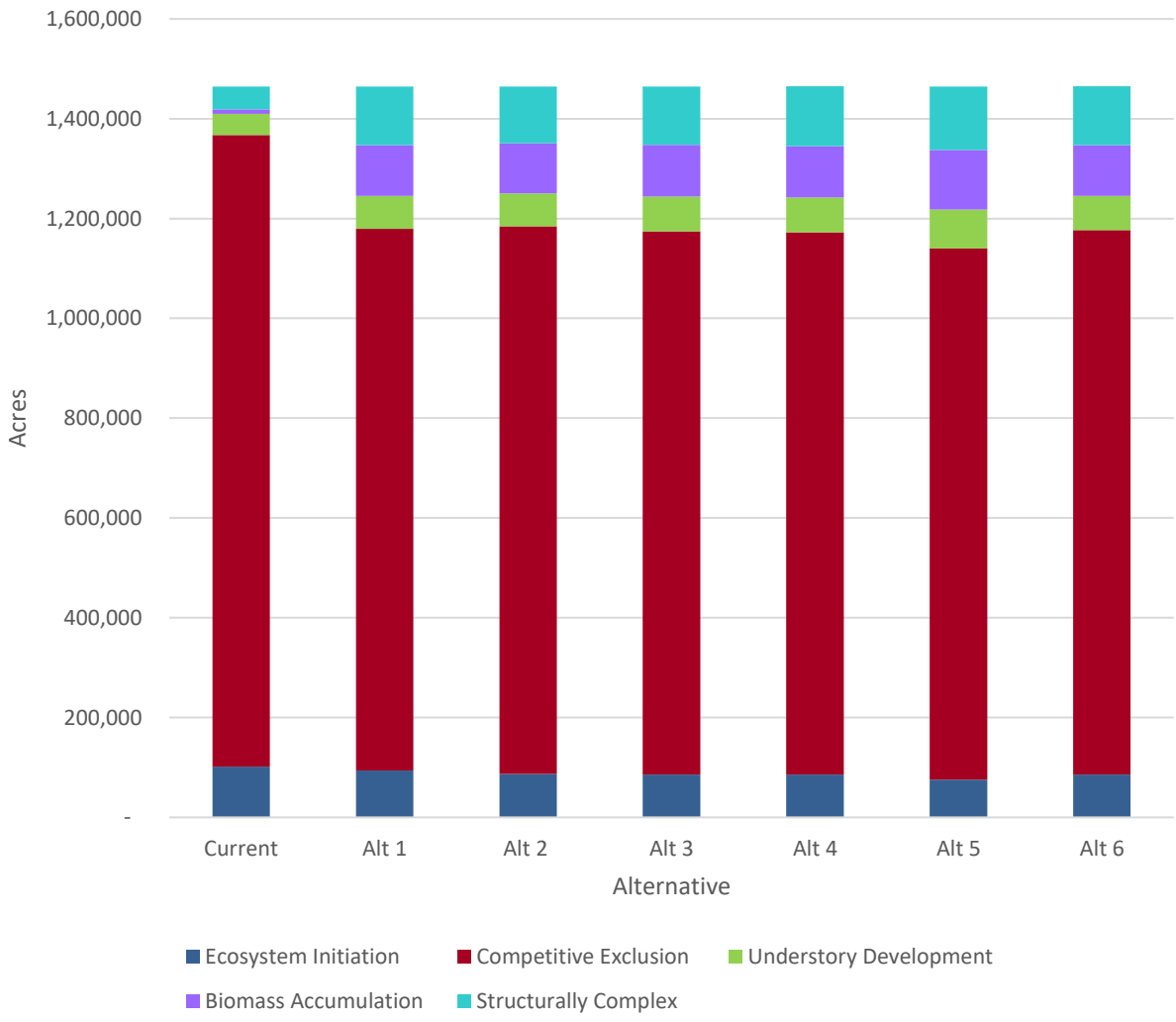
Stand Composition and Structure

As illustrated in Figure 4.3.1, all alternatives result in similar forest stand conditions based on current DNR policy and management direction, including the 1997 HCP and 2006 *Policy for Sustainable Forests*, and overall forest health on state trust lands is expected to increase over time. All alternatives, including

the no action, result in more forests in the Structurally Complex stand development stage and less forest in the Competitive Exclusion stage, as projected over the next 50 years (Figure 4.3.1).

The increase in Structurally Complex area is expected to result in increased species diversity and greater abundance of understory species, particularly those associated with older forest conditions (Halpern and Spies 1995). The Structurally Complex stands are expected to be located in areas that are deferred from harvest or in areas where variable retention harvest is not generally allowed, such as riparian areas.

Figure 4.3.1. Acres by Stand Development Stage for Current Conditions and Each Alternative at the End of 5 Decades



Forest Health

The alternatives do not differ substantially in overall effects on forest health and productivity because the alternatives differ little in projected harvest locations, volumes, and acres as calculated under each

alternative (refer to Chapter 2) and because DNR policies regarding forest ecosystem health and productivity will not change. Under all alternatives, DNR will continue to incorporate cost-effective forest health practices into the management of forested state trust lands to reduce or prevent significant forest resource losses from fire, wind, insects, disease, animals, noxious weeds, and other similar threats to trust assets. DNR will also work closely with the scientific community, other agencies, and other landowners to effectively address forest health issues (per the *Policy for Sustainable Forests*, DNR 2006a).

Information related to forest health and climate change is addressed separately in Sections 3.2 and 4.2.

Vegetation in Special Management or Conservation Status

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 individual large, structurally unique trees. No significant impact is expected to old-growth stands because they are generally deferred. As with all harvest activity, any activity that included the removal of old-growth stands or individual large, structurally unique trees would be subject to SEPA review.

GENETIC RESOURCES

Gene pool reserves are deferred from harvest in all alternatives. No significant impact is expected to this resource.

RARE PLANTS

Potential impacts to rare plants and plant communities are already part of site-specific assessments conducted for forest management activities. Management of sites containing these species would be consistent with DNR's special ecological features policy (DNR 2006a, p. 39). However, because every location of every rare plant is not known, rare plants can be at risk from forest management activities. Unknown occurrences of rare plants or plant communities will likely get an indirect conservation benefit if they are located within a deferred area.

Table 4.3.1. Summary of Potential Impacts on Vegetation

Key questions	Criteria	Measure	Potential impacts
Do any alternatives negatively impact forest composition and structure?	Stand development stages.	Acres of each stand development stage.	No adverse impacts; increase in stands in the Structurally Complex stand development stage and a decrease in stands in the Competitive Exclusion stand development stage.
How do the alternatives impact gene pool reserves, old-growth forests, rare plants, and rare plant communities?	Management changes to gene pool reserves, old-growth forests, rare plants, and rare plant communities.	Policy changes.	No change in policies for gene pool reserves, old-growth forests, rare plants, or rare plant communities. Therefore, no impacts to these resources are likely.

4.4 Aquatic Resources

Analysis Questions

- *How would alternatives affect riparian functions, including riparian habitat, wetlands, water quality and quantity, and fish populations and habitat?*
- *Would any of the alternatives result in impacts to listed fish species in excess of those covered under the 1997 HCP?*

Evaluation Criteria

This section considers how proposed changes in harvest volume and associated forest management activities within and adjacent to aquatic resources could potentially alter key aquatic functions using the following criteria:

- Riparian function is maintained. Key indicators of riparian function are large woody debris recruitment; stream shade, which is one of the primary factors influencing stream temperature; leaf and needle litter recruitment, which provides nutrients to streams that support the aquatic food chain; microclimate, which is moderated by tree cover; peak flows, which should not be elevated due to timber harvest activity; and minimized delivery of sediment into streams (DNR 2016a).
- 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 (Chapter 90.48 RCW).
- Riparian function is maintained. The criterion for fish habitat is functioning riparian habitat, with the same functional indicators identified for riparian function.

The analysis also evaluates whether the alternatives would affect DNR's ability to achieve the objectives of the 1997 HCP riparian conservation strategies.

Scale of Analysis

This section considers overall trends and effects on aquatic resources at the scale of the sustainable harvest calculation analysis area, which is defined in Chapter 1 as all DNR-managed forestlands in western Washington. This analysis scale is used because the proposed action is a non-project action under SEPA and takes place over a large landscape area; therefore, this section cannot consider exactly when and where project-specific forest management activities would occur adjacent to aquatic resources.[2]

[2] 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, Ch. 4).

Those decisions would be made at a later project-specific (operational) level of planning. This section considers 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; therefore, measuring impacts at a smaller (for example, watershed) scale is not necessary since those impacts have been addressed in previously published SEPA documents that analyzed the rules and policies governing those activities.

How Significance Is Measured

The significance of aquatic resource impacts is based on the degree to which the key indicators of aquatic functioning would likely be affected by the alternatives. The alternatives differ primarily in the amount of harvest area, so significance is also considered in terms of the proportion of state trust lands that would be disturbed annually, based on the projected acres of annual harvest under each alternative.

■ Summary of Direct, Indirect, and Cumulative Impacts

The proposed alternatives do not change the existing regulatory framework. DNR would continue to implement the riparian conservation strategy objectives of the 1997 HCP, which are designed to achieve long-term and continuous landscape-level restoration of riparian functions over time. However, the marbled murrelet long-term conservation strategy alternatives may affect harvest volumes and change the area available for potential harvest or thinning, and the riparian harvest options would change the level of harvest in riparian areas in the west-side planning units outside the OESF.

Harvest and Restoration Thinning in Riparian Areas

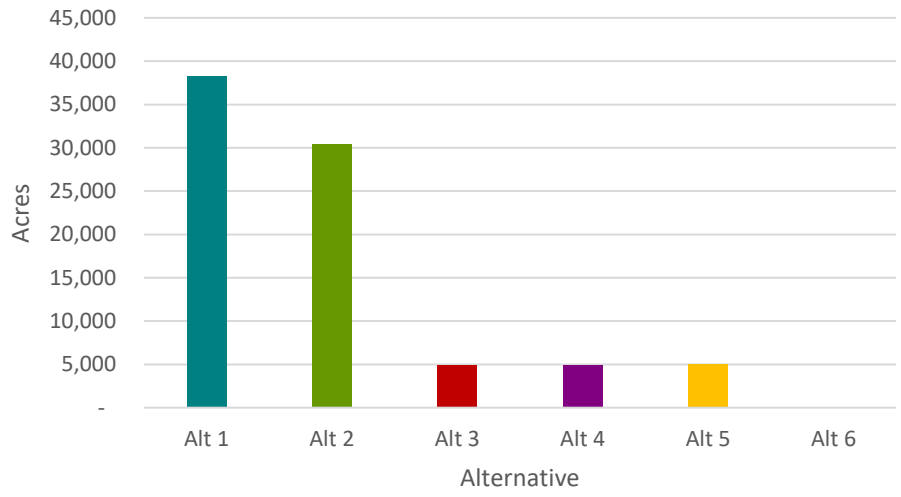
The RFRS was established to use thinning as the primary way to hasten the development of riparian stands and restore riparian habitat functions near streams in the five west-side planning units outside the OESF (DNR 2006c, p. 4). Under the RFRS, commercial thinning is allowed and even encouraged in riparian areas that are not deferred from timber harvest for other reasons, such as wildlife habitat or steep slopes, when compatible with trust duties. Commercial thinning in forested wetlands and wetland buffers can also occur following procedures designed to maintain wetland function (DNR 2006c).

However, due to operational challenges and high costs of thinning operations, relatively little riparian thinning is projected under any alternative. Under Alternatives 1 and 2, approximately 9 and 7 percent of the total riparian forests would be thinned within the first decade, respectively (Figure 4.4.1). Under alternatives 3, 4, and 5, approximately 1 percent of forested riparian area would be thinned over the first decade. Percentage of riparian area thinned under Alternative 6 is unknown since riparian thinning volume under this alternative is not included in the modeled harvest level.

The relatively small proportion of riparian areas projected to be harvested under all alternatives in the planning period would result in correspondingly low adverse impacts from direct harvest disturbance of riparian areas. However, the low thinning area reduces the opportunity for conducting restoration thinning in riparian areas. The lack of riparian harvest may result in some riparian forest areas remaining in relatively low-functioning conditions in the Competitive Exclusion stand development stage for many

decades (DNR 2006c, p. 5). Due to the low levels of restoration thinning that would occur under all alternatives, opportunities for riparian restoration would not vary significantly among the alternatives.

Figure 4.4.1. Acres Thinned in Riparian Areas in the Planning Decade Under Each Alternative



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. 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 that would continue to provide large woody debris.

Example of large woody debris in a stream

Much of DNR's aquatic ecosystems lack the instream large wood debris essential for salmonid habitat, and riparian forests lack the capacity to supply large woody debris in the near future (DNR 2006c, p.6). The reasons for this situation are twofold. First, past forest practices rules provided inadequate protection of riparian forests. As a result, the structurally complex conditions in riparian forests has been greatly reduced on DNR-managed lands. Second, decades ago, instream large woody debris was eliminated from many aquatic ecosystems through practices such as splash damming and clearing of streams for fish passage (Sedell and others 1988).

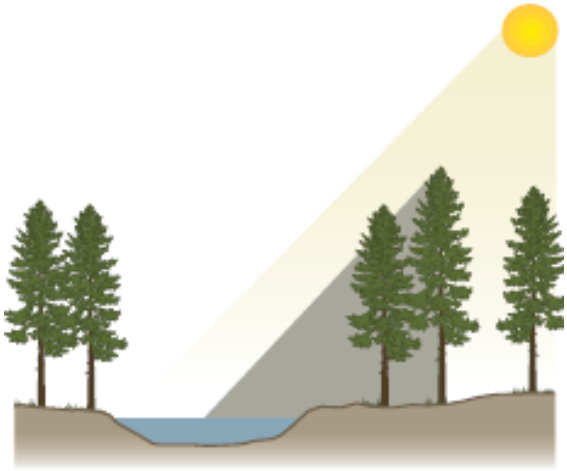
The 1997 HCP riparian conservation strategies, RFRS, and OESF Forest Land Plan are specifically designed to maintain and aid in restoration of riparian habitat, including promotion of the long-term recovery of large woody debris recruitment potential. Under all alternatives, large woody debris would increase over time from natural growth of wood biomass within riparian buffers in all western Washington planning units. Although slightly less than Alternative 1, Alternative 2 allows for more riparian treatments compared to the other action alternatives, which will accelerate restoration. Alternatives 3 through 6 allow for less active management and result in slower progress toward the objective of restoring long-term large woody debris recruitment potential.

PEAK FLOW

Establishing the sustainable harvest calculation would not alter DNR's existing approach to addressing peak flows, which includes objectives for hydrologic maturity in the rain-on-snow and snow-dominated zones (per *PR-14-040-060 Assessing Hydrologic Maturity*). Under all alternatives, including the no action alternative, DNR must maintain the required area of hydrologically mature forest in all applicable basins. This approach ensures that detectible increases in peak flow are avoided and are consistent with the *Policy for Sustainable Forests*, Forest Practices Act, *Washington State Forest Practices Board Manual*, and 1997 HCP. The basins that are currently below the required amount of hydrologically mature forest will be restored to above the required amount before harvest can occur.

STREAM SHADE

Figure 4.4.2 Illustration of 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).

Alternative 1 includes approximately 31,000 acres of thinning in riparian forest, which equates to approximately 7 percent of the total riparian forests being thinned within a 10-year period. Alternative 2 has slightly less riparian thinning compared to Alternative 1. All of the other action alternatives project less riparian thinning acres. While thinning of riparian zones would result in temporary reductions in stream shade, the extent of thinning in any one area would be limited and would not be sufficient to significantly increase stream temperatures. In addition, opening up

overstocked stands within riparian areas through thinning would help promote more diverse riparian understory vegetation and associated shading and habitat values. Therefore, overall effects of thinning on shading from any of the alternatives would be low.

Stream shade functions of riparian areas would be maintained under all alternatives, as required by the existing riparian management framework, which includes the Forest Practices Act, *Washington State Forest Practices Board Manual*, OESF Forest Land Plan, and 1997 HCP.

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 alternatives change existing forest practices rules or DNR procedures regarding road design, maintenance, or abandonment. Therefore, none of the action alternatives is likely to increase fine sediment delivery to wetlands, streams, or any other waters.

Miles of future road management activities are expected to be similar to current miles of activity, with abandonment decreasing to match or be slightly lower than the new construction numbers.

LEAF AND NEEDLE LITTER RECRUITMENT

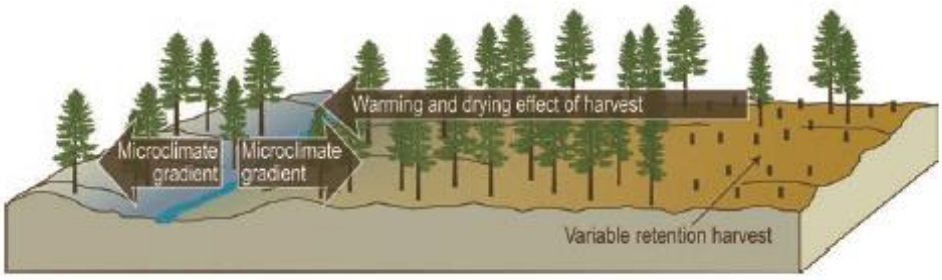
Leaf and needle litter are organic debris produced by the forest canopy that provide nutrients to streams that support the aquatic food chain. Leaf and needle litter account for the majority of nutrient inputs in many small headwater streams and are critically important for the healthy function of these ecosystems (Wallace and others 1997).

The majority of leaf and needle litter recruitment comes from vegetation growing within 100 feet of a stream (FEMAT 1993), and these zones are protected by the HCP riparian conservation strategies and forest practice rules. Therefore, none of the alternatives would alter leaf or needle litter recruitment compared to Alternative 1.

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) (Figure 4.4.3). 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 4.4.3 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 from the stream. In addition, they noted increased relative humidity at distances up to 122 feet from the stream. The heating and drying effects of harvest can extend up to approximately 545 feet into the surrounding unharvested areas (Chen 1991, Chen and others 1995, FEMAT 1993).

Timber harvest may occur well within this 545-foot zone of influence, potentially affecting the microclimate in adjacent areas of riparian forest. However, microclimate is a relatively small component of overall riparian health. Changes in microclimate are not expected to significantly affect riparian habitat.

Effects on Endangered Species Act-Listed Fish

All alternatives would follow the 1997 HCP, RFRS, and associated DNR procedures to protect fish species. As previously evaluated, continued timber harvest in the range of alternatives being considered in this FEIS is not likely to significantly alter the key indicators of aquatic resources or associated habitat values for fish, including bull trout, steelhead, and several species of salmon listed as threatened or endangered under the Endangered Species Act. Under all alternatives, habitat for fish species listed under the Endangered Species Act is expected to continue to recover from damages from forest practices conducted on state trust lands prior to the 1997 HCP.

Cumulative Effects

Timber harvest from state trust lands continues under all alternatives. The cumulative effects of timber harvest practices on aquatic resources are a major focus of DNR's forest management planning. In addition to the riparian forest management regulations under the Forest Practices Act, the *Washington State Forest Practices Board Manual*, 1997 HCP, RFRS (DNR 2006c), and OESF Forest Land Plan, DNR also implements procedures that address cumulative effects, including *PR-14-005-050 Maximum Size for Even-Aged Final Harvest Units* and *PR-14-040-060 Assessing Hydrologic Maturity*. Together, these strategies help DNR minimize the cumulative effects of its timber management activities on aquatic resources.

As part of project-specific timber sale environmental reviews under SEPA, DNR also evaluates the cumulative effects of harvests occurring on state and non-state lands in the past and those expected to occur in the reasonably foreseeable future. These evaluations are conducted at the sub-watershed level

and help DNR determine any potential for significant adverse cumulative impacts associated with the harvest so that DNR can avoid, minimize, and mitigate them.

A trend of gradual improvement of riparian function and associated aquatic resources is expected to continue over time under all alternatives. The regulatory and policy framework guiding DNR management of riparian areas is designed to maintain and improve the riparian and aquatic conditions. Both the *South Puget Sound HCP Planning Unit Forest Land Plan Final Environmental Impact Statement* (DNR 2010) and the *OESF HCP Planning Unit Forest Land Plan Final Environmental Impact Statement* (DNR 2016a) found gradually improving riparian conditions in and associated with aquatic resources in their respective analysis areas, which are managed under the same regulations and policy framework. Due to this framework, the ongoing timber harvests under any of the alternatives are not likely to significantly alter this overall positive trend and result in an adverse cumulative effect.

Table 4.4.1. Summary of Potential Impacts on Aquatic Resources

Key Questions	Criteria	Measures	Potential Impacts
How would alternatives affect riparian functions, including riparian habitat, wetlands, water quality and quantity, and fish populations and habitat?	No net loss of acreage and function of wetlands (*Policy for Sustainable Forests*). No net loss of positive indicators of aquatic function. No net gain of negative indicators of riparian function. Other aquatic and riparian obligate species are maintained (1997 HCP, RFRS). Functions of riparian and wetland habitat for wildlife and water resources are maintained (1997 HCP).	The degree to which these functions are 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 adequately address most potential effects on aquatic resources. Low level of thinning in riparian areas may slow progress toward riparian restoration goals established in the RFRS.
Would any of the alternatives result in impacts on listed fish species in excess of those covered under the 1997 HCP?	Functioning riparian habitat; same criteria as in previous row.	Same as in previous row.	Continued timber harvest is not likely to significantly alter the key indicators of aquatic resources or associated habitat values for fish.

4.5 Wildlife and Biodiversity

This section considers the effects of sustainable harvest calculation alternatives on wildlife.

Analysis Questions

- *How will the level of harvest allowed under each action alternative impact populations of federally listed wildlife species?*
- *How will each alternative affect wildlife habitat?*

DNR-managed lands in South Puget planning unit

Evaluation Criteria

This analysis considers the following criteria for determining whether the *Policy for Sustainable Forests* and the 1997 HCP are maintained under the alternatives:

- Northern spotted owl habitat targets and conservation strategies are maintained.
- Species listed as threatened or endangered do not experience adverse impacts from the alternatives.
- Wildlife habitat, species diversity, and the ecological functions needed to support them on DNR-managed lands in western Washington are maintained.

Scale of Analysis

For this FEIS, effects on listed species and biodiversity are considered in terms of trends over the entire analysis area for a five-decade period, the duration of the 1997 HCP.

How Significance Is Measured

Significance is based on the degree to which alternatives would comply with the 1997 HCP and the *Policy for Sustainable Forests*. For listed species, significance is also based on the degree to which the alternatives may interfere with species recovery and the ability of the species to breed, feed, or seek shelter.

The significance of wildlife habitat changes due to timber harvest is based on the change in amount of each forest stand development stage over time, as projected by the forest estate model for each alternative. This model uses stand age to estimate stand development stage.

■ Summary of Direct, Indirect, and Cumulative Impacts

Northern Spotted Owl

HABITAT IN SPOTTED OWL MANAGEMENT UNITS

Northern spotted owl habitat within designated spotted owl dispersal management areas, and nesting, roosting, and foraging management areas would not be harvested under any of the alternatives until threshold targets established by the 1997 HCP are met (DNR 2007a). In the OESF, spotted owl habitat is managed consistent with the OESF Forest Land Plan. Harvest of spotted owl habitat may occur in the few spotted owl management units that are above threshold. These spotted owl management units above threshold are dispersal management areas, except for two in the OESF where land planning units do not have a habitat area designation. Any harvest of spotted owl habitat would be associated with a timber sale that would include a thorough site-specific review, including a SEPA checklist.

SETTLEMENT AGREEMENT

None of the alternatives would change the way DNR manages or protects spotted owl habitat under the 1997 HCP.

Under the action alternatives, the 2006 Settlement Agreement would terminate, resulting in potential harvest in low-quality spotted owl habitat (sub-mature habitat or young forest marginal habitat, refer to Appendix A in DNR 2019b for a description of spotted owl habitat classifications used by DNR). None of these lands are considered critical to DNR's HCP conservation strategy for the spotted owl to provide demographic support to the *USFWS Northern Spotted Owl Recovery Plan* (USFWS 2011).

The total area of habitat subject to the Settlement Agreement is about 5,000 acres. Most of this habitat is in small, isolated patches (average patch size is 25 acres) not continuous with federal lands or DNR nesting, roosting, and foraging management areas in the five west-side HCP planning units. None of the acres are located in the OESF. Some of this habitat is in areas that will not be harvested due to other policies and laws. The area that may be harvested depends on the alternative (Table 4.5.1). Impacts due to harvest of these areas are speculative and cannot be quantified, but due to the small patch size, isolation of the patches, and low-quality of the habitat, harvest is unlikely to interfere with spotted owl recovery.

Table 4.5.1. Area of Northern Spotted Owl Habitat Subject to the Settlement Agreement Available for Harvest in Each Alternative

	HCP planning units					
Alternative	**Columbia**	**North Puget**	**South Coast**	**South Puget**	**Straits**	**Total**
Alternative 1	0 acres – Settlement Agreement is retained in this alternative					
Alternative 2	245 acres	8 acres	1,180 acres	1 acres	482 acres	1,917 acres
Alternative 3	245 acres	8 acres	1,180 acres	1 acres	468 acres	1,902 acres
Alternative 4	245 acres	8 acres	1,180 acres	1 acres	468 acres	1,902 acres
Alternative 5	203 acres	4 acres	1,021 acres	0 acres	482 acres	1,711 acres
Alternative 6	245 acres	8 acres	1,180 acres	1 acres	482 acres	1,917 acres

No acres of northern spotted owl habitat subject to this this aspect of the Settlement Agreement are in the OESF HCP planning unit.

ENHANCEMENT THINNING

The Settlement Agreement results in Alternative 1 including more thinning in the OESF than the action alternatives. However, under the action alternatives, DNR would continue treatments where needed to reach spotted owl habitat thresholds and allow harvest as described in the OESF Forest Land Plan. Since habitat enhancement activities would continue to occur, the deduction of thinning acres in the action alternatives have no effect on the spotted owl.

CONTINUED INCREASE IN HABITAT WITHIN DESIGNATED AREAS

The area of northern spotted owl habitat on DNR-managed lands will continue to increase over time under all alternatives as habitat continues to develop within designated spotted owl management units and OESF landscapes.

Impacts on Northern Spotted Owl in the Context of Barred Owls

The 1997 HCP was completed at a time when federal and state land managers were expecting northern spotted owl populations to stabilize due to the *Northwest Forest Plan* (DNR 1998). However, as considered in both the 2004 sustainable harvest calculation (DNR 2004) and the 2007 Addendum (DNR 2007a), northern spotted owl populations are still in decline (Buchanan 2016). Competition and predation by barred owls is believed to be a major cause of this decline (Buchanan 2016, Davis and others 2016, Lesmeister and others 2018).

Based on the wide-ranging nature of declines in northern spotted owl populations—even within National Parks and National Forest lands where relatively large blocks of old-growth habitat have been retained—it is likely that the factors driving the decline are not specific to DNR-managed lands. The overall strategy taken by DNR and the USFWS under the 1997 HCP was to focus spotted owl conservation in areas most important to spotted owl conservation by protecting clusters of spotted owls that occur largely on federal reserves (DNR 1997, p. IV-3). DNR-managed lands in the OESF and in nesting, rooting, and foraging and dispersal management areas are designed to provide either demographic support, maintain species

distribution, or allow for dispersal. The continued decline of spotted owls does not seem to undermine this overall conservation strategy. With the continued threat of barred owls, providing support to large core areas that support clusters of active spotted owl territories are still likely to be the highest spotted owl management priority for state trust lands.

Other Threatened and Endangered Species

GRAY WOLF

No alternative changes the management of the gray wolf. Under the 1997 HCP, all harvests and road-building comply with forest practices rules and state wildlife regulations. These activities are not expected to significantly interfere with the recovery of the gray wolf.

GRIZZLY BEAR

Timber harvest on the eastern portions of state trust lands within the North Puget and South Puget HCP planning units could potentially affect grizzly habitat suitability by increasing human activities. However, because grizzly bears occur primarily in roadless, alpine and subalpine areas (USFWS, 1997b) and because state trust lands primarily have roads and are located below subalpine forests, continued timber harvest on state trust lands is not likely to significantly interfere with the recovery of grizzly bear populations within the North Cascades ecosystem, a designated recovery area.

NON-FOREST OPENING AND WETLAND SPECIES

Columbian white-tailed deer, streaked horned lark, Oregon spotted frog, Oregon silverspot butterfly, and Taylor's checkerspot butterfly occur in non-forest openings or wetland areas and rarely, if ever, occur within the forests managed for timber harvest that are subject to the sustainable harvest calculation. Impacts on these species are not expected to be significant and would be addressed as part of project-specific planning and SEPA review.

Wildlife Habitat and Species Diversity

DECLINE IN COMPETITIVE EXCLUSION AND INCREASE IN STRUCTURALLY COMPLEX FOREST

As documented in Section 3.3, Vegetation, all alternatives result in very similar forest stand composition and structure over time (refer to Figure 4.3.1). Forest in the Competitive Exclusion stage is the most abundant habitat type on forested trust lands and would remain so under all alternatives.

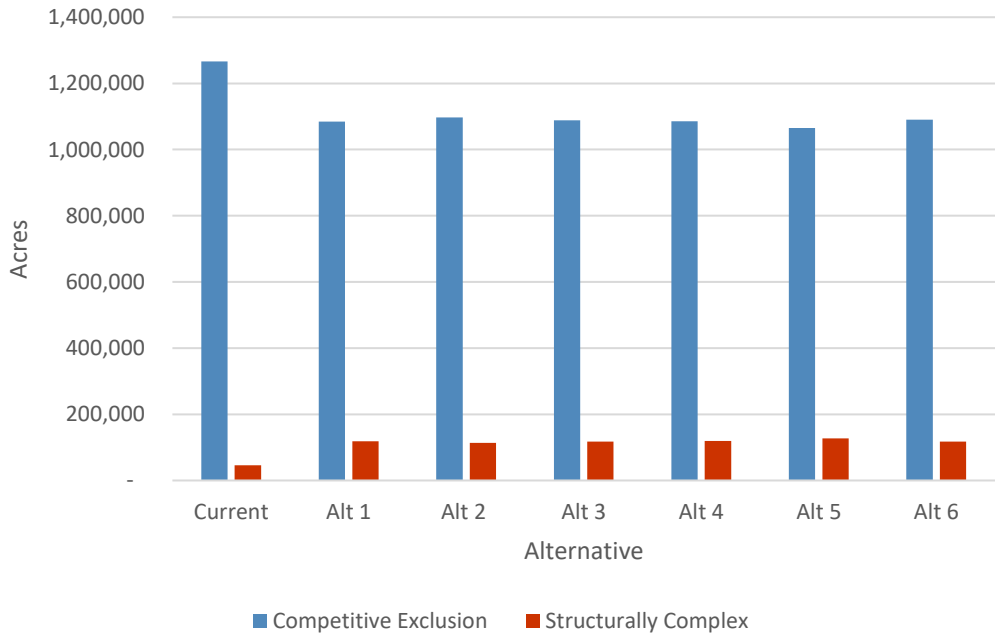
The Competitive Exclusion stage tends to have lower species diversity and contains less abundant understory vegetation than later stages (Halpern and Spies 1995, Johnson and O'Neil 2001). The majority of timber harvest is also expected to occur in this stand development stage under all alternatives and throughout the 5-decade analysis period.

Under any of the alternatives, wildlife habitat areas and distributions on state trust lands would follow very similar trends. The Competitive Exclusion stage would continue to be the dominant stand development stage, but the number of stands in this stage would decrease over time. The area of forest in the Competitive Exclusion stage would gradually reduce over time through two processes: conversion to ecosystem initiation forest through high-volume timber harvest, and—on lands deferred from timber harvest for marbled murrelet or other reasons—development into structurally complex forest through natural forest succession and forest management activities such as thinning.

All alternatives would reduce the amount of Competitive Exclusion stands on DNR-managed lands in western Washington (Figure 4.5.1). For the most part, decreases in the amount of Competitive Exclusion forests correspond to increases in the amount of Structurally Complex forests (Figure 4.5.1). The increase in area of Structurally Complex forests is expected to result in increased species diversity, particularly for late successional guild species such as northern goshawk, northern pygmy owl, brown creeper, Vaux's swift, Townsend's warbler, red tree vole, black bear (for denning), and northern flying squirrel (based on Johnson and O'Neil 2001).

Populations of non-listed species that are important for recreational, economic, cultural, and ecological values—including hawks, deer, elk, bear, cougar, and forest grouse—are expected to be maintained throughout state trust lands as all alternatives would result in a similar mosaic of habitat types. The moderate reduction of competitive exclusion forests and increase in structurally complex forests are likely to moderately benefit these species over time.

Figure 4.5.1. Changes in Competitive Exclusion and Structurally Complex Forests for Current Conditions and Under Each Alternative at the End of Five Decades



Timber harvest would continue to create Ecosystem Initiation stands, edge habitat, and associated high wildlife use. On lands where variable retention harvest is allowed, forest stands would, over decades, cycle between Ecosystem Initiation and Competitive Exclusion, never reaching Structurally Complex

stages. These lands would still provide habitat for the many species of wildlife associated with the Ecosystem Initiation stage and edges. While Competitive Exclusion stands make a relatively small contribution to biodiversity, they still contain features important to supporting wildlife diversity, including legacy trees and tree patches, riparian and wetland areas, and non-forest habitat types such as talus and balds.

All alternatives are expected to increase overall wildlife habitat and species diversity across DNR-managed lands, as habitat both within and outside of deferred areas 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 wildlife habitat and biodiversity within the working forest landscape (DNR 2016a, p. 3-25).

OTHER FOREST MANAGEMENT ACTIVITIES: ROADS, ACCESS, TRAFFIC

The alternatives may result in minor adjustments to road management. However, none of the alternatives are expected to alter road densities, the amount of road traffic, or road locations to the point that the diversity of wildlife habitats or species is affected.

Sensitive and Regionally Important Wildlife

None of the alternatives are likely to affect populations of species listed in Appendix J at the landscape level. The increase in Structurally Complex forests projected under all alternatives would potentially increase breeding, resting, and hiding habitat for several sensitive species.

Table 4.5.2. Potential Impacts to Wildlife

Key questions	Criteria	Measures	Potential impacts
How will the level of harvest allowed by each alternative impact populations of listed wildlife species?	Northern spotted owl habitat targets and conservation strategies are maintained. Species listed as threatened or endangered are not adversely affected.	Degree to which alternatives would comply with applicable policies and plans, including the 1997 HCP. Effect of alternatives on key habitat components important to breeding, feeding, and seeking shelter.	None of the alternatives would change DNR management prescriptions for listed species. Timber harvest may have local effects on the distribution and habitat use of gray wolf and grizzly bear, but no significant effects on these species or their recovery is likely.
How will the alternatives affect wildlife habitat?	Wildlife habitat and species diversity on DNR-managed lands are maintained.	Changes in the amount of forest in Competitive Exclusion and Structurally Complex stand development stages over time.	All alternatives will result in decreases in low-value Competitive Exclusion habitats and increases in high-value Structurally Complex forests, resulting in a net benefit to wildlife habitats and diversity over time.

4.6 Marbled Murrelet

Impacts to marbled murrelet resulting from different configurations and quantities of long-term forest cover are analyzed in Section 4.6 of the marbled murrelet long-term conservation strategy FEIS (DNR 2019a). This FEIS incorporates the analysis by reference. The sustainable harvest calculation alternatives incorporate long-term forest cover from five of the eight marbled murrelet long-term conservation strategy alternatives. The conservation strategy alternatives that are not included in the sustainable harvest calculation alternatives are alternatives C, G, and H. The impacts from Alternative C are expected to be similar to alternatives D and E. The impacts from Alternative G should be within the range of impacts analyzed in this FEIS, and would specifically be between Alternatives E and F. In addition, the total harvest levels for both Alternatives C and G would be within the range of levels analyzed in this FEIS. The marbled murrelet strategy included in Alternative 6 of this FEIS, DNR's Amendment (refer to Appendix Q of DNR 2019a), is very similar to conservation strategy Alternative H analyzed in the marbled murrelet long-term conservation strategy FEIS in terms of acres of conservation and acres of harvest. Therefore, impacts under Alternative 6 to the marbled murrelet will be very similar to those analyzed under Alternative H in the marbled murrelet long-term conservation strategy FEIS (refer to Table 4.6.16 in DNR 2019a).

The analysis in the marbled murrelet long-term conservation strategy FEIS assumes harvest levels outside of long-term forest cover will remain similar to past harvest levels. Since 2005, between 432 and 654 MMBF have been sold from DNR-managed lands in western Washington each year. All of the sustainable harvest calculation alternatives result in harvest levels within this range.

Portions of western Washington included in the sustainable harvest calculation analysis area but outside of the marbled murrelet analysis area are not expected to support marbled murrelet because they are beyond the 55-mile inland range of the marbled murrelet. Therefore no additional analysis of impacts to the marbled murrelet is necessary.

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Chapter 5

CUMULATIVE EFFECTS

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Chapter 5

Cumulative Effects

This chapter characterizes the cumulative effect of each alternative on the elements of the affected environment described in Chapter 3.

Guidance on Assessing Cumulative Effects

SEPA Regulations

Under Washington State SEPA rules, the scope of impacts analyzed in an Environmental Impact Statement includes cumulative impacts (WAC 197-11-060(4)(e); 197-11-792).

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?*

Significant cumulative adverse effects are determined based on whether the effects of proposed timber harvest levels would result in significant adverse impacts when combined with the adverse effects of other past, present, and reasonably foreseeable future actions. And whether those effects have already been considered and addressed by previous DNR decisions and associated SEPA administrative records, including the following:

- *Final (Merged) Environmental Impact Statement for the Habitat Conservation Plan (DNR 1998).*
- *Final Environmental Impact Statement on Alternatives for Sustainable Forest Management of State Lands in Western Washington and for Determining the Sustainable Harvest Level (DNR 2004).*
- *Final Environmental Impact Statement on the Policy for Sustainable Forests (DNR 2006b).*

- *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 (NMFS and USFWS 2006).*
- *Addendum to a Final Environmental Impact Statement (SEPA File #02-022201) (DNR 2007a).*
- *South Puget HCP Planning Unit Forest Land Plan Final Environmental Impact Statement (DNR 2010).*
- *Olympic Experimental State Forest HCP Planning Unit Forest Land Plan Final Environmental Impact Statement (DNR 2016a).*

In addition, 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 adverse environmental impact on that element of the environment. Therefore, the first criterion for identifying significant cumulative effects is whether the proposed action would result in any incremental adverse impacts for the specific elements of the environment included in the scope of this FEIS.

As described in Chapter 4, no potentially adverse direct or indirect impacts to the elements of the environment were found. Since this finding applies to all alternatives, the alternatives are discussed collectively. However, in a few cases, the differences between the alternatives are indicated.

Individually Minor but Collectively Significant Actions

As described under the evaluation criteria section, one of the two questions considered in this cumulative impact assessment is whether the proposed sustainable harvest level would involve individually minor but collectively significant actions taking place over a period of time.

Based on data projected by the sustainable harvest calculation forest estate model, all alternatives would result in cumulative timber harvest and thinning area within forested state trust lands in western Washington in the range of 114,000 to 200,000 acres during the 2015–2024 planning decade. This equates to a harvest of between approximately 8 to 14 percent of forested state trust lands in western Washington. Each harvest or thinning activity will be implemented following the 1997 HCP, forest practices rules, the OESF and the South Puget Forest Land plans, and the *Policy for Sustainable Forests*, all of which include provisions designed to mitigate impacts and all of which were analyzed for cumulative effects. More details for each element of the environment are provided in Chapter 4 of this FEIS.

None of the alternatives would result in significant adverse impacts on the elements of the environment evaluated in Chapters 3 and 4. Under all alternatives, environmental indicators for vegetation, wildlife, and aquatic resources are expected to improve as DNR continues to implement the 1997 HCP, the *Policy for Sustainable Forests*, and related policies and procedures stemming from this policy framework. Soils and potentially unstable slopes will be unaffected by the alternatives.

Incremental Impacts of Alternatives

The question considered in this section of the cumulative impact assessment is whether the incremental impacts of the alternatives—when added to the adverse impacts of other past, present, and reasonably foreseeable future actions—result in significant adverse effects.

■ Forest Management in the Analysis Area: Past, Present, and Future Trends

An important aspect of cumulative effects is the mix of land ownership within the landscapes upon which cumulative effects may occur. Within the approximately 19.5-million-acre analysis area (terrestrial lands in western Washington), 29 percent are federal lands (primarily National Forest and National Park), 8 percent are managed by DNR, and approximately 63 percent of the lands 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, and Pierce counties, and federal lands make up more than half of the forestlands within Whatcom, Jefferson, and Snohomish counties.

Past, Present, and Future 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.

The 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 1997 HCP strategies also increased protection of riparian areas, northern spotted owl habitat, marbled murrelet habitat, and unique habitats (such as caves, cliffs, and balds). Since signing the HCP, DNR has increased the acres of protected natural areas (Natural Area Preserves and Natural Resource Conservation Areas) and increased protection of old growth. In addition, management on state lands follows forest practices rules for road construction which are included in the Forest Practices HCP (DNR 2005b), which protects aquatic and riparian-dependent species and provides Endangered Species Act compliance for these species.

This existing underlying policy and regulatory framework currently governs forest management on state trust lands and will continue to govern forest management into the foreseeable future.

Past, Present, and Future Management of Federal Lands

Federal forestlands within western Washington are located in National Parks, National Forests, National Wildlife Refuges, and Department of Defense military reservations. As with state-managed lands, timber harvests have occurred extensively on federal lands outside of the National Parks and designated Wilderness Areas. As a result, large areas of National Forest lands now contain densely stocked tree plantations rather than structurally and biologically diverse stands.

The *Northwest Forest Plan* (U.S. Department of Agriculture and U.S. Department of the Interior 1994) included a set of standards and guidelines for the management of federal forestland in the Pacific Northwest, including all federal forestlands in western Washington. These guidelines were designed to maintain and support native species—particularly those associated with late-successional and old-growth forests—protect riparian areas and waters, and maintain a supply of timber. Under the Northwest Forest Plan, the focus of forest management on 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 on the Olympic National Forest (USFS 2015a) and the Hansen Creek Vegetation Project on the Mount Baker Snoqualmie National Forest (USFS 2015b). These management practices are likely to continue into the foreseeable future.

Past, Present, and Future Management of Private Forestlands

Private forestlands (industrial and non-industrial private lands) in western Washington encompass over 7 million acres. Private industrial forestlands are intensively managed. Very few late-stage forests are present on such lands, and most stands are less than 50 years old. Private industrial forestlands are focused on timber production, with many areas harvested on relatively short rotations (in the range of 40 to 50 years) (Davies and others 2011). Private forestlands within the analysis area are also being converted to other uses, including industrial and residential developments.[1]

Private timber harvest in Washington must comply with the Washington Forest Practices Act (RCW 76.09) and the Washington forest practices rules (WAC 222), although the requirements could vary if the landowner has a federally approved HCP. Washington has an approved HCP with associated incidental take permits for the forest practices rules and the Forest Practices Program to conserve fish and amphibian species (DNR 2005b). The Forest Practices HCP covers all non-federal and non-tribal forestland owners. This regulatory framework is expected to continue to govern these lands into the foreseeable future.

Forest Conversion

Permanent clearing of forest and conversion of forest to agriculture and real estate development reduces the forestland area in Washington. Forest conversion was occurring at a rate of about 1 percent per year as of 2007 (University of Washington 2007). The population of Washington state grew 1.6 percent during the April 1, 2018 to April 1, 2019 period to 7,546,600 (Office of Financial Management 2019). This population growth contributes to forestland conversion for homes and businesses. The population of

[1] Refer to http://file.dnr.wa.gov/publications/em_fwflanduse.pdf.

Washington is expected to continue to grow, and with it, the conversion of forestlands to other uses is likely.

■ Incremental Impacts of the Alternatives—When Added to Other Past, Present, and Reasonably Foreseeable Future Actions

Forested lands within the project area—including state, federal, and private forestlands—have been and will continue to be subject to a variety of human-caused disturbances; however, none of the alternatives are likely to add any adverse impacts to the elements discussed in Chapter 3 and Chapter 4. Thus, when added to other past, present, and reasonably foreseeable actions occurring across state, federal, and private lands within western Washington the alternatives do not add to significant adverse impacts from these activities. The existing underlying policy and regulatory framework remain unchanged under the action alternatives, and impacts of these existing policies and regulations, including harvest impacts, have been previously analyzed and determined to have no cumulative adverse impacts.[2] Table 5.1.1 summarizes the incremental impacts of the alternatives considered collectively with past effects and future trends on state, federal, and private forestlands in western Washington.

Cumulative Impacts

■ Cumulative Impacts by Element of Environment

Under all alternatives, environmental indicators for aquatic resources, vegetation, and wildlife are expected to continue to improve on state trust lands as DNR continues to implement the 1997 HCP, the *Policy for Sustainable Forests*, and related policies and procedures. None of the alternatives, when added to other past, present, and reasonably foreseeable actions occurring across state, federal, and private lands within western Washington, are expected to result in significant adverse cumulative impacts on these elements of the environment.

[2] Refer to Final Environmental Impact Statement on Alternatives for Sustainable Forest Management of State Lands in Western Washington and for Determining the Sustainable Harvest (DNR 2004, 2007a); Final (Merged) Environmental Impact Statement for the Habitat Conservation Plan (DNR 1998); Forest Practices Habitat Conservation Plan Final Environmental Impact Statement (DNR 2005b); and Final Environmental Impact Statement of the Policy for Sustainable Forests (DNR 2006b).

Table 5.1.1. Incremental Effects of Alternatives: Impacts Added to Past Effects and Future Trends in Western Washington Forestland Under State, Federal, and Private Management

	Past	Present	Future actions and trends	Incremental additions of the alternatives
Forest management	Historic timber harvest, clearing for agriculture and development, and reforestation over the past 100 years have created densely stocked stands with reduced timber productivity and wildlife habitat values. Wildlife habitat has been significantly reduced due to the loss and fragmentation of Structurally Complex forest stands.	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 regulatory framework. Active thinning improves timber production and wildlife habitat values. Thinning is conducted as part of commercial forest management.	DNR-managed lands will be managed consistent with the 1997 HCP, including future changes due to the marbled murrelet long-term conservation strategy, *Policy for Sustainable Forests*, and forest practices rules. On federally managed forestlands in western Washington, most management will be designed to improve wildlife habitat. Timber harvest will continue on private forestlands in western Washington following forest practices rules, including the Forest Practices HCP and other HCPs.	All action alternatives result in lower harvest levels than the no action alternative. Thinning would decrease under the action alternatives compared to the no action alternative.
Conversion of forestland to other uses	Lands on suburban/wildland interface converted to residential and agricultural uses.	Continued decline in private forestlands due to land use conversions (University of Washington 2007). Some large blocks have been secured by conservation groups.	Private forestlands near urban and suburban areas likely to continue to be converted to other land uses, reducing the overall footprint of forestlands, particularly in productive lands in river valleys near urban centers.	No change.

6

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

Basal area per acre: Basal area is the cross sectional area of a stem measured at breast height. Basal area per acre is the sum of basal areas of trees in a stand divided by the area of the stand in acres.

Biodiversity: The full range of life in all its forms (Washington Biodiversity Council).

Biodiversity pathways: An approach to achieving goals of biodiversity and conservation while also supporting revenue production in managed stands that was popularized by research biologist Andrew Carey. Biodiversity pathways consist of the following principles: retention of biological legacies at harvest (snags, downed wood, large trees, and other features) and soil organic matter; pre-commercial thinning to bypass the Competitive Exclusion stage and promote woody plant diversity; thinning at variable densities to promote heterogeneity; natural regeneration of western hemlock, western redcedar, and deciduous trees; and long rotations (70–130 years).

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 (BNR or Board): As defined and authorized in RCW 43.30.215, the BNR 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 BNR's duties include establishing department policy and setting appraisal value of lands and valuable materials including timber values offered for sale. Refer to RCW 43.30.215 for more duties of BNR.

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.

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.

Deferral: As used in this FEIS, 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.

Discount rate: The rate used to discount future costs and revenues, such as projected costs and revenues a harvest schedule, to calculate net present value.

Dispersal management area: A discrete area to be managed for dispersal or better northern spotted owl habitat.

Dispersal habitat: A northern spotted owl habitat definition for stands with structural characteristics that allow for the movement of young spotted owls from nesting sites to new breeding sites.

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.

Genotype: The entire genetic constitution (expressed or latent) of one individual.

HCP planning unit: A geographic area that is based on watersheds for the purpose of tying the minimization and mitigation more closely to the natural systems and geographic variation in habitat, to gain economies of scale, and to provide greater efficiency in planning and implementing the HCP. The western Washington planning units are Olympic Experimental State Forest, South Coast, Columbia, Straits, North Puget, and South Puget.

Hydrologic maturity: The degree to which hydrologic processes (for example, interception, evapotranspiration, snow accumulation, snowmelt, infiltration, runoff) and outputs (for example, water yield and peak discharge) in a particular forest stand approach those expected in a late-seral stand under the same climatic and site conditions. In DNR's 1997 HCP, a hydrologically mature forest with respect to rain-on-snow runoff is a well-stocked conifer stand that is at least 25 years old.

Large data overlay: A complex GIS model composed 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.

LiDAR: Short for "light detection and ranging," a remote sensing technology that uses lasers to detect distant objects and determine their position, velocity, or other characteristics by analyzing reflections. It has a wide variety of uses, including measuring tree canopy heights, making topographical maps, and mapping floodplains.

Natural Area Preserve (NAP): 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 Resources Conservation Area (NRCA): 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 Natural Area Preserves. 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 northern 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.

Net present value: The sum of future revenues and costs discounted into current dollars.

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, about 261,000 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.

Plant association: A concept that recognizes different plant communities as representing distinct ecological characteristics. Plant associations are defined by the presence, absence, and relative abundance, of key plant species. The presence, absence, and relative abundance of these indicator plants are direct and composite reflections of moisture, nutrient, and climatic gradients. As such, the plant association concept provides a useful predictor for site quality, productivity, and response to disturbance, such as timber harvesting.

Peak flow: Periods of high stream flow usually associated with storm events.

***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.

Rain-on-snow zone: An elevation band in which it is common for snow pack to be partially or completely melted during rainstorms several times during the winter.

Resource management cost account: As defined in RCW 79.64.020, this is an account in the state treasury created solely for the purpose of defraying the costs and expenses necessarily incurred by the DNR in managing and administering state lands and aquatic lands and the making and administering of leases, sales, contracts, licenses, permits, easements, and rights of way as authorized under this statute. Appropriations from the resource management cost account to the DNR shall be expended for no other purposes. Funds in the resource management cost account may be appropriated or transferred by the legislature for the benefit of all of the trusts from which the funds were derived.

Riparian areas: A protected band of vegetation adjacent to wetlands, lakes, rivers, and streams that varies in width based on stream/wetland size and presumed ecological significance. The 1997 HCP designated riparian areas in order to protect salmonid and other aquatic and riparian-obligate species.

SEPA: The State Environmental Policy Act codified under Chapter 43.21C RCW.

Site class: A grouping of site indices.

Site index: A species-specific measure of actual or potential forest productivity (site quality, usually for even-aged stands), expressed in terms of the average height of trees included in a specified stand component. In the sustainable harvest calculation, site index is calculated based on the height of Douglas fir at 50 years.

Stumpage: The price of standing trees along with the right to harvest. The price does not include costs such as harvesting and transporting logs to mills. DNR sells timber at the stumpage price. In the sustainable harvest calculation, stumpage is dollars per thousand board feet.

Sub-mature habitat: A northern spotted owl habitat definition for stands with the structural characteristics necessary to provide roosting, foraging, and, rarely, nesting functions.

Timber sale: A sale of timber from DNR-managed forested state trust land that is separate from the land.

Trust: A fiduciary relationship (created by a settlor) with respect to property, in which the person who holds the title to the property (the trustee) is subject to equitable duties to keep or use the property for the benefit of another (the trust beneficiary). A trust imposes numerous enforceable provisions and emplaces on the relationship the duty to act with utmost honesty and candor and solely in the interest of the trust beneficiaries. For the state of Washington, the Enabling Act of 1889 conveyed the intent of Congress (the settlor) to establish a trust; through this act, Congress conveyed title to land (the trust property) to the state (the trustee) for specifically identified beneficiaries (the trusts) such as, common schools, universities, and normal schools. The Legislature has further enacted that DNR is the agent that manages the trust property for the state.

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.