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Chapter 3

AFFECTED ENVIRONMENT

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Chapter 3

Affected Environment

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

Elements of the Environment

The purpose of this chapter is to describe the elements of the natural environment within the analysis area, which is defined as all DNR-managed forestlands in western Washington (refer to Figure 1.3.1) that could be affected by the proposed alternatives. Each section will describe a different element of the environment, its current condition, and the policy and regulatory context for management of the element. The environmental impacts of the action alternatives on these current conditions are analyzed over time in comparison to the no action alternative (refer to Chapter 4, Environmental Consequences).

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

- Earth (geology and soils)
- Climate
- Vegetation
- Aquatic resources (water, riparian habitats, and fish)
- Wildlife and biodiversity
- Marbled murrelet

[1] WAC 197-11-444.

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

Element of the environment	Findings
Air quality (other than climate)	No new emissions or increases in emissions of pollutants that could affect air quality are proposed under the alternatives.
Visual/scenic resources/light, and glare	No change to DNR policy guiding management of visual impacts.
Water: Runoff/absorption/flooding/groundwater and public water supplies	Stream peak flows and water quality impacts are addressed in the Aquatic Resources section. No public water supply sources will be affected by the proposal or any alternatives.
Traffic and transportation	No change in management of forest roads under forest practices rules or the 1997 HCP. The proposal will not impact traffic or transportation on public roadways.
Noise	No change in management of noise.
Urban land uses (including population and housing impacts), sewer, and solid waste	Harvest and thinning activities occur in non-urban environments. No urban land uses will be affected.
Cultural and historic resources	No change in management of cultural or historic resources.
Agricultural lands/crops	There are no significant agricultural lands within the analysis area.

■ Data Sources

DNR’s 2018 large data overlay is the primary source of data for describing the current conditions of each element of the environment. Additional databases maintained separately by DNR were also used as appropriate. Previously adopted plans, policies, and regulations are also sources of data for describing each element of the environment. Expert knowledge from DNR staff is also a source of information for describing the policy and regulatory context for each element of the environment.

■ Scope and Scale of Analysis

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

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

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

3.1 Earth: Geology and Soils

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

■ Why Are Geology and Soils Important?

Long-term forest management consistent with the *Policy for Sustainable Forests* and the 1997 HCP depends on healthy forests. Healthy soils are the foundation of healthy, productive forests. Understanding how the alternatives could potentially affect soil stability, erosion, and productivity is an important part of determining environmental impacts.

■ Current Conditions

The soils and geology of DNR-managed lands within the analysis area have previously been described in several DNR documents, including the *South Puget HCP Planning Unit Forest Land Plan Final Environmental Impact Statement* (DNR 2010), *Final Environmental Impact Statement on Alternatives for Sustainable Forest Management of State Trust Lands in Western Washington (DNR 2004*), the *Final Environmental Impact Statement for the Proposed Issuance of Multiple Species Incidental Take Permits or 4(d) Rules for the Washington State Forest Practices Habitat Conservation Plan* (NMFS and USFWS 2006), and Appendix B of the *Washington State Forest Practices Board Manual*, Section 16 (Washington Forest Practices Board 2016). These conditions are briefly summarized here.

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

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

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

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

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

Soil Productivity

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

Landslides

Landslides are the movement of a mass of rock, debris, or earth down a slope caused by natural events such as high precipitation, river bank erosion, or earthquakes. Management actions such as timber harvest and road-building on potentially unstable slopes can make these areas more susceptible to landslides.[2] Protection of potentially unstable slopes is a major consideration in DNR's planning for timber harvests, road building, and road removal because landslides pose significant risks to human safety, state trust land assets, public resources, and overall forest productivity. DNR identifies and verifies areas of landslides and potentially unstable slopes on forested trust lands at the site scale during individual timber sale planning and layout. For landscape-scale planning projects, DNR uses the best available knowledge from a variety of screening tools to estimate the occurrence of potentially unstable landforms. Screening tools include Forest Practices GIS data, DNR State Uplands GIS data, LiDAR, and other mapping tools. The features identified using these tools reflect where DNR suspects there could be potentially unstable slopes.

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

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

[3] Percentages derived from the "UNSTABSLPS" field in DNR's large data overlay created on January 12, 2018. The "UNSTABSLPS" field indicates the type/presence of an "important" unstable slope polygon originating from the Forest Practices Landslide Inventory and Hazard Zonation and DNR's Trismorph GIS layer.

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

Surface Erosion

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

Soil Compaction

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

■ Existing Policies and Regulations

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

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

Preventing Landslides in Potentially Unstable Areas

For proposed timber harvests and road-building projects, DNR geologists assist foresters and engineers in identifying and protecting areas that are potentially unstable to reduce the risk of management related landslides. When a DNR geologist identifies potentially unstable slopes in a proposed project area based on available screening tools such as GIS, aerial photos, or other data sources, he or she works with the forester or engineer to do a preliminary field visit and look for indicators of instability at the location.

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

During the field visit, the geologist assesses the risk of slope failure. If risks are deemed too high, the project will be halted or redesigned to avoid and mitigate the risks.

Regulating Activities That Can Damage Soils

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

3.2 Climate

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

■ Why Is Climate Change Important?

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

■ Current Conditions

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

IPCC released their fifth assessment report on climate change in 2013 (IPCC 2013). Within the report, the IPCC examined a range of potential future trends in greenhouse gas concentrations in the atmosphere, called representative concentration pathways (RCPs).[5] Unless otherwise noted, this FEIS reports on trends informed by two of these pathways, a pathway that assumes greenhouse gas emissions peak around 2040 before declining (RCP 4.5), and a pathway that assumes greenhouse gas emissions continue to rise throughout the century (RCP 8.5, Van Vuuren and others 2011).[6]

The RCPs represent different greenhouse gas scenarios, which, in turn, were used as input into general circulation models. These models incorporate our current understanding of key elements and drivers of the climate system to project future climate dynamics, such as trends in precipitation and temperature. Different general circulation models will model distinct climate trends even under the same RCP because all processes that drive climate are not completely understood, and each model uses different assumptions. For this reason, the discussion on projected future climate trends examines not only a range

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

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

of RCPs where possible, but also a range of general circulation models. The majority of general circulation model trends described in the following section have been statistically downscaled to finer resolutions. Regional climate models, which use a dynamical downscaling method to better incorporate simulated general circulation models climate patterns with local terrain, are currently limited in the Pacific Northwest in part because of modeling cost. Consequently, the assessment exclusively relies on output from statistically downscaled general circulation models. Although RCP and global circulation model outputs are produced for every year, projections for any given year are uncertain. Climate-related trends are therefore typically reported over 30-year periods, which is also what this FEIS uses in the analysis. This analysis also focuses on trends through approximately 2070, encapsulating the life of the 1997 HCP.

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

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

Effects of Climate Change on DNR-Managed Resources

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

VEGETATION

Forest Conditions

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

Plant species will respond individually to a changing climate, resulting in changes to plant communities. Both statistical and mechanistic models have been used in the Pacific Northwest to examine trends in individual species (Littell and others 2010, Rehfeldt and others 2006) and broader vegetation types (Rogers and others 2011, Sheehan and others 2015, Halofsky and others 2018a). All modeling efforts project drying in the Puget Sound lowlands and Olympic Peninsula rain shadow, but the degree of projected changes in species composition and/or structure varies by modeling approach, assumptions in how vegetation types may respond to changes in precipitation and temperature, and climate projections.

Studies that cover all vegetation types in western Washington also project a decline in subalpine parkland[7] area due to increased temperatures and decreased snow. Lower elevation vegetation types are likely to move upward in elevation, and species composition may shift to favor more drought-tolerant species in locations that become more water-limited. The timing of such changes is uncertain and will, at least partially, relate to annual and seasonal trends in temperature and moisture, and the timing and frequency of stand-replacing disturbances and disturbance interactions (Vose and others 2018) (refer to next section). While such changes are less likely over the next decade, changes in forest composition will occur over longer time periods with changes in climate and shifts in disturbance regimes and interactions.

Disturbances

Higher temperatures and/or below average precipitation can result in drought conditions, which can increase tree stress and mortality risk, reduce tree growth and productivity, and increase the frequency of drought-related disturbances such as insect outbreaks and wildfire (Allen and others 2015, Littell and others 2016, Vose and others 2016, Vose and others 2018). Drought also can influence the regeneration success of species, potentially resulting in novel forest assemblages (Vose and others 2016). Drought severity could be amplified (Allen and others 2015, Vose and others 2016), exacerbating physical plant responses and disturbance-related events, especially in moisture-limited systems. While future temperature projections for western Washington consistently project a warmer future, precipitation projections are less certain when viewed annually. Future precipitation patterns are more consistent when examined seasonally; typical projections are for less precipitation during the summer (refer to preceding current conditions section for additional detail). It is, therefore, likely that summer drought frequency and severity will be greater in the future in western Washington. However, the timing and duration of such future potential events is unknown (for example, days, months or longer); thus, the magnitude of effects on western Washington forests are uncertain.

In addition to drought, warmer temperatures and reduced summer precipitation will increase the likelihood of wildfire. Several studies project an increase in area burned under a changing climate (Littell and others 2010, Rogers and others 2011, Sheehan and others 2015, Halofsky and others 2018a). Most studies project at least a doubling in area burned, even after accounting for some level of fire suppression. It is likely that future wildfires in western Washington will contain large patches of stand-replacing fire,

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

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

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

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

EARTH

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

AQUATIC RESOURCES

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

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

With projected increases in winter precipitation, little change is expected in winter peak flows in rain-dominant watersheds (Hamlet and others 2013). Those watersheds Hamlet and others (2013) classified as historically mixed rain-snow watersheds in western Washington, primarily found on the west slope of the Cascade Mountains and northeast portion of the Olympic Peninsula, are projected to become rain dominant by the 2080s under moderate warming.[8] Similar to rain-dominant basins, mixed rain and snow watersheds are more likely to display changes in timing of peak flow with increasing temperatures (Elsner and others 2010) because of projected declines in snowpack, possibly resulting in a single, earlier peak streamflow period. In addition to timing changes, flooding magnitude and frequency are also projected to increase with time (Mauger and others 2015), with notable increases occurring in watersheds currently classified as mixed rain and snow (Mantua and others 2010). As rivers adjust to new hydrologic patterns, new sediment loads, and new peak flow magnitudes, changes in the physical environment adjacent to rivers could occur, potentially affecting adjacent riparian vegetation and in-stream habitat.

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

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

WILDLIFE

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

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

Recent work by Case and others in 2015 combined opinions from approximately 300 experts to assess the sensitivities of 195 plant and animal species to a changing climate across the Northwest. According to a database created from the assessment,[9] the marbled murrelet, northern spotted owl, and Taylor's checkerspot butterfly all received overall sensitivity scores of "high" based on a weighted average of sensitivity to eight individual factors (refer to Case and others 2015 for a list of factors). Overall expert confidence in their sensitivity assessment ranged from fair for the marbled murrelet and northern spotted owl to good for the Taylor's checkerspot butterfly. While the work examined species sensitivity, it did not address individual species vulnerability or risk to a changing climate. However, one of the eight sensitivities assessed by Case and others (2015) was habitat. All three species had the highest sensitivity score for habitat, indicating that experts felt all three species are habitat specialists and, therefore, have narrow habitat niches. Expert confidence in habitat sensitivity assignment ranged from very good (the highest confidence ranking) for the butterfly to good (the second most confident ranking) for the murrelet and northern spotted owl. Using data from Case and others (2015), as well as other data sources and opinions, Washington's *State Wildlife Action Plan* (WDFW 2015) examined individual species' vulnerability, defined as the sensitivity and exposure of a species to climatic factors. Marbled murrelet and northern spotted owl, respectively, received moderate and moderate-high vulnerability scores, which in part reflect the habitat specialist nature of both species.

Carbon Sequestration on DNR-Managed Lands

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

Effects of DNR Management on a Changing Climate

While DNR's contribution to global carbon emissions may be small, DNR's possible contribution to a changing climate is considered in this FEIS because global impacts are the result of the sum of individual emissions. Carbon is the leading type of greenhouse gas emitted.[11] A primary source of carbon emissions from DNR-managed lands occurs following tree harvest, during the process of creating wood products such as lumber and paper. Additional carbon emissions occur from nursery operations, and vehicle and equipment emissions related to all timber management activities. Primary sources of carbon sequestration (capture and storage) on DNR-managed lands are tree growth, harvest deferrals, and carbon storage in long-term wood products such as timber rather than paper products. Carbon sequestration in soils and release of carbon from soils via decomposition will vary depending on management intensity. Whether DNR-managed lands sequester and store more carbon than is emitted is analyzed in Chapter 4, Environmental Consequences.

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[9] Refer to http://climatechangesensitivity.org.

[10] A tonne is equivalent to 1,000 kilograms or 2,205 pounds. Tonnes of carbon is a common metric unit of measure for carbon sequestration or release.

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

■ Existing Policies and Regulations

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

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

3.3 Vegetation

This section of the FEIS describes the current conditions of vegetation on DNR-managed land in western Washington, including both general forest conditions as well as vegetation in special management or conservation status. Forest conditions directly related to climate change, riparian areas, and wildlife habitat are described in other sections of this chapter (refer to Sections 3.2, 3.4 and 3.5, respectively).

Forest in South Puget Sound

■ Why Is Vegetation Important?

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

■ Current Conditions

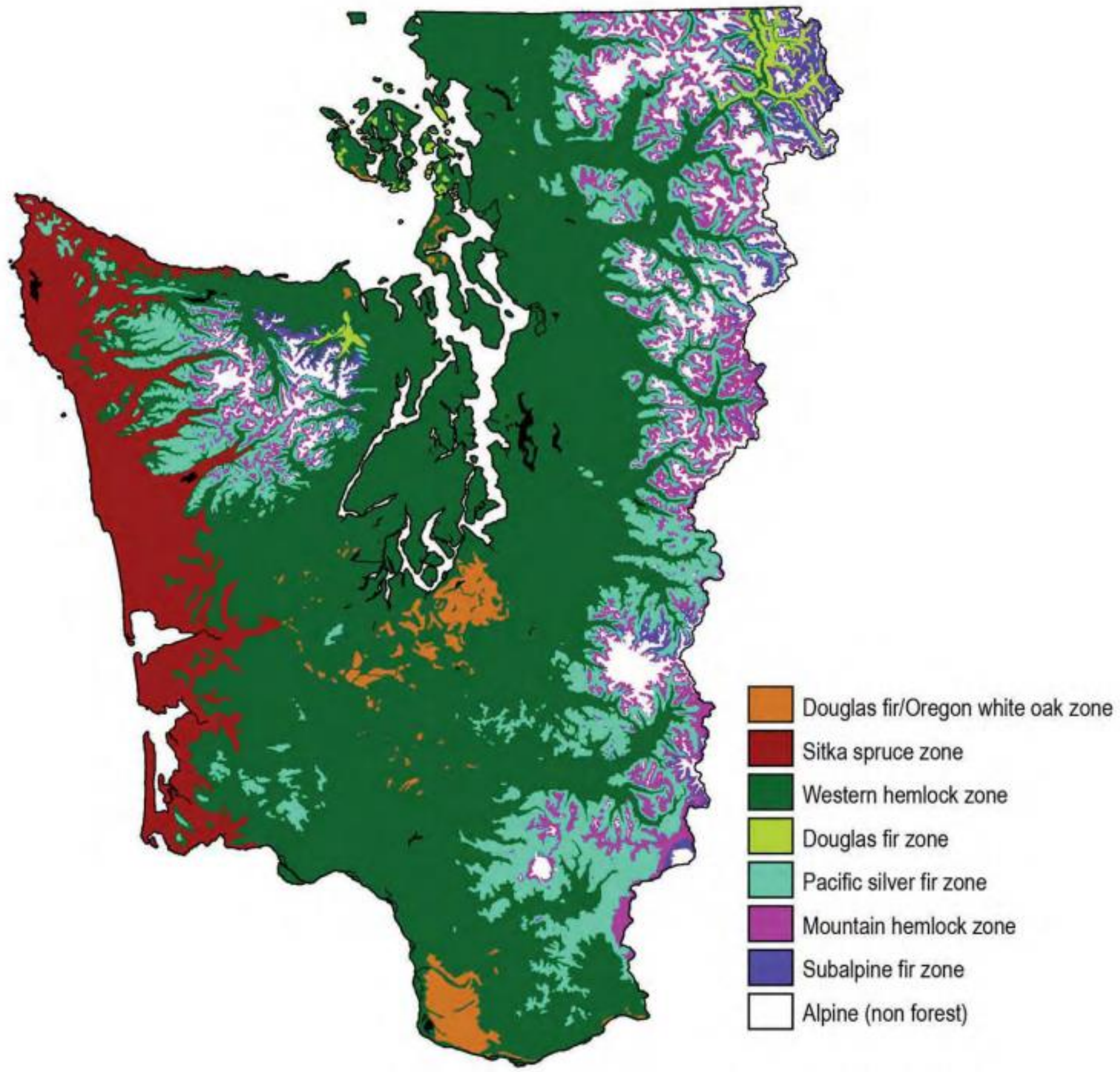
DNR maintains data from various sources on forest conditions in the analysis area. This section summarizes the existing conditions of forestlands in the analysis area in order to understand potential impacts from the alternatives.

The analysis area contains a great diversity of forested habitats. The steep, mountainous topography of western Washington has dramatic effects on precipitation and temperature. Accordingly, tree species have become stratified by their tolerance and competitive abilities (Table 3.3.1). In *Natural Vegetation of Oregon and Washington*, Franklin and Dyrness (1973) separate the region into vegetation zones based on the dominant tree species. In the simplest terms, western Washington can be divided into seven forest vegetation zones (Figure 3.3.1). For more description of the vegetation zones occurring on DNR-managed lands, refer to the 2004 sustainable harvest calculation (DNR 2004, p. 4–6).

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

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

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



General Forest Conditions

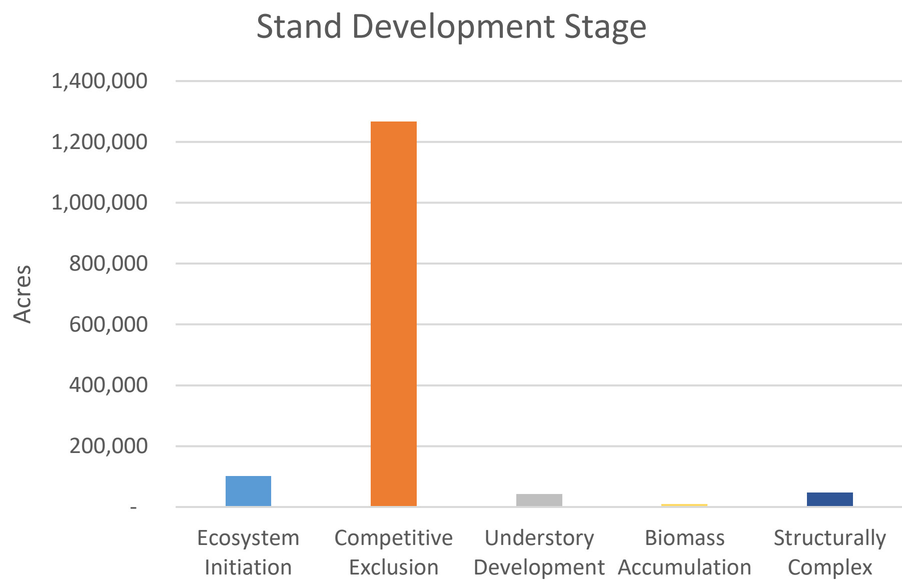
Forest stands are dynamic and diverse systems that constantly change through tree and other plant growth and ecological succession. To account for such change and diversity, DNR classifies forest stands into "stand development stages" that represent the general progression of growth and structural development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

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

Stand development stage		Acres
Ecosystem Initiation Begins soon after most overstory trees have been removed by harvest or natural events. This stage is known to support a high number of wildlife species, particularly as foraging habitat.		101,000
Competitive Exclusion Trees fully occupy the site, competing for light, water, nutrients, and space. Dense overstory means there are few or no shrubs or groundcovers and relatively little wildlife use.		1,266,000
Understory Development Overstory trees die, fall down, or are harvested, creating gaps in the canopy. An understory of trees, ferns, and shrubs develops. This process can be accelerated through active management.		42,000
Biomass Accumulation Numerous large overstory trees rapidly grow larger in diameter, producing woody biomass. Forest stands lack large snags or downed woody debris in this stage.		9,000
Structurally Complex Approaching conditions of natural older forests with multiple tree and shrub canopy layers, dead and downed logs, and well-developed understory. Multiple tree canopies are present, supporting diverse vertebrate and invertebrate species.		46,000

All stands generally progress through these development stages, beginning with Ecosystem Initiation and moving through Competitive Exclusion, Understory Development, and Biomass Accumulation to eventually reach the Structurally Complex stand development stage. However, stand development stages are not equal in terms of the duration stands typically spend in them. For example, stands progress through the Ecosystem Initiation stand development stage in one or a few decades but may spend centuries in the Structurally Complex stand development stage. Currently, most stands on DNR-managed lands are in the Competitive Exclusion stand development stage (Figure 3.3.2).

Figure 3.3.2. Acres by Current Stand Development Stage



FOREST HEALTH AND DISTURBANCE

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

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

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

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

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

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

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

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

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

Vegetation in Special Management or Conservation Status

DNR-managed forestlands within western Washington also include vegetation that is managed for conservation purposes pursuant to the 1997 HCP and DNR's *Policy for Sustainable Forests*. These lands are managed primarily to maintain habitat for protected species, biodiversity, or unique natural features of regional or statewide significance.

OLD GROWTH

DNR policy generally defers from harvest old-growth stands (stands 5 acres and larger that originated naturally before the year 1850) as well as individual very large diameter, structurally unique trees. DNR must notify the Board about any operations that will remove these trees (DNR 2006a, p. 34). According to DNR inventory information, there are approximately 88,000 acres of potential old growth on DNR-managed lands in western Washington, with 60 percent of those acres demonstrating a high potential to be old growth (DNR 2005a). The *Policy for Sustainable Forests* and the department's old-growth timber harvest deferral and protection (west-side) procedure[15] summarizes DNR's management approach to old growth.

GENETIC RESOURCES

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

NATURAL AREAS

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

Natural areas are managed primarily for the protection of important biological or ecological resources, including plant communities that are in good to excellent ecological condition and some mature forests. Research, environmental education, and low-impact recreation activities also occur on these lands. Natural areas are protected under state law from conversion to non-conservation uses. A summary of the status and management of these lands can be found in the State Trust Lands HCP 2018 Annual Report (DNR 2019b).

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

The *Policy for Sustainable Forests* states that DNR will identify forested state trust lands with "special ecological features" of regional or statewide significance. This task is informed by the *State of Washington Natural Heritage Plan* (DNR 2007b, updated in 2018), which identifies and prioritizes plant species and ecosystems for conservation. Rare plants and high-quality ecosystems are priorities for inclusion as natural areas. DNR's Natural Heritage Program maintains a comprehensive database on rare plant species and communities and their locations. The database of known locations is consulted by DNR's regional foresters when planning timber sales activities, with the intent of avoiding impacts to special ecological features. As listed in Appendix H, 50 species of rare plants are currently known to occur on forested DNR-managed state lands in western Washington.

[15] DNR PR 14-004-045.

PLANTS ASSOCIATED WITH UNCOMMON HABITATS

DNR's conservation strategies in the 1997 HCP provide measures to protect wildlife species that rely on uncommon habitats or uncommon habitat elements. These measures specifically protect features such as talus, caves, cliffs, balds, oak woodlands, large snags, and large, structurally unique trees. These uncommon wildlife habitats provide conditions for different types of vegetation and, in some cases, unique vegetation. Oak woodlands composed of the only native oak in Washington, the Oregon white oak, have been designated a priority habitat by the Washington Department of Fish and Wildlife. Talus and cliffs can provide conditions for pioneering vegetation while cliffs provide conditions for shade-tolerant vegetation. DNR's regional foresters consult with staff biologists when planning timber sales activities with the intent of conserving these features.

■ Existing Policies and Regulations

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

3.4 Aquatic Resources

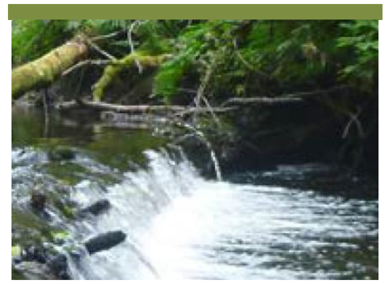
This section describes the existing conditions of riparian habitat, wetlands, rivers and streams, water quality and quantity, and fish populations and habitat, collectively referred to as *aquatic resources*.

DNR sometimes considers these elements of the environment individually when reviewing proposed actions. This FEIS considers these elements collectively because they would all be affected by the alternatives in similar ways, by similar means, and to similar degrees.

■ Why Are Aquatic Resources Important?

Aquatic resources provide a valuable suite of functions and ecosystem services that improve water quality and provide fish and wildlife habitat. DNR's management philosophies are based largely on the underlying approach that maintaining the hydrologic functions of wetlands and riparian areas is essential to maintaining the health and function of forest ecosystems on state trust lands (DNR 2006a, p. 36–38).

Text Box 3.4.1



What Is Riparian Habitat?

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

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

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

■ Current Conditions

Riparian Habitat and Wetlands

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

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

Waters

RIVERS AND STREAMS

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

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

WATER QUALITY

Washington Department of Ecology's Water Quality Assessment lists the water quality conditions for water bodies in the state, as required under Sections 303(d) of the Clean Water Act (Washington Department of Ecology 2019). Not all streams have been assessed for this list, and forest streams are generally not a priority for 303(d) listing due to the regulatory framework in place to protect water quality in working forests. Only localized areas of non-compliance (or inconsistent compliance) with water quality standards are listed for state trust lands. For example in the OESF, out of nearly 3,000 miles of streams on state trust lands, only 10 miles are on the 303(d) list for failure to consistently meet the criteria for stream temperature, dissolved oxygen, turbidity, or fecal coliform bacteria (DNR 2016a).

WATER QUANTITY

Timber harvest and associated roads can increase stormwater runoff that is delivered to rivers, streams, and wetlands. Peak flows are of greatest concern; these have historically occurred within the analysis areas primarily during late fall through early spring (October through March)[19] when Pacific storms deliver large amounts of precipitation to the region. DNR minimizes the effects of peak flows through watershed-level planning and operating procedures. DNR ensures that sufficient amounts of hydrologically mature forest is maintained in each watershed to prevent detectable increases in peak flows that could impact water quality. Detectable increases are defined as a 10 percent or greater increase in peak flows. Currently, 162 out of 213 basins managed for hydrologic maturity have more than the required amount of hydrologically mature forest as defined by the 1997 HCP. Harvests in the basins

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

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

Fish

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

Operations

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

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

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

■ Existing Policies and Regulations

Forest Practices Rules

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

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

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

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

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

Text Box 3.4.2

How Are Aquatic Resources Managed?

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

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

Riparian Conservation Strategies

For state trust lands, riparian conservation is implemented through two riparian conservation strategies in the 1997 HCP. One strategy applies specifically to the OESF HCP Planning Unit, and another applies to the five remaining west-side HCP planning units ("west-side strategy").

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

DNR Procedures

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

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

[21] The northern spotted owl conservation strategy in the HCP applies to certain lands in eastern Washington as well.
[22] WAC 222-16-080(6)(i) (Exempting forest practices consistent with HCP from Class IV-Special classification); WAC 222-12-041(3)(a) (Use of HCPs for aquatic resources).

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

3.5 Wildlife and Biodiversity

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

■ Why Is Wildlife and Biodiversity Important?

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

The conservation of wildlife species and their habitats is an important policy objective (DNR 2006a, p 35). This section describes the current species and overall wildlife biodiversity within the analysis area. Special emphasis is given to a discussion of northern spotted owls (*Strix occidentalis caurina*).

■ Current Conditions

Wildlife Habitat

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

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

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

Wildlife Species

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

WILDLIFE GUILDS

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

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

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

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

FEDERALLY LISTED SPECIES IN THE ANALYSIS AREA

Several federally listed terrestrial species are found in forested habitats or openings within forested areas in the analysis area. The species in Table 3.5.1 occur, or may occur, on 1997 HCP-covered lands within the analysis area. (Fish species are discussed in Section 3.4, Aquatic Resources.) The 1997 HCP provides conservation for these species. These species are currently covered or likely to be covered under the 1997 HCP in the near future. The HCP implementation agreement (IA 25.1(b)) describes the process for adding coverage when species are listed.

Table 3.5.1. Terrestrial Wildlife in Western Washington Listed as Threatened or Endangered Under the Endangered Species Act

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

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

NORTHERN SPOTTED OWL

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

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

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

■ Existing Policies and Regulations

1997 HCP

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

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 2006a, p. 6).

The *Policy for Sustainable Forests* also defines DNR's general silvicultural strategy (DNR 2006a, p. 46), which is to use "biodiversity pathways" (refer to Text Box 3.5.1 and Chapter 7, Key Definitions) to increase wildlife habitat values through active forest management, including the following:

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

3.6 Marbled Murrelet

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