Chapter 3

AFFECTED ENVIRONMENT

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Chapter 3

Affected Environment

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

Elements of the Environment Included

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

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

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

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

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

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

Data Sources

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

Scope and Scale of Analysis

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

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

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

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

3.1 Earth: Geology and Soils

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

Why Are Geology and Soils Important?

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

Current Conditions

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

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

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

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

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

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

Soil Productivity

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

Surface Erosion

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

Soil Compaction

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

Landslides

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

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

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

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

■ Existing Policies and Regulations

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

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

Regulating Activities That Can Damage Soils

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

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

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

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

Preventing Landslides in Potentially Unstable Areas

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

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

3.2 Climate

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

Why Is Climate Change Important?

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

Current Conditions

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

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

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

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

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

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

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

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

Effects of Climate Change on Elements of the Environment

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

VEGETATION

Forest Conditions

Climate plays a key role in driving vegetation dynamics and bounding vegetation occurrences at broad spatial scales. Vegetation in Washington can be classified broadly as moisture- or energy-limited (Milne and others 2002, McKenzie and others 2003, Littell and Peterson 2005). In moisture-limited systems, a lack of moisture constrains vegetation growth. Productivity in moisture-limited forests is likely to become even more limited as plant water needs are exceeded by available atmospheric and soil moisture (Littell

and others 2010, McKenzie and Littell 2017). In energy-limited systems, light or cold temperatures constrain vegetation growth. Examples of energy-limited forests in western Washington are productive forests in which cloud cover or competition limits available light for individuals, and higher elevation forests in which temperatures are colder. Productivity in energy-limited systems may increase at higher elevations as temperatures warm but could decline in lower elevations due to increased summer drought stress (Littell and others 2008). This potential shift in forest productivity illustrates how different factors (for example, energy and moisture) can limit vegetation within a species' range and across seasons (Peterson and Peterson 2001, Stephenson 1990, 1998).

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

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

Disturbances

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

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

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

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

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

EARTH

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

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

AQUATIC RESOURCES

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

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

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

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

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

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

WILDLIFE

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

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

Effects of DNR Management on a Changing Climate

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

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

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

Existing Policies and Regulations

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

3.3 Vegetation

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

Forest in the OESF. Photo: Richard Bigley

■ Why Is Vegetation Important?

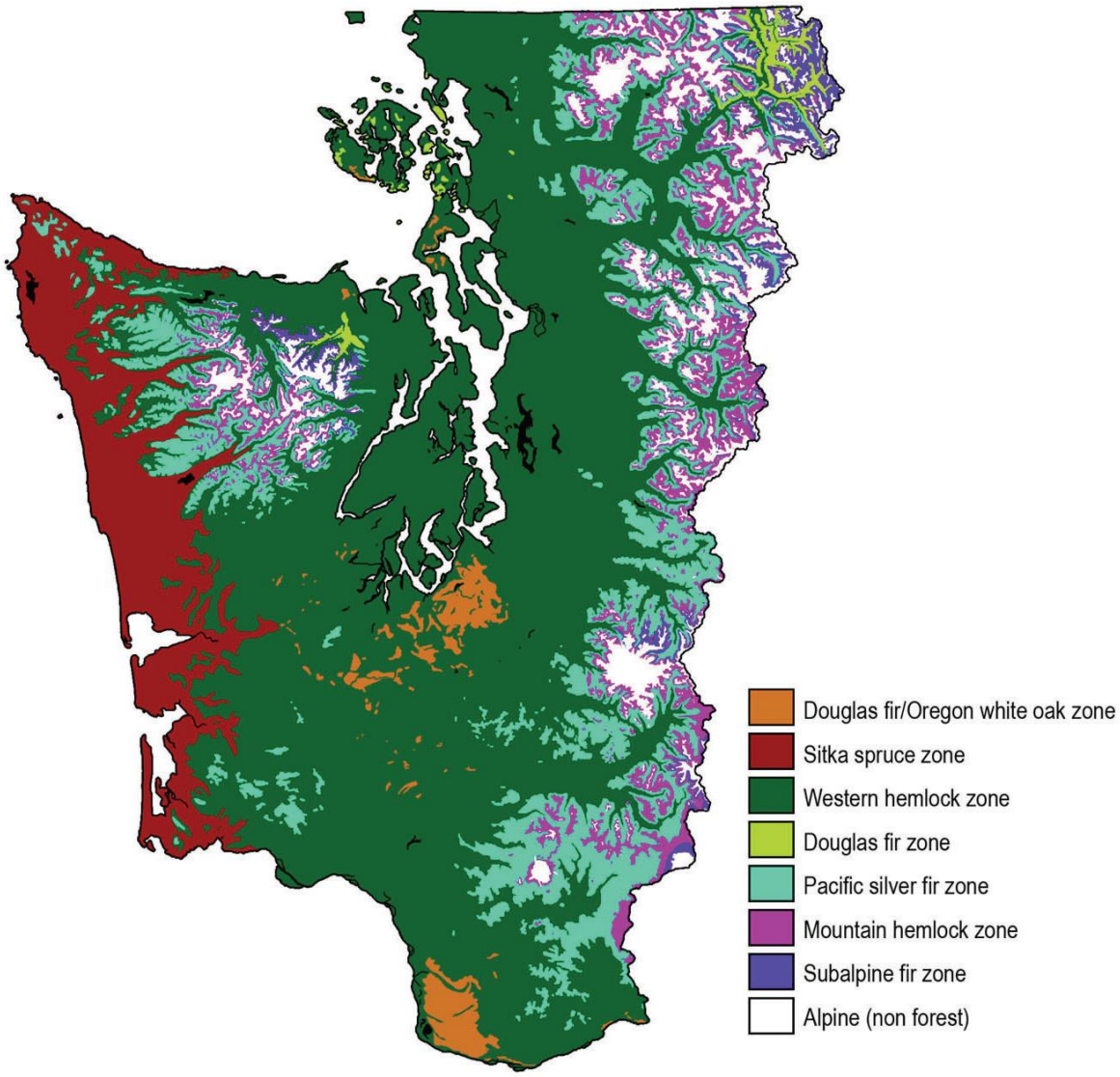
Areas of structurally complex, long-term forest cover provide potential nesting opportunities for the marbled murrelet. The proposed alternatives change the management of vegetation on a small percentage of forestlands in the analysis area to support the development and maintenance of this type of forest.

■ Current Conditions

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

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

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

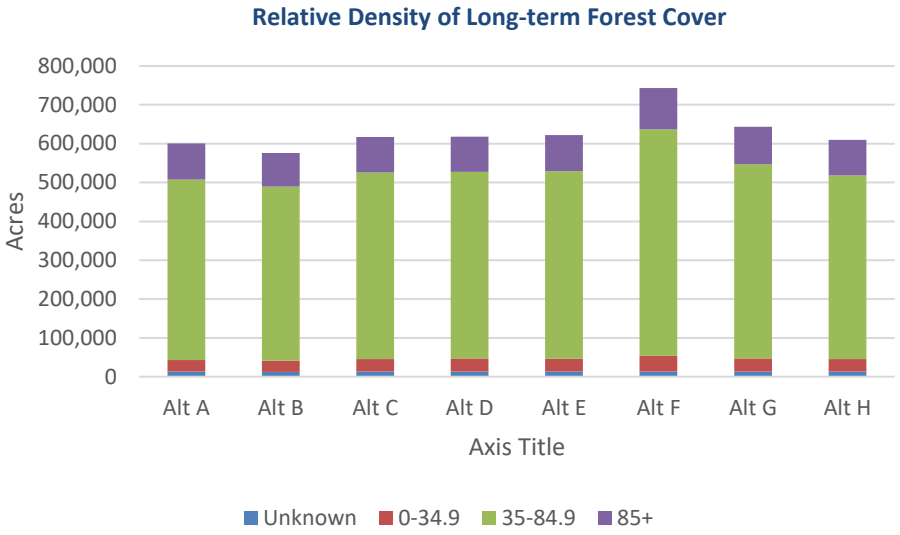


General Forest Conditions

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

increased risks from weather and disease in the presence of other risk factors, such as landscape position, soil, and climate (Powell 1999, Mitchell 2000).

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



Forest Health Issues

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

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

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

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

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

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

Vegetation in Special Management or Conservation Status

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

OLD GROWTH

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

GENETIC RESOURCES

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

NATURAL AREAS

As described in Chapter 1, DNR manages two types of natural areas defined by state law: natural area preserves and natural resources conservation areas. These areas protect native ecosystems, rare plant and animal species, or unique natural features. Both types of natural areas are covered under the HCP and are

included in long-term forest cover for this RDEIS. Natural area preserves are managed under the State of Washington *Natural Heritage Plan*,[12] and some natural area preserves also have site-based management plans. The natural resources conservation areas are managed under the *State of Washington Natural Resources Conservation Areas Statewide Management Plan*[13] or individual management plans.

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

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

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

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

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

PLANTS ASSOCIATED WITH UNCOMMON HABITATS

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

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

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

3.4 Aquatic Resources

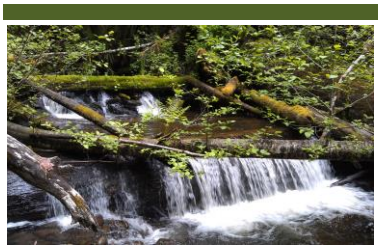
This section describes the existing conditions of riparian habitat, wetlands, water quality and quantity, and fish populations and habitat within the analysis area, which this RDEIS refers to collectively as aquatic resources.

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

■ Why Are Aquatic Resources Important?

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

Text Box 3.4.1. What Is Riparian Habitat?



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

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

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

■ Current Conditions

Riparian and Wetland Habitat

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

Waters

RIVERS AND STREAMS

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

WATER QUALITY

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

WATER QUANTITY

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

Fish

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

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

Existing Policies and Regulations

Forest Practices Rules

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

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

Text Box 3.4.2. How Are Aquatic Resources Managed?

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

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

Riparian Conservation Strategies

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

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

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

[16] Refer to Chapter 7 for definition.

3.5 Wildlife and Biodiversity

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

Black Bear. Photo: WDFW

■ Why Is Wildlife Important?

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

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

■ Current Conditions

Wildlife Habitat

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

Table 3.5.1. Stand Development Stages and Associated Wildlife Species Diversity

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

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

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

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

Wildlife Species

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

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

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

STATE-LISTED, CANDIDATE, SENSITIVE AND REGIONALLY IMPORTANT SPECIES

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

FEDERALLY LISTED SPECIES IN THE ANALYSIS AREA

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

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

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

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

Northern Spotted Owl

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

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

nesting, roosting, and foraging areas and dispersal areas is available in the 2015 *State Trust Lands HCP Annual Report* (DNR 2016).[17]

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

Existing Policies and Regulations

The 1997 HCP

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

Text Box 3.5.1. What Are Biodiversity Pathways?

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

Policy for Sustainable Forests

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

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

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

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

3.6 Marbled Murrelet

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

Marbled Murrelet at Sea. Photo: DNR

■ Why Is the Marbled Murrelet Important?

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

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

■ Current Population Trends and Habitat Conditions

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

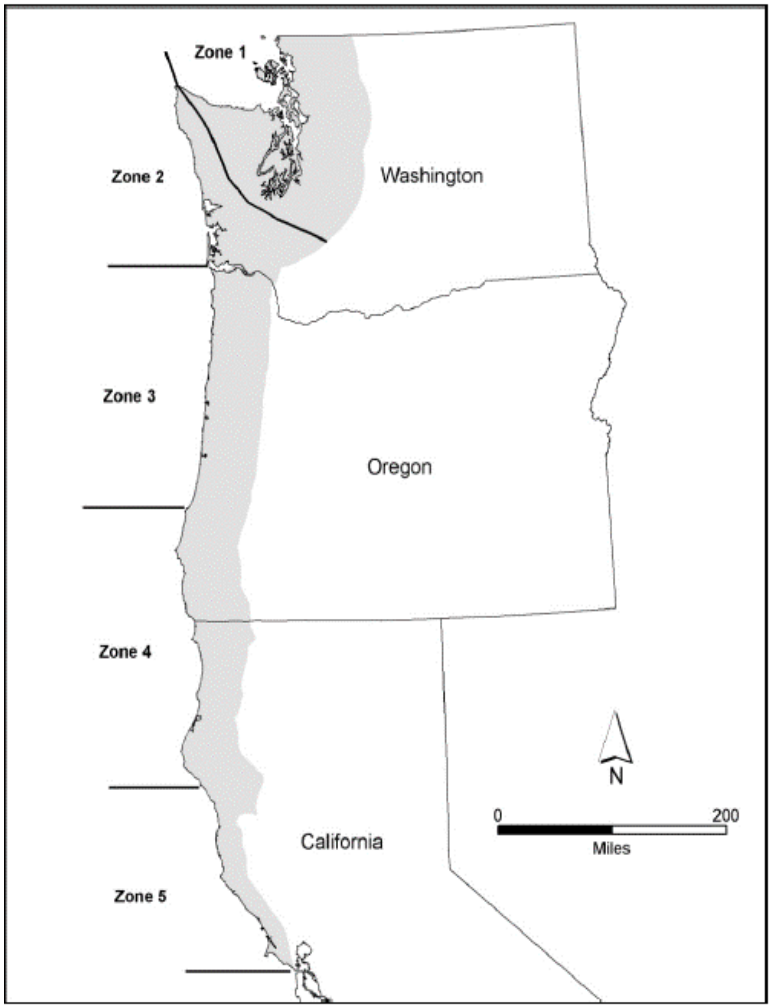
[19] Inland habitat means marbled murrelet habitat on land, in other words nesting habitat. The term "inland habitat" is used in this section and in Section 4.6 of this RDEIS to distinguish inland habitat from marine habitat.

Population Decline

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

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

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



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

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

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

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

MARINE CONDITIONS

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

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

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

AVAILABILITY OF INLAND HABITAT

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

Marbled Murrelet Egg in Nest. Photo: Nicholas Hatch

Causes of Habitat Loss Within the Listed Range

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

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

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

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

[21] Habitat-capable land refers to areas within the *Northwest Forest Plan* boundaries capable of developing into forest.

[22] A discussion of how the P-stage model compares with other available habitat models is provided in Appendix E.

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

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

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

FACTORS INFLUENCING NEST SUCCESS

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

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

impacts, other human activities and land uses can disturb nesting marbled murrelets, which can affect their nesting success. These activities are summarized *in Appendix H* and are quantified in Section 4.6.

Edge Conditions

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

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

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

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

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

Habitat Distribution

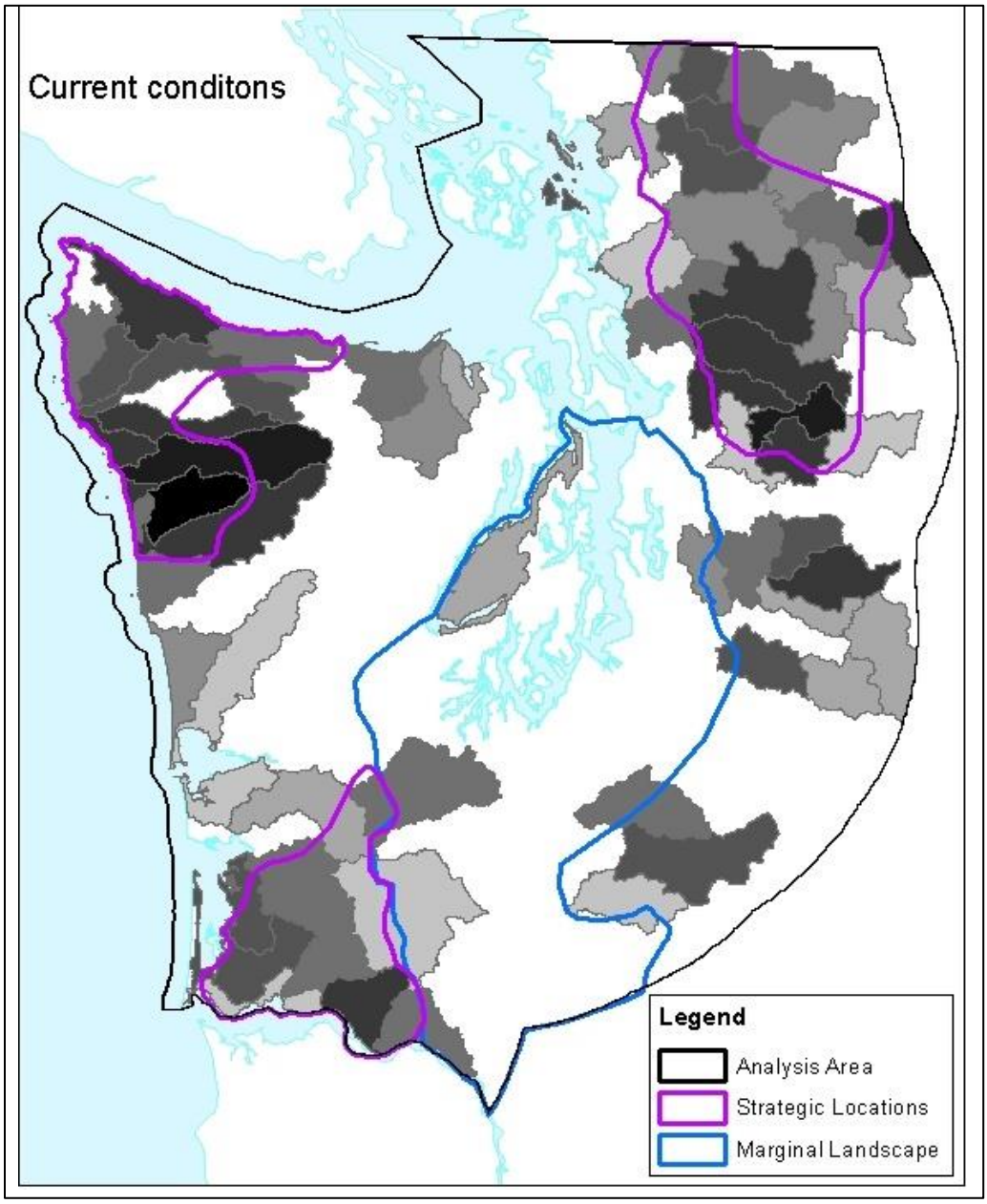
During development of the RDEIS, the Joint Agencies identified the importance of adequate distribution of inland habitat for marbled murrelets. Inland habitat that is well distributed will contribute to stable and increasing populations, increase geographic distribution, and promote a population that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

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

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

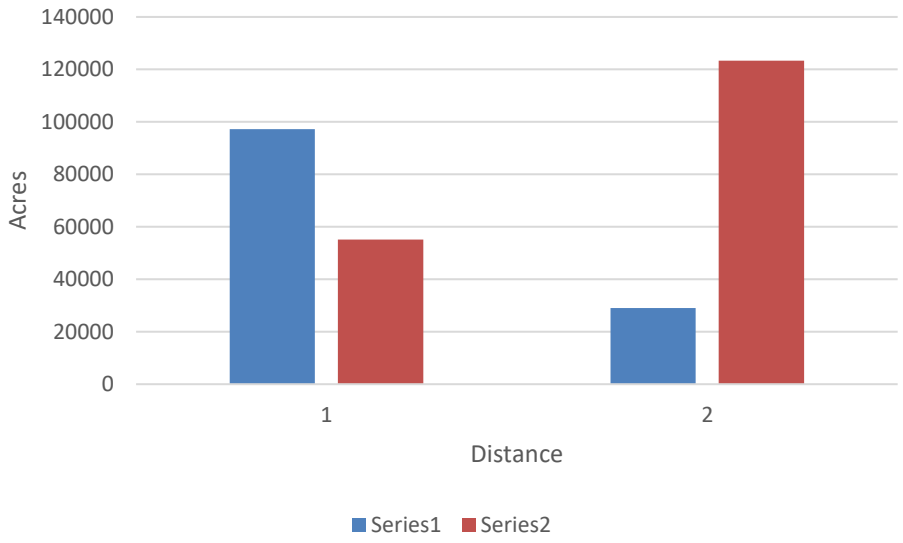
[23] For this analysis, watersheds are defined as hydrologic unit code fifth-level basins (also known as a 10 digit-HUC). Fifth-level bases are typically about 100,000 to 150,000 acres in size.

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



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

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

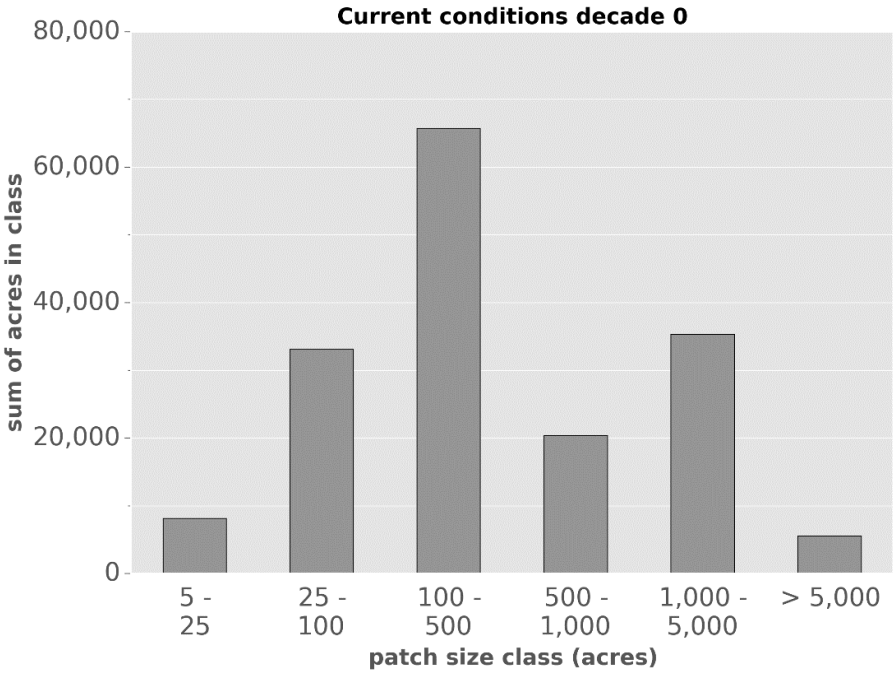


- **Habitat Patch Size:** As described under edge conditions, interior forest provides higher quality habitat than forest near an edge. In general, larger patches of habitat contain more interior forest and less edge, although this is not always true depending on patch configuration. For the RDEIS, the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

Table 3.6.3. Current Size Distribution of Habitat Patches

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

Figure 3.6.4. Current Size Distribution of Habitat Patches



■ Existing Policies and Regulations

Federal Designation of Critical Habitat

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

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

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

HCPs

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

State Forest Practices Rules

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

Washington State Listing and Periodic Status Review

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

Interim Strategy (No Action Alternative)

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

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

[25] WAC 220-610-010

3.7 Recreation

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

Why Is Recreation Important?

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

Current Conditions

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

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

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

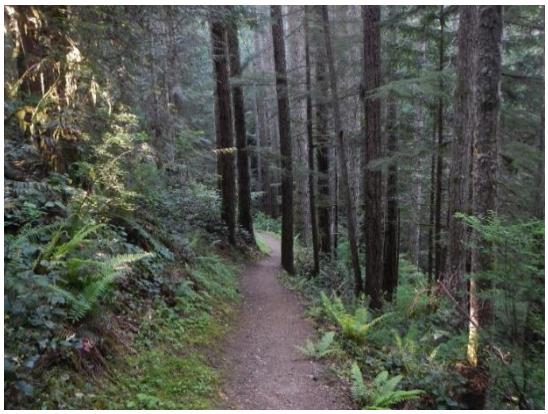
Recreational use of DNR-managed lands, both designated and non-designated, is influenced by many factors. These include, but are not limited to, historic use of the area; topography of the landscape; presence of landscape features that are attractive to the recreating public; publicly accessible roads;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

Types of Facilities and Trails

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

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

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



Trail Through DNR-Managed Forest. Photo: DNR

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

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

Recreation Planning

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

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

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

A critical step in formal recreation planning is the recreation suitability assessment for the landscape. This assessment is a process in which scientists, lands managers, planners, and GIS analysts identify criteria, gather data, and map areas that have long-term limiting

factors for recreational use. Criteria are grouped into three categories: biological, geological/soils, and management. Maps are created to reflect areas with moderate to no suitability for recreational development. For recreation landscapes in the analysis area, marbled murrelet habitat has been identified as an important biological criterion in the recreation suitability maps. Three landscapes in the analysis area have undergone formal recreation planning: Reiter Foothills Forest, Snoqualmie Corridor, and Green Mountain and Tahuya State Forests.

Current Projects and Planning

BAKER TO BELLINGHAM RECREATION PLANNING

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

DARRINGTON TO NORTH MOUNTAIN TRAIL DEVELOPMENT

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

■ Existing Policies and Regulations

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

[26] RCW 79.10.100

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

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

Recreation Under the Interim Strategy

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

STRAITS, COLUMBIA, SOUTH COAST PLANNING UNITS

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

OESF, NORTH PUGET, AND SOUTH PUGET HCP PLANNING UNITS

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

3.8 Forest Roads

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

Forest Road on DNR-managed Land. Photo: DNR

■ Why Are Forest Roads Important?

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

■ Current Conditions

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

Road Miles in the Analysis Area

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

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

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

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

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

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

Example of Recently Abandoned DNR Forest Road. Photo: DNR

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

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

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

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

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

ROCK PITS

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

How Roads Impact the Environment

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

HABITAT IMPACTS

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

NOISE

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

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

STREAM CROSSINGS

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

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

DISRUPTION OF WATER FLOW PATHS

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

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

Inadequately sized culverts in non-fish bearing streams cause an imbalance in the channel, creating deposits of sediment upstream and scouring streambed material downstream. They also increase the chance of culvert blockages and flooding across the road. Flooding at culverts can lead to a distinct failure

of the road at the culvert site or a long failure along the road or ditch line. Replacing undersized culverts with larger structures vastly reduces the risk of these types of failures.

LANDSLIDES

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

EROSION AND WATER QUALITY

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

■ Existing Policies and Regulations

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

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

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

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

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

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

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

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

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

3.9 Public Services and Utilities

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

■ Why Are Public Services and Utilities Important?

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

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

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

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

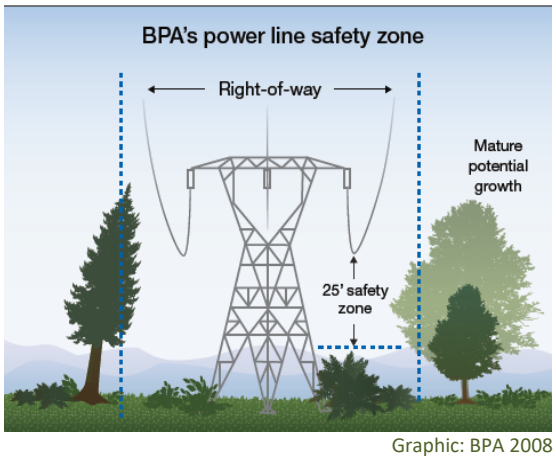
■ Current Conditions

Utility Rights-of-Way

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

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

Text Box 3.9.1. How Are Transmission Lines Managed?



Graphic: BPA 2008

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

Leases for Communications and Energy-Related Facilities

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

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

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

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

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

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

Existing Policies and Regulations

Policy for Sustainable Forests

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

The 1997 HCP

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

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

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

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

3.10 Environmental Justice

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

■ Why Is Environmental Justice Important?

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

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

Text Box 3.10.1. Who Relies on the Forest?

Photo: University of Washington

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

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

■ Current Conditions

Minority Forest Workforce

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

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

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

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

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

Minority and Low-income Populations

For this assessment, minorities are considered within the following U.S. census tracking data racial and ethnicity categories:

- Black or African American
- American Indian and Alaska native
- Asian
- Native Hawaiian and other Pacific Islander
- Hispanic
- Two or more races

Minority and low-income populations are listed in Table 3.10.1 by county.[30] Acres of DNR-managed land within the county are provided for context.

Table 3.10.1. Minority and Low-Income Populations, by County, With Acres of DNR-Managed Land

County	Minority population (% of county population)	Low-income population (% of county population)	Acres of DNR-managed lands
Clallam	18.3	16.2	162,041
Cowlitz	17	20.6	28,270
Grays Harbor	22.5	19.6	90,603
Island	21.5	10.3	340
Jefferson	12.4	14.1	203,774
King	40.2	11.3	116,880

[30] Environmental justice guidelines developed by the Council on Environmental Quality (1997) and the U.S. Environmental Protection Agency (1998) indicate that low-income populations should be identified based on the annual statistical poverty thresholds established by the U.S. Census Bureau. The U.S. Census Bureau defines a poverty area as a census tract or other area in which at least 20 percent of residents are below the poverty level. Median household income and per capita income are other measures that can be used to identify low-income environmental justice populations.

County	Minority population (% of county population)	Low-income population (% of county population)	Acres of DNR-managed lands
Kitsap	24.4	11.2	14,235
Kittitas	17.1	18.6	2,591
Lewis	17.4	17.1	96,317
Mason	21	15.6	58,925
Pacific	19.5	17.8	86,898
Pierce	34.7	13.1	24,959
San Juan	11.8	12.7	1,193
Skagit	27.3	15.7	139,540
Snohomish	30.2	9.9	157,225
Thurston	26.2	11.9	64,588
Wahkiakum	10.9	13.9	40,195
Whatcom	22.1	15.7	88,903
Total (Average)	32.1	13.2	1,377,477

Source: U.S. Census 2015

Existing Policies and Regulations

Executive Order 12898 requires federal agencies to take appropriate steps to identify and avoid disproportionately high and adverse effects of federal actions on the health and surrounding environment of minority and low-income persons and populations. All federal programs, policies, and activities that substantially affect human health or the environment shall be conducted to ensure that the action does not exclude persons or populations from participation in, deny persons or populations the benefits of, or subject persons or populations to discrimination under such actions because of their race, color, income level, or national origin. Executive Order 12898 also was intended to provide minority and low-income communities with access to public information and public participation in matters relating to human health and the environment.

3.11 Socioeconomics

This section describes the economic conditions that may result from current management practices on state trust lands. Impacts of the alternatives on these conditions will be discussed in Section 4.11.

■ Why Are Socioeconomics Important?

DNR-managed forestland plays an important role in the local economies of 18 counties in the analysis area. Changes to how much land is available to harvest or use for other ecosystem services can impact these local economies. Maintaining funding to state trusts is an important piece of the need, purpose, and objectives for the long-term conservation strategy.

The affected environment for this section is all trusts and counties with state trust lands inside the marbled murrelet analysis area (Table 3.11.1). Counties that do not contain state trust lands within the analysis area are not part of the affected environment. State trust lands are defined in Chapter 1.

Table 3.11.1. Acres of DNR-Managed Lands by Management Category in Counties within the Analysis Area (Counties Containing State Trust Lands Only)

County	DNR-managed lands in analysis area Acres	No harvest allowed Acres (%)	Harvest is constrained Acres (%	Available for harvest Acres (%)	DNR-managed lands outside the analysis area Acres (%)
Clallam	162,000	48,000 (29%)	73,000 (45%)	41,000 (26%)	0
Cowlitz	28,000	1,900 (7%)	14,000 (49%)	13,000 (44%)	58,000
Grays Harbor	91,000	23,000 (25%)	20,000 (22%)	48,000 (53%)	0
Island	340	340 (100%)	0 (0%)	0 (0%)	0
Jefferson	208,000	88,000 (42%)	103,000 (50%)	17,000 (8%)	0
King	117,000	56,000 (48%)	39,000 (33%)	22,005 (19%)	0
Kitsap	14,000	6,100 (43%)	2,800 (20%)	5,300 (37%)	0
Kittitas[a]	3,000	2,500 (97%)	82 (3%)	3 (0%)	206,000
Lewis	96,000	19,000 (19%)	44,000 (45%)	35,000 (36%)	0
Mason	59,000	19,000 (33%)	14,000 (8%)	35,000(60%)	0
Pacific	87,000	25,000 (29%)	24,000 (27%)	38,000 (44%)	0
Pierce	25,000	6,800 (27%)	16,000 (65%)	1,800 (7%)	0
San Juan	1,200	1,200 (100%)	0 (0%)	0 (0%)	0
Skagit	140,000	41,000 (29%)	59,000 (42%)	41,000 (29%)	0

County	DNR-managed lands in analysis area Acres	No harvest allowed Acres (%)	Harvest is constrained Acres (%	Available for harvest Acres (%)	DNR-managed lands outside the analysis area Acres (%)
Snohomish	157,000	65,000 (41%)	40,000 (26%)	52,000 (33%)	0
Thurston	65,000	12,000 (18%)	14,000 (21%)	39,000 (61%)	0
Wahkiakum	40,000	13,000 (32%)	10,000 (24%)	17,000 (43%)	0
Whatcom	89,000	32,000 (37%)	29,000 (33%)	28,000 (31%)	0
Total	1,383,000	460,000 (33%)	492,000 (38%)	433,000 (30%)	

[a]DNR-managed lands in Kittitas County are not subject to the interim strategy for marbled murrelet in the 1997 HCP. A small portion of this county is included within the inland range of the marbled murrelet and is listed here for context. No impacts from the strategy are expected due to the small amount of operable area within the analysis area in this county.

Current Conditions

Population

The total human population in affected counties in the marbled murrelet analysis area as of 2017 is about 5 million (Office of Financial Management (OFM) 2018a; Table 3.11.2).

Text Box 3.11.1. How Resilient Are Local Economies to Changes in DNR Forest Management?

While most counties in the analysis area have medium to high socioeconomic resiliency, Pacific and Wahkiakum counties are highly dependent on DNR-managed lands and "may experience difficulty adapting to changes in forest management strategies." (Daniels 2004)

Economic Diversification and Timber Dependency

Daniels (2004) assessed the economic diversity[31] and socioeconomic resiliency[32] of Washington counties. Most counties in the analysis area were found to have medium or high socioeconomic resiliency and be among the counties with greater economic diversity in the state. There were notable exceptions, however. Wahkiakum County is one of the least socioeconomically resilient and least economically diverse county in the state (refer to Table 3.11.2). Pacific County also has low socioeconomic resiliency and below-median economic diversity. All counties in the analysis area are classed as having medium or high forest dependence.[33] Daniels (2004) identified Pacific and Wahkiakum counties as "DNR counties of concern" due to the relatively large role DNR-managed lands have in the

[31] Economic diversity is measured by Daniels 2004 using an index of regional specialization.
[32] Socioeconomic resiliency is defined by Daniels 2004 as the ability to adapt to change. Daniels assumes that communities with high social and economic diversity are more resilient.
[33] Forest dependence is determined by Daniels 2004 based on the forest area in each county.

socioeconomic well-being of these counties. Daniels states that these counties "may experience difficulty adapting to changes in DNR forest management strategies."

Since the Daniels study was done in 2004, the economies of Pacific and Wahkiakum counties have not changed markedly. The Washington Employment Security Department (2017a) shows that employment fell in Pacific County from 2007 to 2011 and has since recovered slowly. The primarily industries in the county were natural resource-based including shellfish farming, forest-products, and other farming. The only sectors with an increase in employment were the information and finance sectors, but these sectors were relatively small in Pacific County. For Wahkiakum County, the Washington Employment Security Department (2017b) and OFM (2018b) show that logging is the main industry in the county, and local government is the main source of jobs and wages. Total employment in the county has declined since the 1990s. Most of this decline has been from the loss of service jobs, including a nursing home that was Wahkiakum County's second largest private employer (Washington Employment Security Department 2017b, St. John 2012). However, logging employment had declined from 140 in the mid-2000s to 50 in 2016 (Washington Employment Security Department 2017b).

Table 3.11.2. Socioeconomic Resiliency and Economic Diversity Rating (Modified From Daniels 2004)

County	Socioeconomic resiliency	Economic diversity 4 = high diversity	Population, 2017 (OFM 2018a)	Employment, 2015 (Washington Employment Security Department 2018a)
Clallam	Medium	3	74,240	22,714
Cowlitz	High	4	105,900	37,975
Grays Harbor	Medium	3	72,970	22,220
Island	High	3	82,790	15,793
Jefferson	Medium	3	31,360	8,372
King	High	4	2,153,700	1,315,412
Kitsap	High	4	264,300	86,197
Kittitas	Medium	2	44,730	14,400
Lewis	Medium	3	77,440	24,679
Mason	Medium	2	63,190	14,032
Pacific	Low	2	21,250	6,417
Pierce	High	4	859,400	295,384
San Juan	Medium	2	16,510	5,690
Skagit	High	4	124,100	49,574
Snohomish	High	4	789,400	283,151
Thurston	High	4	276,900	110,206
Wahkiakum	Low	1	4,030	700
Whatcom	High	4	216,300	88,100
Total	N/A	N/A	5,278,510	2,924,740

Demographics

Since 2001, the period for which DNR has county-specific forest products sector employment data, overall employment, income and population growth in counties in the marbled murrelet analysis area have followed different trajectories.

POPULATION TRENDS

Total

Since 2001, all counties in the analysis area have experienced an increase in population. In most counties, the increase was at least 11 percent. Thurston County had the largest rate of increase at 32 percent. Three southwest Washington counties, Grays Harbor, Pacific, and Wahkiakum counties, were the only counties with single digit increases, at 6 percent, 1 percent, and 5 percent, respectively (Table 3.11.3; OFM 2018a).

Table 3.11.3. Change in Employment in Marbled Murrelet Analysis Area Counties (OFM 2018a; Washington Employment Security Department 2018)

County	Change in population (2001-2017)	Change in working age population (15–64 years old, 2001- 2017)	Change in number of jobs (2001-2016)	Change in median household real income (2001-2015, 2017 dollars)	Median household real income in 2015, rounded to the nearest '000 (2017 dollars)
Clallam	15%	6%	11%	5%	46,000
Cowlitz	13%	8%	0%	0%	50,000
Grays Harbor	6%	3%	-4%	-12%	44,000
Island	15%	3%	10%	1%	60,000
Jefferson	18%	0%	1%	12%	53,000
King	23%	21%	15%	10%	81,000
Kitsap	13%	5%	18%	-4%	65,000
Lewis	12%	8%	0%	2%	47,000
Mason	26%	19%	17%	-10%	54,000
Pacific	1%	-7%	6%	-13%	41,000
Pierce	21%	18%	24%	-1%	60,000
San Juan	15%	0%	13%	-2%	59,000
Skagit	19%	14%	13%	-7%	56,000
Snohomish	28%	26%	35%	6%	75,000
Thurston	32%	25%	30%	-9%	62,000
Wahkiakum	5%	-11%	-12%	-13%	50,000
Whatcom	27%	21%	28%	4%	55,000
Total	16% (analysis area counties)	12% (analysis area counties)	19% (analysis area counties)	4% (Washington State)	$63,000 (Washington State)

WORKING AGE

The working age population, defined as ages 15–64[34], increased in all counties except Pacific and Wahkiakum. In these counties, the working age population fell by 7 percent and 11 percent, respectively, between 2001 and 2017. Wahkiakum and Jefferson counties had the largest difference in population and working age population change. In these counties, the rate of change in population exceeded the rate of change in working age population by 17 and 18 percent, respectively.

Employment Trends

Total employment in counties in the marbled murrelet analysis area increased by 19 percent between 2001 and 2016.[35] Employment in most counties increased in that time, but decreased in Grays Harbor and Wahkaikum counties, both located in southwest Washington (Table 3.11.3). Employment numbers were stagnant in two other southwest Washington counties, Cowlitz and Lewis. The largest increases in employment occurred in urban counties surrounding Seattle including Snohomish, Pierce, and Thurston counties. Whatcom County also experienced employment growth well above the average for marbled murrelet analysis area counties.

Real Income

Changes in median real incomes between 2001 and 2014[36] ranged from a 12 percent increase in Jefferson County to a 13 percent decrease in Pacific and Wahkiakum counties. The median real income decreased in eight counties, increased in nine counties, and remained unchanged in one county. Along with Pacific and Wahkiakum counties, Grays Harbor, Mason, Pierce counties experienced a decrease in real income of at least 10 percent, with decreases of 12 percent, and 10 percent, respectively. Median real incomes in southwest Washington are low compared to the rest of the analysis area. Five of the six lowest median real incomes are in southwest Washington, Cowlitz, Lewis, Grays Harbor, Pacific, and Wahkiakum counties. Median real incomes decreased in three of these counties over the 2001 to 2015 period. King, Snohomish, and surrounding counties had the highest median incomes in 2014.

Trust Revenue

State trust lands provide revenue for trust beneficiaries (refer to Chapter 1). Timber sales are the single largest source of revenue. However, other revenue sources exist, including leasing of lands for communication sites and special forest products,[37, 38] interest income, permits, fees, and miscellaneous sales and other revenue.

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[34]This definition comes from the Organization for Economic Cooperation and is used by the Federal Reserve Bank (Organization for Economic Cooperation 2018, Federal Reserve Bank of St. Louis 2018)

[35] Most current finalized data available from the Washington Employment Security Department

[36] 2015 real income data was not included because only preliminary estimates were available.

[37] Such as brush and boughs.

[38] Other lease categories include agriculture, mineral and hydrocarbon, special use, real estate, and right-of-way.

From 2011 to 2017, an annual average of about $172 million (2017 dollars) was distributed to trust beneficiaries that receive revenue from state trust lands within the analysis area (Tables 3.11.4 and 3.11.5). Some of these beneficiaries also received revenue from lands outside of the analysis area. Total distributions vary due to fluctuations in timber and agricultural markets. The Common School and Escheat Trust received distributions from land transactions under the Trust Land Transfer Program[39] while Pacific and Wahkiakum counties received distributions from land transactions under the State Forest Trust Land Replacement Program (DNR 2013b). Funding for these programs varies from year to year.

Distributions from most major sources have been relatively stable over the 2011 to 2017 period. The exception is funds for the Trust Land Transfer Program, which have decreased over the period. Timber sales generated an average of $114.5 million per year. Other important sources of trust revenue are agricultural and commercial leases and fund transfers through the Trust Land Transfer Program. From 2011 to 2017, the Trust Land Transfer Program provided an average of $25.5 million (2017 dollars) per year, all to the Common School Trust. Leases allowing harvest of non-timber forest products from state trust lands generated about $500,000 or less per year in revenue. Refer to DNR annual reports[40] for more detail on trust revenues and distributions. The revenue generated from sales and leases varied based on market conditions and qualities sold.

Table 3.11.4. Average Annual Fund Distribution to Beneficiaries of the Federally Granted Trusts[41] for Fiscal Years 2011–2017 in 2017 Real Dollars (Revenue From State Trust Lands Statewide)

Trust(s)	Distributions from timber sales and timber sale related activities	Distributions from all other revenue sources	Total distributions
Agricultural School Grant	$4,457,076	$518,953	$4,976,030
Capitol Building Grant	$7,101,043	$152,213	$7,253,256
CEP&RI and CEP&RI transferred[a]	$3,986,344	$1,032,389	$5,018,734
Common School and Escheat	$35,576,513	$50,266,399	$85,842,911
Normal School	$2,493,594	$181,106	$2,674,700
Scientific School Grant	$6,029,248	$1,193,949	$7,223,196
University Grant (original and transferred)	$1,895,838	$280,495	$2,176,333
Total	$61,539,656	$53,625,504	$115,165,160

[a] CEP&RI refers to charitable, educational, penal, and reformatory institutions as defined by the state.

[39] More information available at https://www.dnr.wa.gov/managed-lands/land-transactions
[40] Available at https://www.dnr.wa.gov/about/fiscal-reports/dnr-annual-reports
[41] Trusts supported by State Lands, which are lands granted to the state by the Federal government at statehood through the Omnibus Enabling Act of 1889.

Table 3.11.5. Average Annual Distribution of Funds to Beneficiaries of State Forest Trust Lands (State Forest Transfer and State Forest Purchase Trusts) for Fiscal Years 2011–2017, in 2017 Dollars[42]

Beneficiary county[a]	Distributions from timber sales and timber sale related activities	Distributions from all other revenue sources	Total distributions
Clallam	$5,956,953	$351,647	$6,308,600
Cowlitz	$2,011,851	$27,729	$2,039,580
Grays Harbor	$1,874,525	$3,140	$1,877,666
Jefferson	$1,682,566	$26,218	$1,708,784
King	$1,781,053	$76,093	$1,857,146
Kitsap	$529,047	$67,427	$596,474
Lewis	$6,673,487	$8,623	$6,682,110
Mason	$3,529,674	$166,931	$3,696,605
Pacific	$1,952,524	$11,350	$1,963,874
Pierce	$372,293	$1,318	$373,611
Skagit	$9,734,264	$62,702	$9,796,966
Snohomish	$9,802,379	$162,119	$9,964,498
Thurston	$4,431,154	$147,536	$4,578,690
Wahkiakum	$1,606,065	$3,049	$1,609,114
Whatcom	$3,303,822	$69,717	$3,373,539
Total	$55,241,658	$1,185,599	$56,427,257

State Trust Lands Acreage and Management Options

State trust lands are distributed throughout the state. State Lands (lands granted to the state by the Federal government at statehood) are located both inside and outside the marbled murrelet analysis area. State Forest Lands (lands acquired from counties) are present in 15 of the counties that fall within the analysis area (Table 3.11.6). For all counties in the analysis area except Cowlitz County, State Forest Transfer Lands and State Forest Purchase Lands (which are types of State Forest Lands) are entirely within the analysis area (Table 3.11.7). (Refer to Chapter 1 for a discussion on the types of state trust lands).

[42] Includes only counties that benefit from lands within then analysis area. Several counties in the analysis area do not contain State Forest Trust lands and several counties contain State Forest Trust lands outside the analysis area. Does not include of interest distributed to state forestland beneficiaries.

State trust lands are organized into land classes that define areas with different management constraints. State trust lands may be deferred or constrained from harvest to meet objectives defined by the 1997 HCP, *Policy for Sustainable Forests*, or state or federal laws. Examples of these constraints include northern spotted owl habitat, unique habitats, riparian and wetland management zones, and associated potentially unstable slopes. In most cases, only thinning can occur on lands in riparian management zones, although very limited regeneration harvest is allowed in riparian management zones in the OESF HCP Planning Unit.

Table 3.11.6. Statewide Management Options by Trust or Trust Group Under the No Action Alternative

Acres Where Harvest is Limited Includes Both the Uplands with Specific Objectives and the Riparian Land Classes; Rounded

	Trust(s)	No harvest allowed Acres (%)	Harvest is constrained Acres (%)	Available for harvest (includes non-forested lands) Acres (%)	Total trust area Acres (% of acres in the analysis area)
State Lands	**Agricultural School Trust**	11,000 (15%)	17,000 (24%)	44,000 (61%)	71,000 (35%)
	Capitol Building Trust	29,000 (27%)	43,000 (39%)	37,000 (34%)	110,000 (73%)
	CEP&RI (including CEP&RI transferred) Trust	7,700 (11%)	11,000 (16%)	51,000 (73%)	70,000 (38%)
	Common School and Escheat Trust	266,000 (15%)	393,000 (22%)	1,137,000 (63%)	1,795,000 (28%)
	Normal School Trust	13,000 (19%)	25,000 (37%)	29,000 (44%)	67,000 (39%)
	Scientific School Trust	16,000 (19%)	31,000 (37%)	37,000 (45%)	84,000 (51%)
	University Trust (original and transferred)	15,000 (17%)	27,000 (30%)	47,000 (53%)	89,000 (50%)
Other lands	**Community College Forest Reserve**	72 (2%)	790 (22%)	2,700 (75%)	3,500 (100%)
	Community Forest Trust	52,000 (100%)	0	0 (0%)	52,000 (3%)
	Land Bank	170 (100%)	0	0 (100%)	170 (1%)
	Water Pollution Control Division Trust	1,700 (28%)	650 (11%)	3,600 (61%)	6,000 (100%)
	Other	167,000 (99%)	30 (0%)	1,000 (1%)	168,000 (67%)

Table 3.11.7. Management Options on a) State Forest Transfer Trust and b) State Forest Purchase Trust Within the Analysis Area, by County, for Alternative A (Rounded)

A) State Forest Transfer Trust

County	No harvest allowed Acres (%)	Harvest is constrained Acres (%	Available for harvest Acres (%)	Total trust area Acres (% of acres in the analysis area)
Clallam	26,000 (28%)	36,000 (39%)	31,000 (33%)	93,000 (100%)
Cowlitz	550 (5%)	4,200 (38%)	6,300 (57%)	11,000 (47%)
Grays Harbor	410 (17%)	330 (14%)	1,600 (68%)	2,300 (100%)
Jefferson	2,100 (14%)	2,300 (16%)	10,000 (70%)	15,000 (100%)
King	9,100 (40%)	8,500 (37%)	5,300 (23%)	23,000 (100%)
Kitsap	1,900 (25%)	2,200 (29%)	3,500 (46%)	7,600 (100%)
Lewis	8,200 (20%)	15,000 (39%)	16,000 (41%)	40,000 (100%)
Mason	8,300 (29%)	2,300 (8%)	18,000 (62%)	28,000 (100%)
Pacific	4,400 (29%)	3,500 (23%)	7,200 (48%)	15,000 (100%)
Pierce	2,700 (30%)	6,200 (70%)	10 (0%)	8,900 (100%)
Skagit	21,000 (25%)	32,000 (38%)	31,000 (37%)	85,000 (100%)
Snohomish	14,000 (22%)	20,000 (31%)	29,000 (47%)	62,000 (100%)
Thurston	2,700 (14%)	4,600 (23%)	13,000 (63%)	20,000 (100%)
Wahkiakum	3,800 (30%)	3,200 (25%)	5,600 (45%)	12,600 (100%)
Whatcom	8,300 (28%)	8,900 (30%)	12,000 (41%)	29,000 (100%)
TOTAL	113,000 (25%)	150,000 (33%)	190,000 (42%)	453,000 (100%)

B) State Forest Purchase Trust

County	No harvest allowed Acres (%)	Harvest is constrained Acres (%	Available for harvest Acres (%)	Total trust area Acres (% of acres in the analysis area)
Clallam	100 (42%)	10 (2%)	130 (55%)	240 (100%)
Cowlitz	30 (11%)	80 (27%)	170 (62%)	280 (100%)
Grays Harbor	3,600 (12%)	6,600 (23%)	19,000 (65%)	29,000 (100%)
Jefferson	10 (31%)	0 (0%)	10 (69%)	16 (100%)
Kitsap	20 (24%)	30 (32%)	40 (44%)	79 (100%)
Kittitas	3 (100%)	0 (0%)	0 (0%)	3 (100%)
Lewis	200 (7%)	660 (21%)	2,200 (72%)	3,100 (100%)
Mason	300 (53%)	30 (4%)	240 (42%)	560 (100%)

County	No harvest allowed Acres (%)	Harvest is constrained Acres (%	Available for harvest Acres (%)	Total trust area Acres (% of acres in the analysis area)
Pacific	2,700 (33%)	2,400 (30%)	3,100 (37%)	8,200 (100%)
Pierce	610 (18%)	2,700 (82%)	0 (0%)	3,300 (100%)
Skagit	0 (0%)	1 (50%)	1 (50%)	2 (100%)
Snohomish	60 (3%)	330 (20%)	1,300 (77%)	1,700 (100%)
Thurston	3,400 (14%)	4,200 (18%)	16,000 (68%)	24,000 (100%)
Whatcom	250 (25%)	220 (22%)	520 (53%)	1,000 (100%)
TOTAL	11,000 (16%)	17,000 (24%)	42,000 (60%)	71,000 (100%)

Tax Revenue

Timber harvests generate direct revenue for county governments and the state general fund through the forest tax and create economic activity that results in other state and local tax revenue (Washington Department of Revenue 2018a). From 2011 to 2016, an average of $29.6 million per year (in 2017 dollars) was distributed to counties within the analysis area from forest tax revenue (Table 3.11.8 Washington Department of Revenue 2015, 2018b). Average sales tax distributions were $450 million in the same period. Sales tax distributions exceed forest tax distributions in all counties in the analysis area except Pacific and Wahkiakum counties.

Looking broadly at taxes generated by harvest of timber and manufacture of wood products, Mason and Lippke 2007 reported that the state and local taxes generated per million board feet of annual timber production equaled $210,000 (in 2004 dollars, which equals $270,000 in 2017 dollars), not including the forest tax. DNR harvested 5.038 billion board feet in western Washington in the 2005 through 2014 period. At this harvest volume, state and local taxes generated from state trust lands is about $136 million per year (2017 dollars).

Other activities, such as recreation and harvesting of non-timber forest products on state trust lands, also have the potential to generate tax revenue in counties within the analysis area. The extent to which they do is not known. A report by Briceno and Schundler (2015) looking at all ownerships estimated that outdoor recreation generates state and local tax contributions of about $2.1 billion per year (2017 dollars). They estimated that recreation expenditures, excluding equipment, related to trust lands was $477 million per year (2017 dollars), while expenditures, excluding equipment, on all lands was $13.4 billion (2017 dollars). If the state and local tax contributions from state trust land recreation is proportional to the contribution of state trust land recreation to total expenditures, the state and local taxes generated by recreation on state trust lands is $76 million per year (2017 dollars).

Table 3.11.8. Average Sales Tax Distributed to Counties in the Analysis Area in 2011–2016, in 2017 Real Dollars
(Rounded; Washington Department of Revenue 2015, 2018b)

County	Average annual sales tax distribution by county	Average annual forest tax distribution by county	Ratio of forest tax distribution to sales tax distribution (>1.0 indicates timber tax distribution exceeds sales tax distribution)
Clallam	$8,500,000	$2,100,000	0.24
Cowlitz	$8,600,000	$3,100,000	0.36
Grays Harbor	$6,200,000	$3,800,000	0.61
Island	$7,800,000	$100,000	0.01
Jefferson	$4,500,000	$1,200,000	0.26
King	$155,600,000	$1,300,000	0.01
Kitsap	$30,800,000	$400,000	0.01
Kittitas	$6,600,000	$100,000	0.01
Lewis	$8,600,000	$5,300,000	0.61
Mason	$6,500,000	$1,500,000	0.23
Pacific*	$1,700,000	$3,300,000	1.92
Pierce	$69,700,000	$1,700,000	0.02
San Juan	$5,300,000	$<10,000	0.00
Skagit	$16,400,000	$1,400,000	0.09
Snohomish	$58,700,000	$1,500,000	0.03
Thurston	$28,600,000	$1,300,000	0.05
Wahkiakum*	$400,000	$900,000	2.40
Whatcom	$26,400,000	$800,000	0.03
Total	$450,900,000	$29,600,000	0.07

* Indicates counties in which the forest tax distribution exceeds sales tax distribution.

Forest Products Industry Employment

Activities on state trust lands directly support employment in counties in the analysis area. These jobs, in turn, indirectly support employment in these counties. Examples of direct employment include land management staff hired by DNR, timber harvest operators, and non-timber forest product harvesters. Examples of indirect employment includes equipment servicers and local shops.

Mason and Lippke (2007) found that direct employment resulting from both the harvesting and processing of 1 million board feet of timber in Washington State is equal to 8.67 full time jobs. These jobs were divided between logging jobs, mill jobs, and wood product manufacturers (Table 3.11.9). Since 2005, harvest activities have occurred on state trust lands in 15 of the 17 counties in the marbled murrelet

analysis area. No harvest occurred in San Juan or Island counties. Mills that have purchased timber from DNR since 2005, the start of the last sustainable harvest planning decade, are located in 12 of the 17 counties (Table 3.11.10)[43].

Table 3.11.9. Jobs Created for Each Million Board Feet of Timber Harvested in Washington State (Reproduced From Mason and Lippke 2007)

	Logging	Sawn wood	Secondary wood products [a]	Primary Paper products [b]	Total
Direct employment	1.30	2.97	3.26	1.13	8.67
Indirect employment	0.53	1.14	0.83	0.12	2.62
Total	1.83	4.81	4.09	1.25	11.28

[a] Secondary wood products include manufactured wood products such as doors, molding, and furniture.
[b] Primary paper products are pulp and paper manufactured from pulp logs and wood chips.

Table 3.11.10. Counties With and Without Mills That Have Purchased Timber From DNR Since 2005[a]

Location of mills that have purchased timber directly from DNR*		Other counties
Clallam	Mason	Island
Clark	Pacific	King
Cowlitz	Pierce	San Juan
Grays Harbor	Skagit	Thurston
Jefferson	Snohomish	Wahkiakum
Lewis	Whatcom	

[a] Island, King, San Juan, Thurston, and Wahkiakum counties either do not have mills that purchased DNR timber or lack mills.

DNR used Bureau of Labor Statistics data for western Washington Counties to update the results in Mason and Lippke (2007) (Bureau of Labor Statistics 2017). These data showed similar direct employment rates as Mason and Lippke (2007) per million board feet harvested (Table 3.11.11). However, these data show a slight downward trend in employment per million board feet, indicating increasing productivity over time, with an abrupt drop during the recession in 2009 (Figure 3.11.1)[44].

[43] Sales from DNR to mills only. Some mills may have purchased DNR timber from other mills or brokers that purchased DNR timber.

[44] The Bureau of Labor Statistics does not disclose employment data if there are few businesses active in a county in a particular industry. Mill surveys by DNR show a continuous reduction in the number of sawmills since 2006 and a decline the total number in mills of all types since 2000 (DNR 2008, 2017). The reduction in operations results in an increase in counties where Bureau of Labor Statistics data are not disclosable. For example, the wood products manufacturing data for Pacific County show employment numbers though 2007, with 246 jobs in 2007. After that year, jobs numbers are reported as "not disclosable" and so not included in the summary graphs of jobs. The 2016 Washington Mill Survey reports that there are still two activity sawmills in Pacific County. A 2017 article from the Pacific County Economic Development Council report states that one of the mills employs between 145 and 160 workers. As a results, the magnitude of the drop in mill employment is appears greater in the Bureau of Labor Statistics data than actually occurred.

Table 3.11.11. Jobs per Million Board Feet Harvested in Counties in the Marbled Murrelet Analysis Area. Data From Bureau of Labor Statistics (2017)

	Forestry and logging	Wood products manufacturing	Paper manufacturing	Total
Direct jobs	1.5	4.5	2.1	8.1

Total jobs in the forest products sector declined during the recession and there was no subsequent recovery, even as the total harvest volume from all ownerships increased following the recession (Figure 3.11.2). Total employment in the sector shows no relation to harvest levels on DNR-managed lands in the marbled murrelet analysis area. The three job categories in the sector, forestry and logging, wood products manufacturing, and paper manufacturing, show slightly different patterns of job loss since 2001 (Figure 3.11.3). Forestry and logging jobs were in decline from 2001 to 2009 but have been stable since then. Paper manufacturing has been in near continuous decline since 2001; however, most of that decline occurred between 2004 and 2012. In the years since 2001, wood products manufacturing jobs experienced a peak in 2006, followed by a 38 percent decline to 2009. Since 2009, jobs in wood products manufacturing have been relative stable. Employment in these job categories do not show a strong link with harvest volumes from DNR-managed lands (Figure 3.11.4).[45] Since 2006, the timber volume exported out of Washington and Oregon ports has increased (DNR 2018b). These timber exports are mainly whole logs harvested on private timberlands in Washington and Oregon. Export of timber from DNR-managed and Federal lands is prohibited.[46] The effect of the increase in timber exports since 2006 on wood products and paper manufacturing is uncertain as the period with the greatest increase in exports corresponds to the period with the sharpest decline in timber harvest volume from all ownerships (Figure 3.11.5).

[45] DNR tracks both the volume sold and the volume harvest. Most timber sales have a two-year harvest contact. Purchasers can harvest timber anytime within that two-year period.
[46] WAC 240-15 and 36 C.F.R.§ 223.48

Figure 3.11.1. Forest Product Sector Jobs by Category in Counties in the Marbled Murrelet Analysis Area

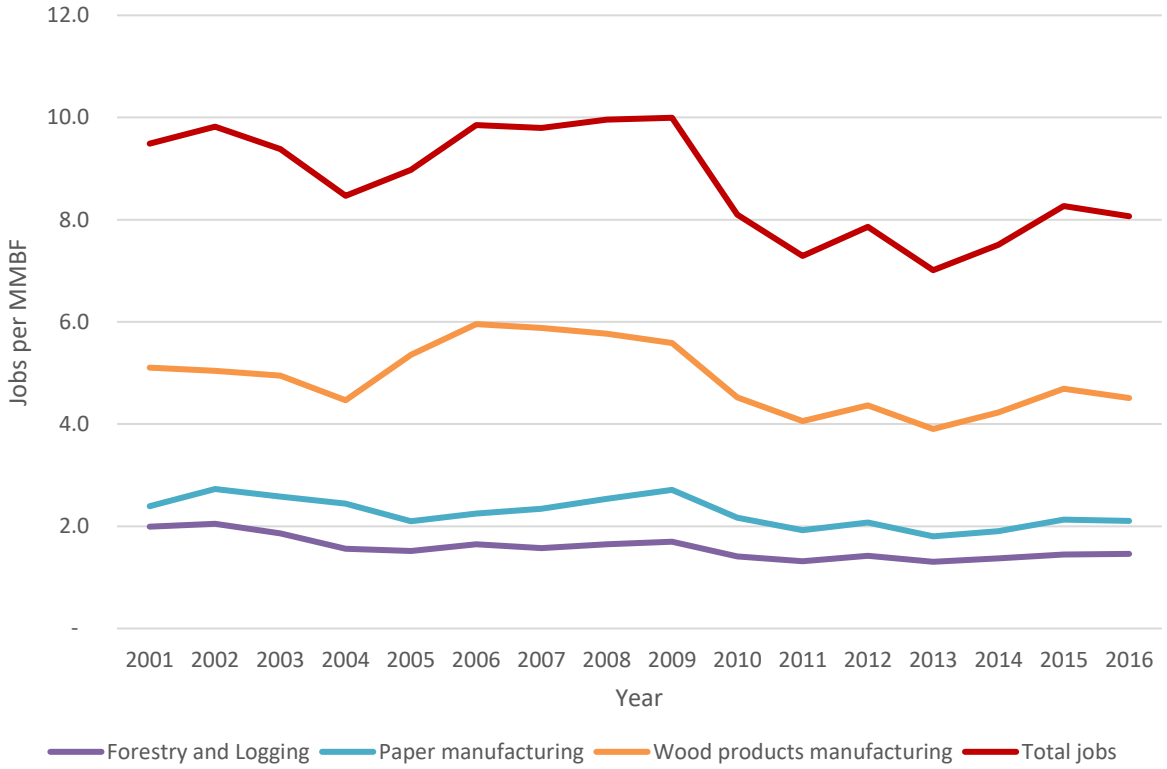


Figure 3.11.2. Forest Product Sector Jobs and Harvest Volumes from State Trust Lands and all Ownerships in Counties in the Marbled Murrelet Analysis Area

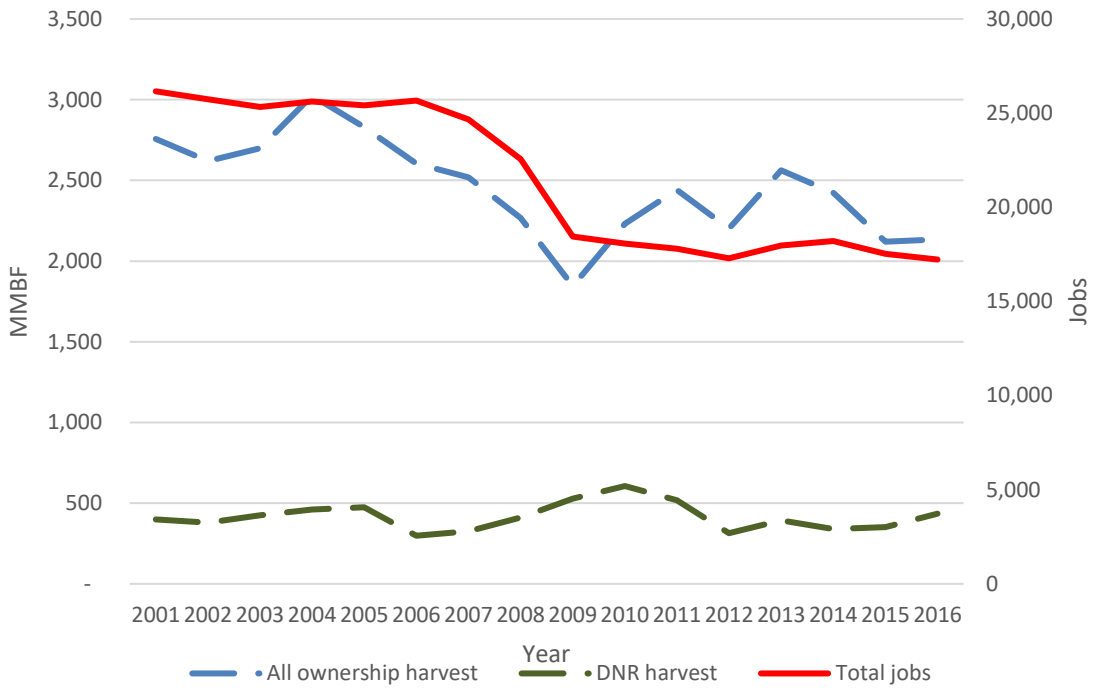


Figure 3.11.3. Forest Product Sector Jobs by Category and Harvest Volumes From All Ownerships in Counties in the Marbled Murrelet Analysis Area

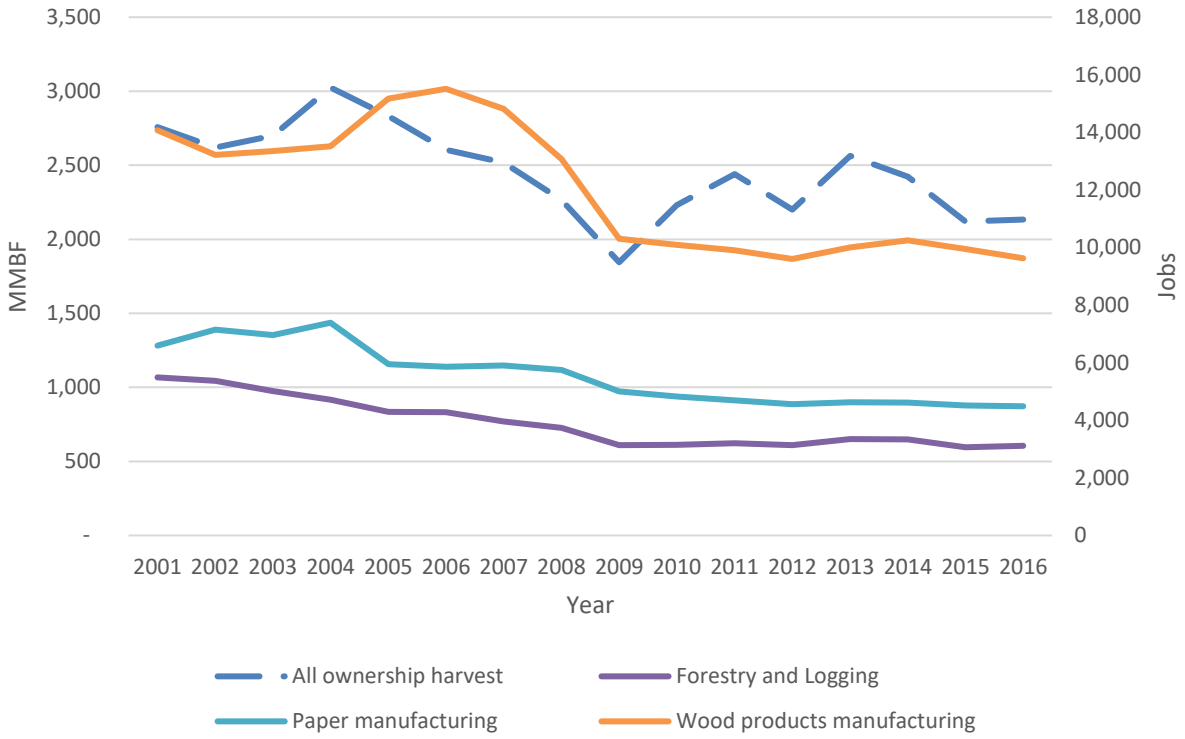


Figure 3.11.4. Forest Product Sector Jobs by Category and DNR Harvest Volumes From Washington and Oregon

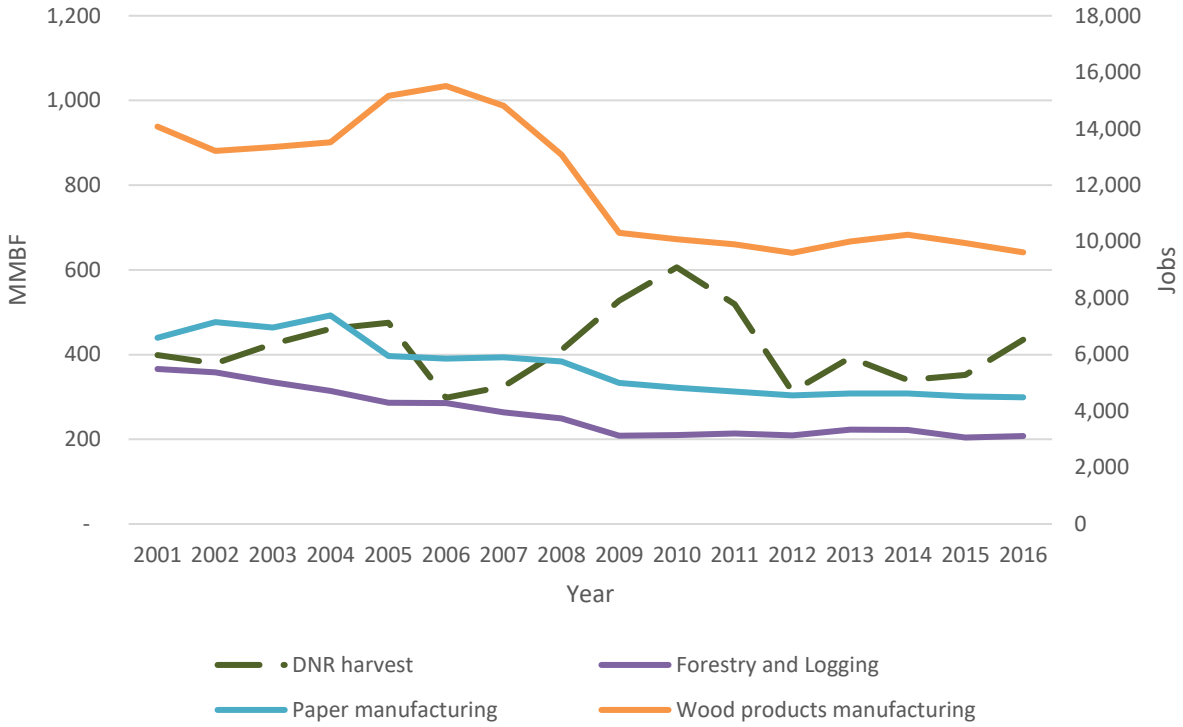
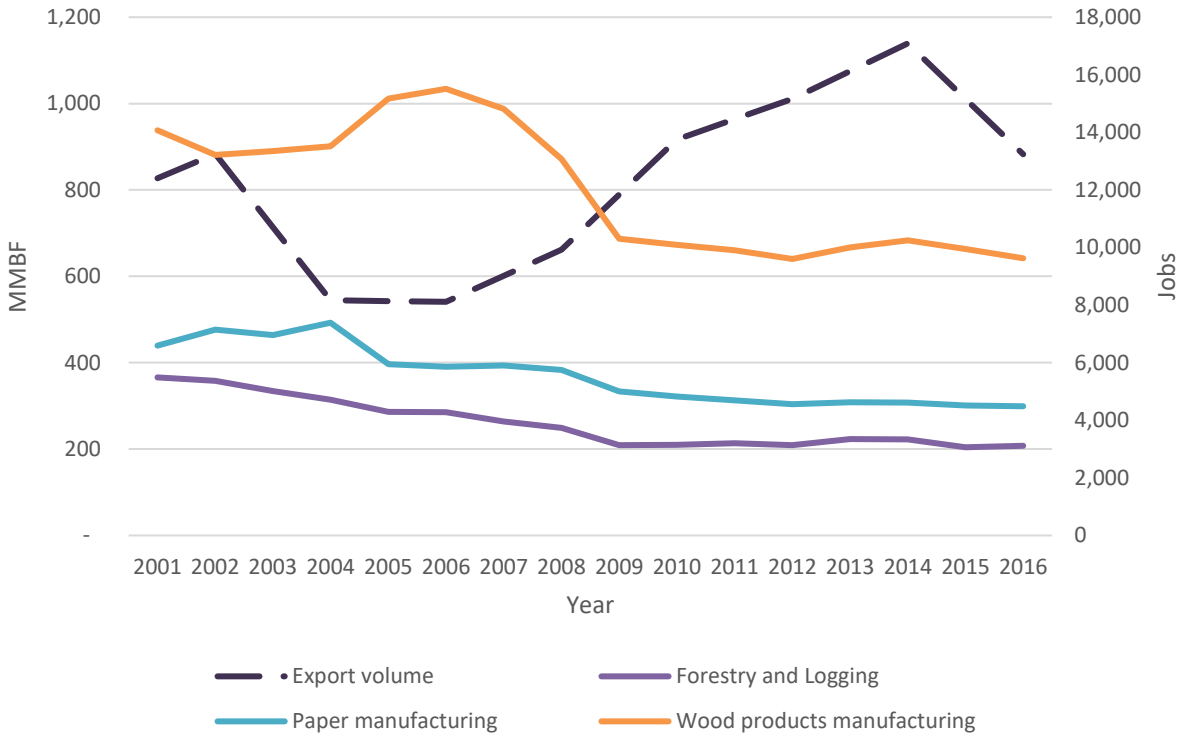


Figure 3.11.5. Forest Product Sector Jobs by Category and Export Volumes From State Trust Lands in Counties in the Marbled Murrelet Analysis Area



No data are available for the number of non-timber jobs supported by DNR-managed lands. These jobs include harvesting of forest greens, mushrooms, and other products, as well as jobs supported by recreation. The Washington Employment Security Department reports that between 46,100 to 49,100 jobs were in the "Arts, Entertainment and Recreation" category in 2014 and 2015 (Washington Employment Security Department 2016). The data do not show the wages associated with these jobs nor whether they are full or part-time. Others estimated higher numbers of jobs supported by recreation. Briceno and Schundler (2015) estimated that approximately 200,000 full- and part-time jobs are supported by outdoor recreation in Washington.

As illustrated in Table 3.11.12, most counties have a low percentage of total paid employees identified by the Bureau of Labor Statistics as working in the logging or wood product manufacturing sectors. Cowlitz and Wahkiakum counties had the highest percentage of their paid employees employed in the logging or wood product manufacturing sectors (Bureau of Labor Statistics 2017, OFM 2018b).

Statewide, the annual unemployment rate has fallen every year since 2010 from 9.9 percent (June 2010) to 4.5 percent (November 2017). The unemployment rate in Washington has closely tracked the nationwide rate since the 1990s, though with higher state-level unemployment in economic downturns (OFM 2016b).

Table 3.11.12. December 2015 Employment Information for Each County with State Trust Lands in the Analysis Area

County	% of total county paid employees forest products sectors[a]	Unemployment rate[b]	Socioeconomic resiliency	Economic diversity (4 = high diversity)	Population 2015
Clallam	3%	5.9 %	Medium	3	72,650
Cowlitz	10%	5.4 %	High	4	104,280
Grays Harbor	6%	6.1 %	Medium	3	73,110
Island	0%	4.8 %	High	3	80,600
Jefferson	0%	5.4 %	Medium	3	30,880
King	0%	3.9 %	High	4	2,052,800
Kitsap	0%	4.5 %	High	4	258,200
Kittitas	No data	4.5 %	Medium	2	42,670
Lewis	9%	5.9 %	Medium	3	76,660
Mason	5%	5.7 %	Medium	2	62,200
Pacific	3%	6.5 %	Low	2	21,210
Pierce	1%	4.7 %	High	4	830,120
San Juan	0%	3.7 %	Medium	2	16,180
Skagit	2%	4.8 %	High	4	120,620
Snohomish	0%	4.3 %	High	4	757,600
Thurston	0%	4.4 %	High	4	267,410
Wahkiakum	14%	6.0 %	Low	1	3,980
Whatcom	2%	4.3 %	High	4	209,790
Statewide rate	1%	4.5 %	N/A	N/A	

[a] Calculated from data from Bureau of Labor Statistics (2017) and OFM (2018b)
[b] Non-seasonally-adjusted unemployment rate, November 2017 (Washington Employment Security Department 2018b).

Carbon Sequestration

Currently, no state trust lands generate revenue though the sale of credit for carbon sequestration, and there is no program applicable to these lands.

Environmental Services and Other Non-Market Values

Estimating the value of DNR-managed timber lands beyond markets directly related to timber production requires looking at estimates of the value of environmental services and other land uses provided by forestlands.

ENVIRONMENTAL SERVICES AND CONSERVATION VALUES

Surveys have been developed to understand these non-market values and assess the value of different management options. For example, Garber-Yonts and others (2004) studied Oregon residents' willingness to pay for conservation in the Oregon Coast Range. They found that a hypothetical policy to increase the area of forests with old-growth characteristics resulted in a willingness to pay up to $380 per household per year. Willingness to pay for large (40 to 180 square miles) biodiversity reserves peaked at $45 per household per year. For all conservation polices, willingness to pay for additional conservation peaked at moderate levels of conservation and was negative for all policies at high levels of conservation.

Some people place value on the continued survival of species. Richardson and Loomis (2009) reviewed studies valuing preservation of threatened, endangered, and rare species. They found that willingness to pay for protection of these species ranged from $8 to $311 per year per household.

Cedar River Group and others (2002) studied the value of the property attributes of a 4,800-acre block of state trust land on Blanchard Mountain in Skagit County. These attributes included 18 different non-timber social, environmental, and economic resources. They found that the total value of these resources to Skagit and Whatcom county residents was $8.5 million. The study does not assess how this value may change with different levels of timber harvest.

Briceno and Schundler (2015) estimated that land and waters that provide recreation experiences also provide at least $143 billion to $264 billion (2017 dollars) in economic benefits from clean water, wildlife habitat, aesthetic attributes, and enhanced recreation experiences for the entire state.

Recreation

Across Washington State, recreation is an important contributor to the economy. Briceno and Schundler 2015, in a report for the Washington State Recreation and Conservation Office, estimated that recreation expenditures, excluding equipment, related to state trust lands was $477 million per year (2017 dollars).

State trust lands provide opportunities for recreation. The value of these opportunities has not been studied in detail for all state trust lands in the marbled murrelet analysis area. However, the value of one area, state trust lands on Blanchard Mountain in Skagit County, have been studied. There, the Cedar River Group and others (2002) estimated that between 30,000 and 50,000 people visited the 4,800-acre block of state trust lands. The economic impact of these visits to Skagit and Whatcom counties was $534,000 per year. They compared this value to the estimated value of harvest of 2 million board feet. This harvest level provided $1.6 million per year in economic impact to Skagit and Whatcom counties. The economic impact of these activities to the entire state is estimated as greater than $938,000 per year for recreation and $6.6 million per year for harvest of 2 million board feet.

Minerals and Hydrocarbons

The leases in this category include surface mining leases for rock, sand, and gravel, and prospecting leases for minerals or hydrocarbons. Nearly all of this revenue comes from the surface mining leases. The total revenue to the trusts in the analysis area from surface mining grew from fiscal year 2011 to 2015

from $594,000 to $1.1 million. This revenue comes from royalties from two surface mines. Revenue varies as extraction volume changes. No new surface mine leases are currently planned.

Harvest of Non-Timber Forest Products

Collection of non-timber forest products for non-tribal uses is allowed with a valid permit. Collection for tribal use does not require a permit. Permits are issued by the DNR region in which the harvesting occurs. The price varies; permits for small quantities of firewood are free, while other permits are priced in a bid process. Revenue from the collection of non-timber forest product on trust lands statewide is about $500,000 annually (2017 dollars), mostly from western Washington.

Existing Policies and Regulations

Trust Distribution Rate

Revenue generated for the trusts is split between the trust beneficiaries and DNR's management funds. The distribution rate of funds to the beneficiaries and DNR's management accounts[47] differs between the State Lands trusts, State Forest Transfer trust, and State Forest Purchase trust (Table 3.11.13). One State Lands trust, the Agriculture School trust, receives 100 percent of the revenue for activity on the lands in that trust (DNR 2015b). The Washington State Legislature sets the maximum allowable distribution to DNR's management funds.[48] The Board of Natural Resources sets the rate received by these funds within this limit. These rates have changed over time.

Revenue from State Forest Transfer and State Forest Purchase trusts is distributed within counties based on junior tax districts, which are tax districts created to fund particular services such as schools, emergency services, and libraries. Junior tax districts may receive a proportion of the revenue generated within the district. The proportion of the revenue they receive depends on factors such as the number of tax districts receiving revenue and the tax rate within the district as directed by RCW 76.64.110.

Table 3.11.13. General Distribution Rates, Upland Trust Revenue as of April 2018

Trust group	Beneficiaries	State general fund	DNR management accounts
Federally granted trusts	69%	0%	31%
State Forest Transfer	75%	0%	25%
State Forest Purchase	26.5%	23.5%	50%

[47] These accounts are the Resource Management Cost Account and the Forest Development Account. The Resource Management Cost Account receives money from State lands. The Forest Development Account receives money from the State Forest Transfer and State Forest Purchase lands.
[48] RCW 79.64.040

Tax Rates

The state timber tax is applied to harvests on private and state trust lands. The current rate is 5 percent of the stumpage value (Washington Department of Revenue 2018a).[49] Revenue from this tax is split between the state general fund and counties, with 20 percent going to the general fund and 80 percent to the county in which the harvest occurred. Sales tax varies by location due to local taxes, in addition to the 6.5 percent state sales tax. There are numerous other state and local taxes in counties in the marbled murrelet analysis area. Current state tax rates can be accessed at the Washington Department of Revenue.[50] Other tax rates are available from county governments.

[49] Stumpage is the price of standing timber or the right to harvest timber. Stumpage does not include costs of harvesting or transporting timber.
[50] https://dor.wa.gov

3.12 Cultural and Historic Resources

This section describes cultural and historic resources commonly found within the analysis area and how DNR manages those resources.

■ Why Are Cultural and Historic Resources Important?

DNR-managed lands within the analysis area contain many types of cultural and historic resources. DNR routinely surveys for these resources as part of its forest practices. DNR works with tribes to ensure protection of and access to traditional cultural materials and foods, as well as sites of cultural importance to tribal communities.

Text Box 3.12.1. How Are Cultural Resources Investigated in the Field?

Photo: Sara Palmer

DNR has its own archaeological staff and cultural resource technicians. DNR also works closely with tribal staff to locate and document cultural resources.

■ Current Conditions

Washington State law (WAC 222-16-010) defines cultural resources for forest practices as "archaeological and historic sites and artifacts and traditional religious, ceremonial, and social uses and activities of affected Indian Tribes." Cultural and historic resources on DNR-managed lands include archaeological and historic sites, resources, and objects.[51] Common examples on state trust lands include logging railroad grades, logging camps, mining camps, homesteads, and culturally modified trees. Logging railroad grades are the most common archaeological site type found on DNR-managed lands.

Traditional cultural properties, materials, and foods also are found on DNR-managed lands. These are places that have been identified as playing a significant role in a community's historically rooted beliefs, customs, and practices. Traditional cultural properties are eligible for listing in the National Register of Historic Places (refer to the following section). Traditional cultural materials and foods include many plants, fish, animals, and minerals traditionally used for food, medicine, and raw materials by Native peoples. There are 25 federally recognized tribes within the analysis area.[52] Maintaining tribal access to state trust lands for cultural practices, including the harvest of traditional plants, fish, roots, berries, wildlife, cedar bark, and boughs, is an important part of DNR's stewardship of state trust lands. Use of these resources is part of treaty rights for some tribes.

[51] See WAC 25-48-020(9)-(11).
[52] For a list of federally recognized tribes in Washington, refer to www.goia.wa.gov/Tribal-Directory/TribalDirectory.pdf.

Existing Policies and Regulations

DNR Review and Consultation

DNR's practice is to avoid impacts to cultural resources when managing forestlands. Field staff routinely survey for cultural resources as part of forest practices. The *Policy for Sustainable Forests* directs DNR to identify and protect significant historic and archaeological sites, consistent with state and federal law, and to work with tribes and interested stakeholders to address culturally significant areas.[53] DNR consults with the Department of Archaeology and Historic Preservation (DAHP) and affected tribes to ensure avoidance and protection of cultural and historic resources. Tribes and DAHP regularly review and provide input for proposed forest management activities to ensure that areas of cultural significance are not disturbed.

Federal Review and Consultation

The issuance of an Endangered Species Act incidental take permit is considered a federal undertaking. The principal federal law addressing cultural resources is the National Historic Preservation Act of 1966 as amended (54 United States Code, Section 300101 et seq.) and its implementing regulations (36 CFR, Part 800), which address compliance with Section 106 of the National Historic Preservation Act. The regulations describe the process for identifying and evaluating historic properties, assessing the effects of federal actions on historic properties, and consulting with interested parties, including the State Historic Preservation Officer, to develop measures that would avoid, reduce, or minimize adverse effects. Federal consultation with federally recognized tribes also is mandatory, where applicable.[54]

Under the National Historic Preservation Act, the term "historic properties" refers to cultural resources that are listed on or meet specific criteria of eligibility for listing on the National Register of Historic Places. These criteria include the following: the resource is at least 50 years old (generally), demonstrates historical significance, and meets other criteria related to significant historical use or contribution. Section 106 of the National Historic Preservation Act describes the procedures for identifying and evaluating eligible properties, assessing the effects of federal actions on eligible properties, and consulting to avoid, reduce, or minimize adverse effects. Section 106 does not require preservation of historic properties but ensures that decisions of federal agencies include meaningful consideration of cultural and historic values and options to protect those properties.

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[53] Several state and federal laws address these resources, including Archaeological Sites and Resources (RCW 27.53), Forest Practices Application approval (WAC 222-16-010), SEPA (WAC 197-11-960), and Section 106 of the National Historic Preservation Act. Department policies and procedures addressing this topic include Executive Order 05-05, Commissioner's Order on Tribal Relations, Identifying and Protecting Cultural Resources (PR 14-004-030), Interim Direction on Special Ecological Features and Archaeological Resources (PO 14-012), and the Cultural Resources Inadvertent Discovery Guidelines.

[54] Also refer to Fish and Wildlife Native American Policy (2016); Department of Interior's Policy on Consultation with Indian Tribes and Alaska Native Corporations (512 DM 4).