2020

Western Oregon State Forest Management Plan

Cover Photo: A Douglas-fir seedling on the Western Lane District, October 2018. Photo by Jason Cox, Public Affairs Specialist, Oregon Department of Forestry.

Western Oregon State Forests Management Plan

Oregon Department of Forestry

Draft Plan

December 2019

Stewardship in Forestry

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Acknowledgements

This plan has been developed through a team effort by many talented individuals from government agencies, organizations, and the general public. Through their hard work and expertise, these people have developed a plan that will guide the western Oregon state forests into the next century. I extend my sincere thanks and appreciation to all who participated in the planning process. Specifically, I wish to thank:

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Peter Daugherty
Oregon State Forester

Chapter 1 – Introduction

About Oregon State Forest Lands

Land Ownership and Governance

State forest lands consist of Board of Forestry lands and Common School Forest lands; two types of land that were acquired by the State of Oregon in different ways. They are owned by different state government entities. The Board of Forestry owns most state forest lands, while the State Land Board owns Common School Forest lands. Each land ownership has its own set of legal and policy mandates. This FMP applies only to Board of Forestry lands.

Areas and Districts

ODF divides responsibility for forest management into three administrative areas (Northwest, Eastern, and Southern Oregon Areas), each led by an Area Director. Each area is further divided into districts, each led by a District Forester. District boundaries overlap state forest boundaries. This FMP covers state forests in the Northwest Oregon Area and Southern Oregon Area, but not the Eastern Oregon Area.

Location

Most state forest lands (approximately 613,000 acres) are in 14 counties across western Oregon. The three largest blocks are the Tillamook, Clatsop, and Santiam State Forests. Smaller tracts are scattered throughout the planning area. The locations of these lands are shown on the vicinity map (Figure 1).

The Clatsop (Figure 2) and Tillamook (Figure 3 and Figure 4) State Forests are in the northern end of the Oregon Coast Range, roughly 25 miles northwest of Portland. The Pacific coast is a few miles to the west and the Columbia River is to the north and east. Local communities include Forest Grove to the east, Astoria to the northwest, and Tillamook to the west. Tillamook is the largest state forest, dedicated in 1973 and located on the Tillamook and Forest Grove Districts. Clatsop is the second largest state forest, created in 1937 and located on Astoria District.

The Santiam State Forest (Figure 5) is in the Cascade Range, roughly 25 miles southeast of Salem. Local communities include Mill City and Scotts Mills. Santiam is the third largest state forest, dedicated in 1974 and located on North Cascade District.

Smaller tracts of state forests are scattered throughout western Oregon. Many tracts are in the Coast Range between Newport and Corvallis (West Oregon District; Figure 6). There are additional tracts between Florence and Eugene in the Coast Range, scattered in a checkerboard pattern (Western Lane District; Figure 7). Some tracts are between Reedsport and Coos Bay (Figure 8) and others are between Riddle and Grants Pass (Figure 9).

Geo-regions

State forest lands in northwestern Oregon have two distinct biological areas differentiated by geology, climate, and ecosystems.

The Coast Range generally has steep, highly dissected slopes with narrow ridges. The underlying rock includes both sedimentary and volcanic rocks. Annual rainfall ranges from 45-100 inches or more. This area is dominated by forests of Douglas-fir, western hemlock, and western red cedar, with Sitka spruce in a narrow coastal strip. Red alder and big leaf maple are the most common hardwood species although less prevalent across the landscape than the coniferous species. Due to extensive wildfires and logging during the last century, there are few old growth forests.

The West Cascades have ridge crests at generally similar elevations, separated by steep, highly dissected valleys. The underlying rock is volcanic. Annual precipitation ranges from 45-80 inches, with some snow precipitation. This area is dominated by forests of Douglas-fir and western hemlock at low to mid-elevations and true fir at higher elevations and a smaller component of hardwoods such as red alder and big leaf maple.

State forest lands in Southwest Oregon lie in a region with a complex geological history and unique biodiversity. Three mountain ranges of different geological origins converge in southwest Oregon: the Oregon Coast Range, the Cascades, and the Siskiyou (Klamath) Mountains. The 3,500-4,000 feet high Umpqua Mountains form the Rogue and Umpqua River divide and stretch from the Coast Range to the Cascades, breaking southwest Oregon into the two major river systems. The climate is drier and more extreme than northwest Oregon. Summer high temperatures are coupled with low humidity typical of a Mediterranean climate. Fire is the major natural disturbance. This area is dominated by conifers, especially Douglas-fir, along with a variety of hardwoods.

Figure 1. Map of all Board of Forestry lands in Oregon managed by the State Forests Division. Note: this plan does not address the management of the lands in the Klamath Lake District.

Astoria District

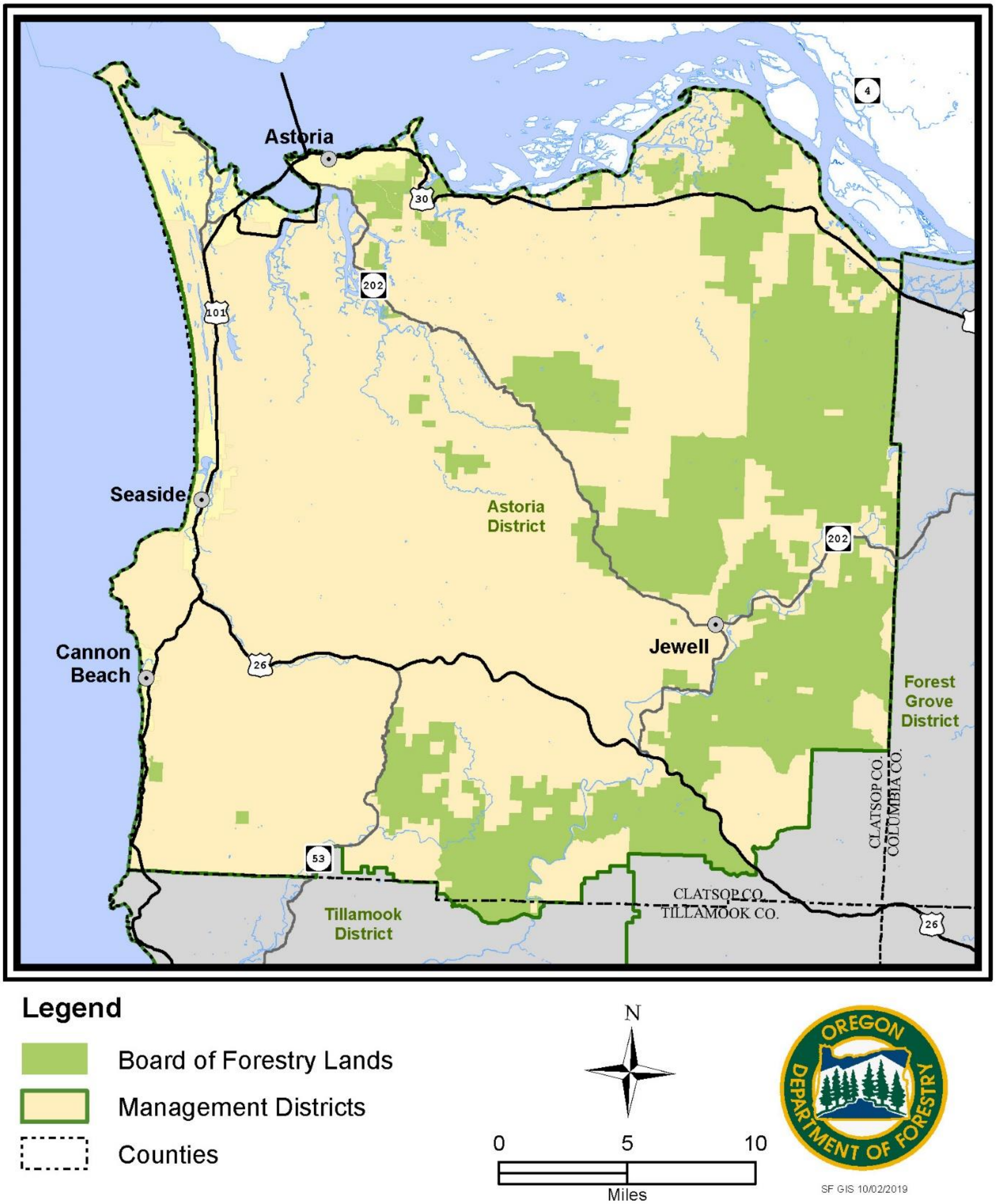

Figure 2. Map of the Astoria District Board of Forestry lands. These forest lands are also known as the Clatsop State Forest.

Tillamook District

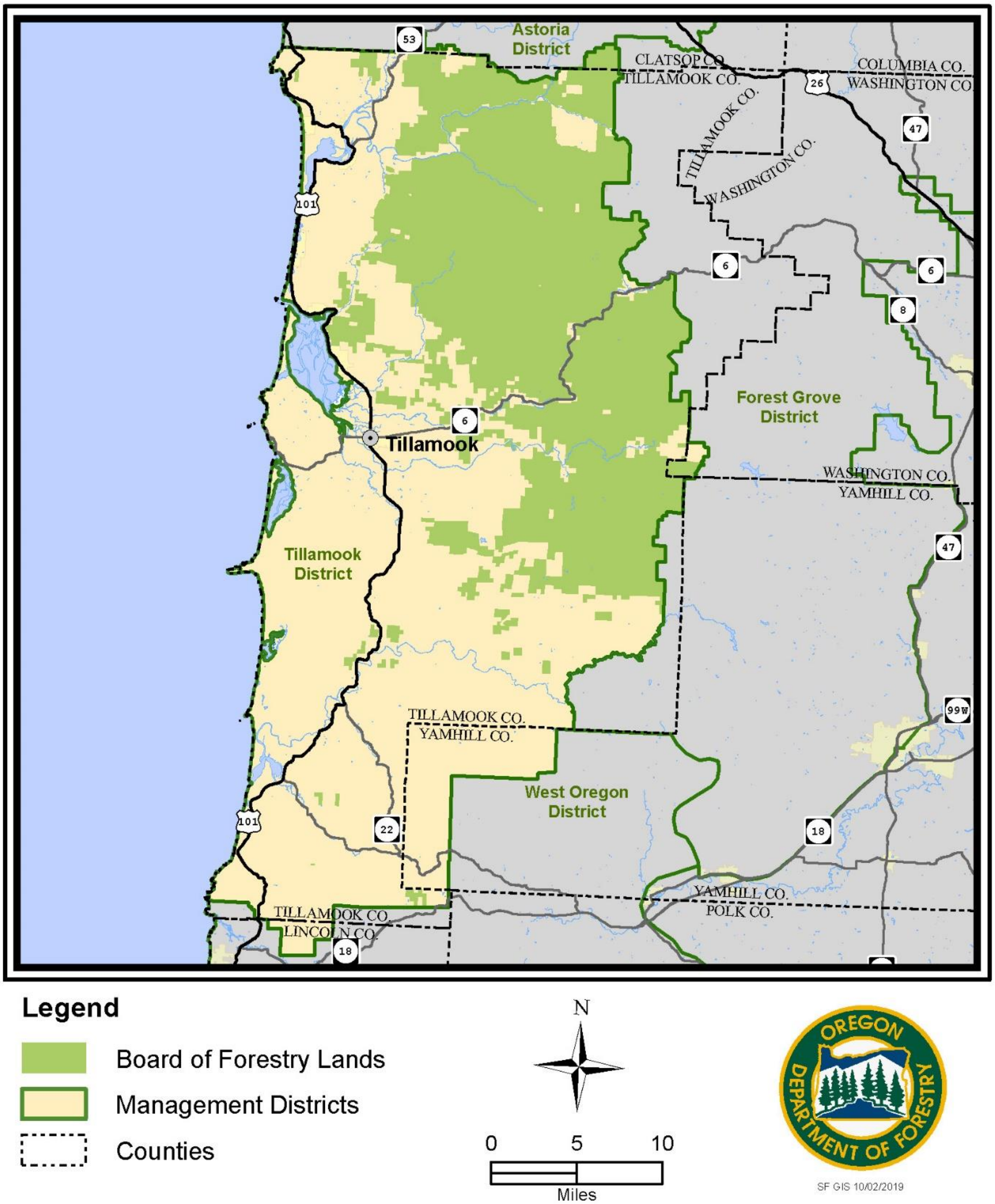

Figure 3. Map of the Tillamook District Board of Forestry lands. These forest lands, along with the Forest Grove District, comprise the Tillamook State Forest.

Forest Grove District

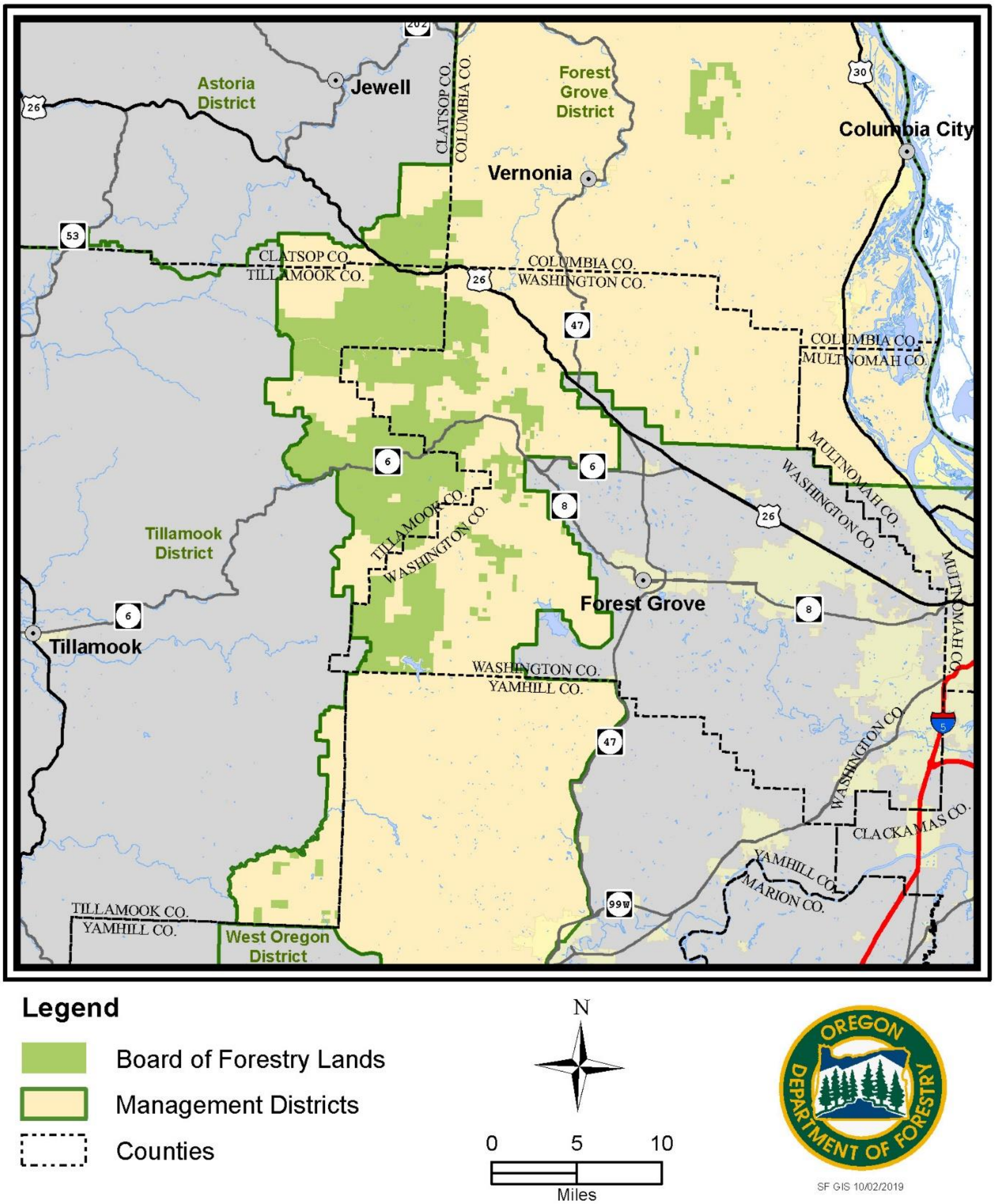

Figure 4. Map of the Forest Grove District Board of Forestry lands. These forest lands, along with the Tillamook District, comprise the Tillamook State Forest.

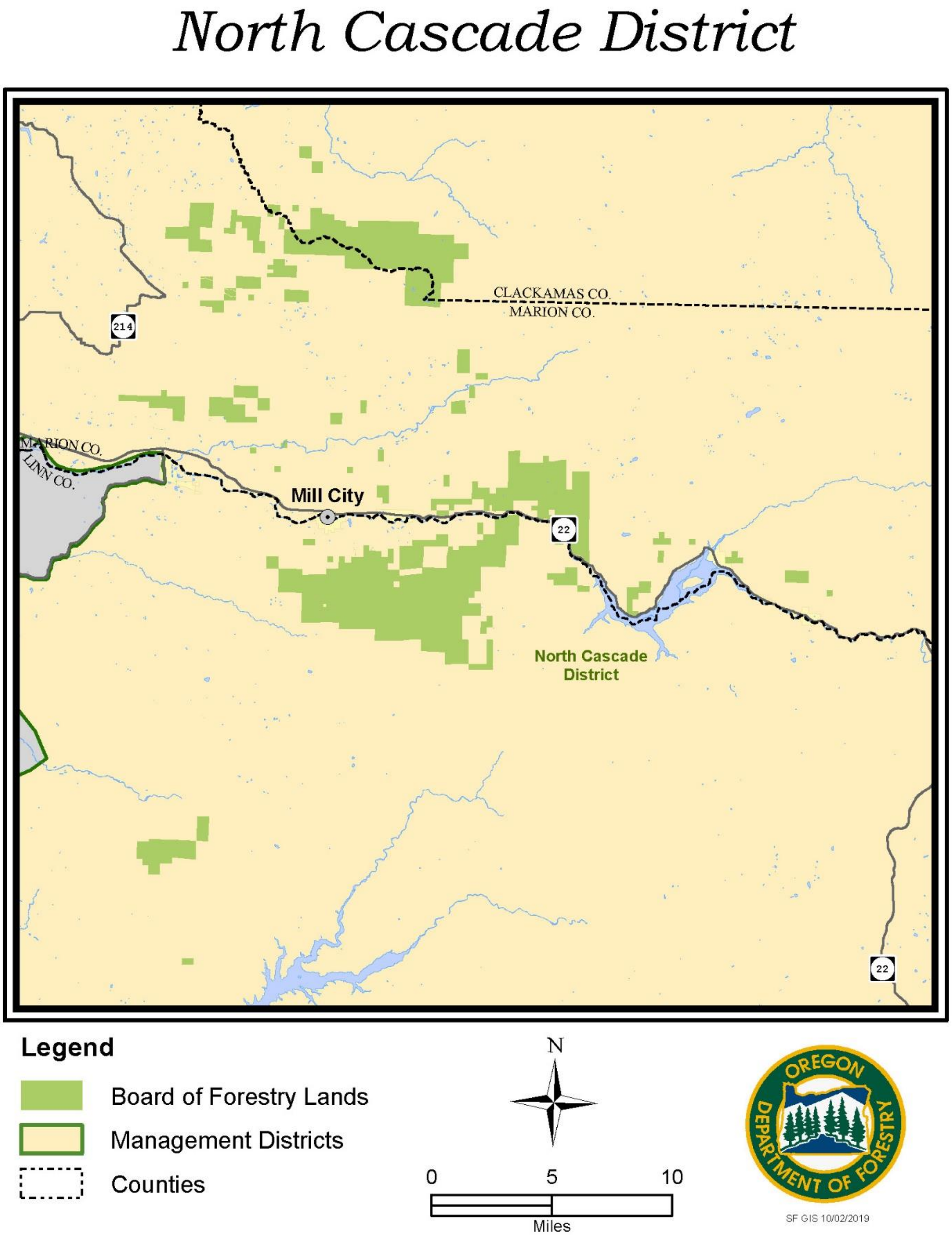

Figure 5. Map of the North Cascade District Board of Forestry lands. These forest lands are also known as the Santiam State Forest.

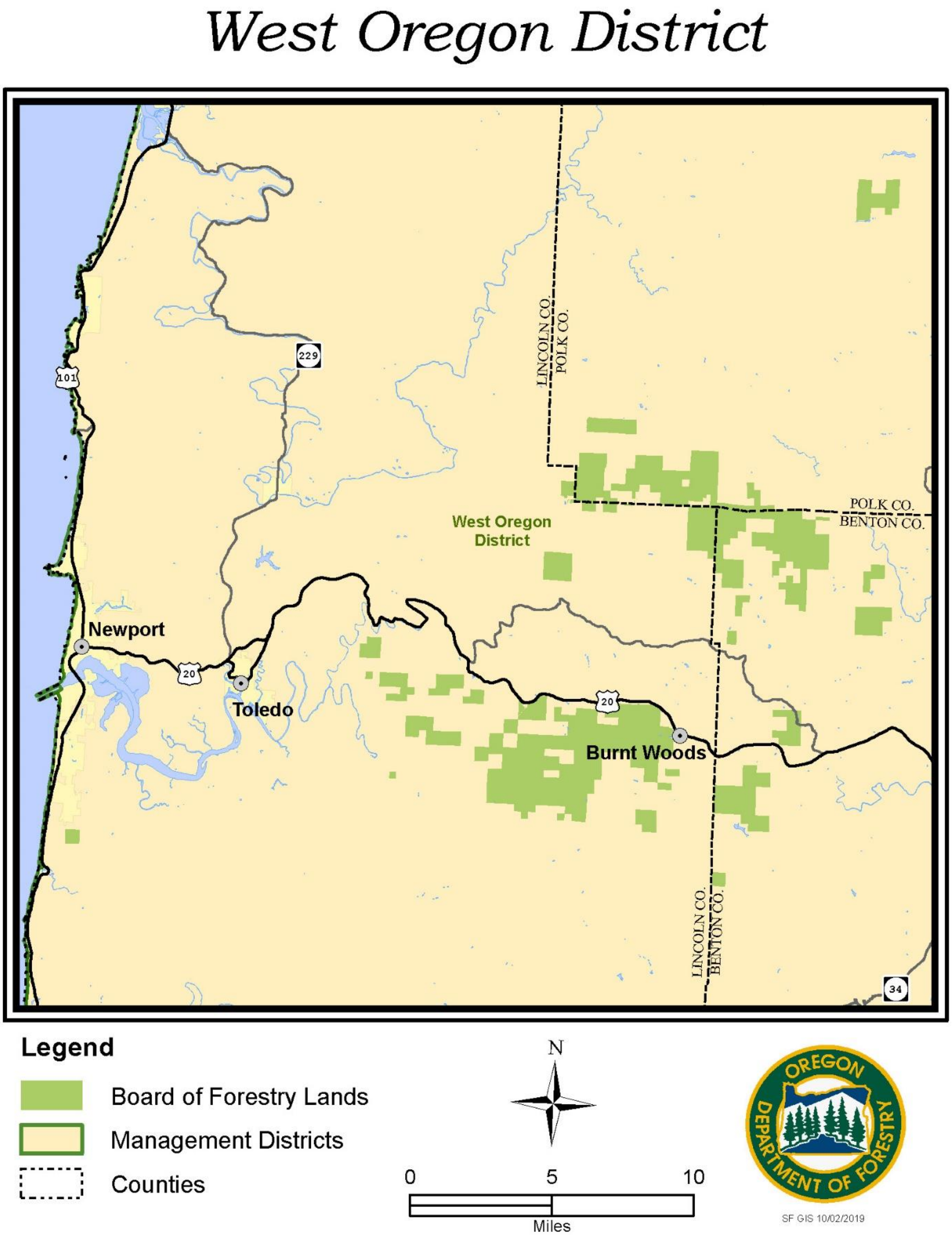

Figure 6. Map of the West Oregon District Board of Forestry lands.

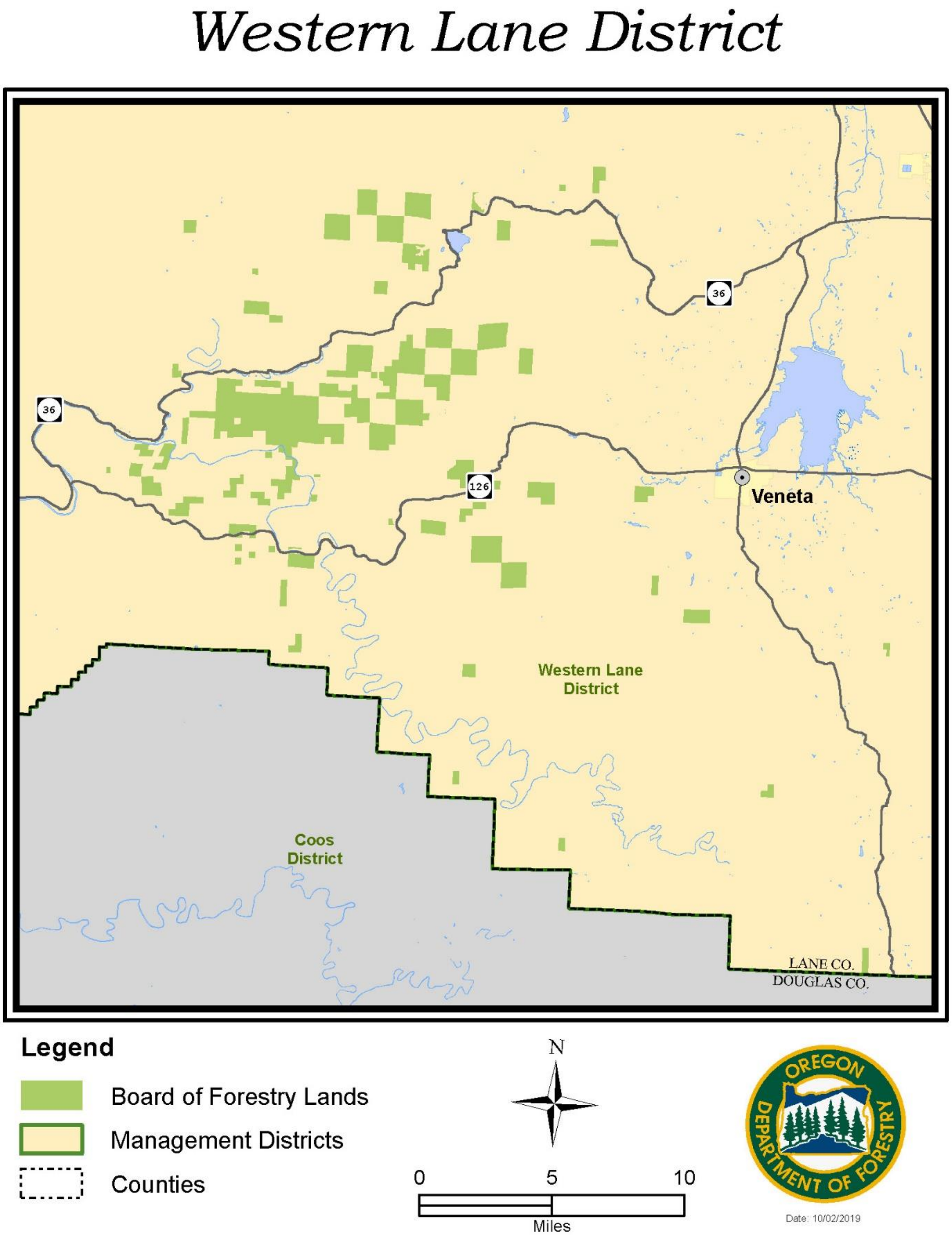

Figure 7. Map of the Western Lane District Board of Forestry lands.

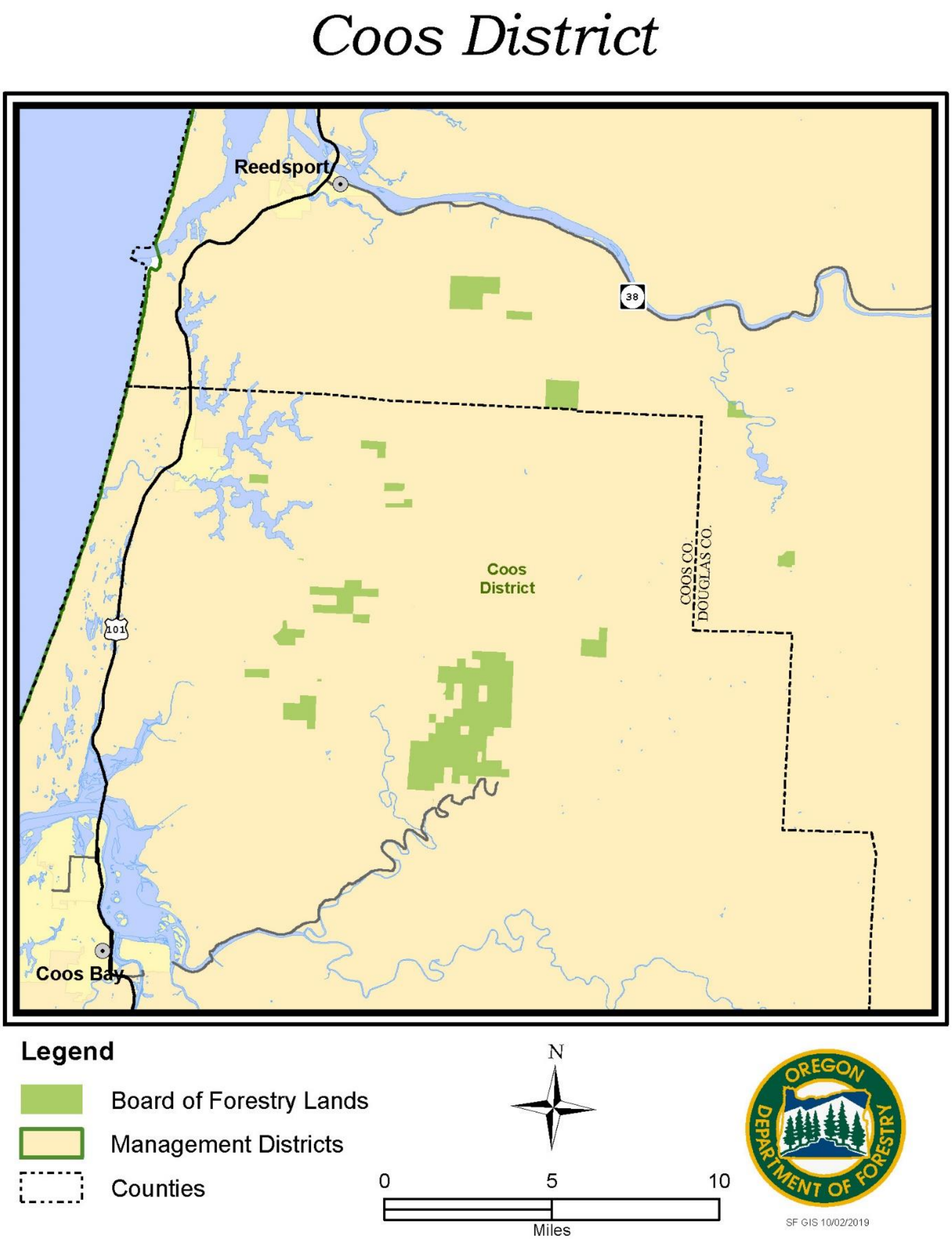

Figure 8. Map of the Coos District Board of Forestry lands.

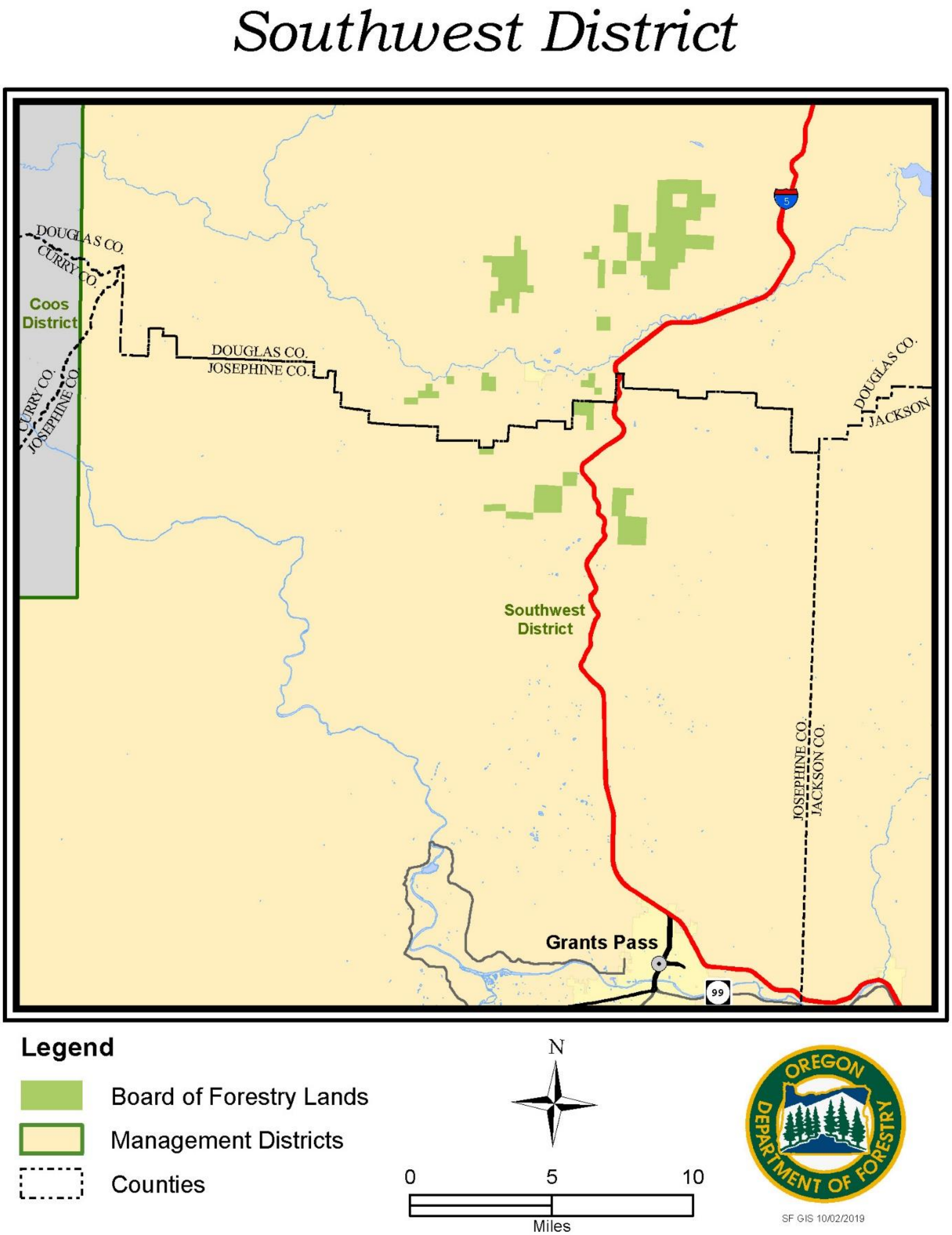

Figure 9. Map of the Southwest District Board of Forestry lands.

The Origin and Development of State Forests

Prior to BOF ownership, most state forest lands had been owned and managed by private landowners. Most lands deeded to the state had been burned (possibly re-burned), cutover, salvage-logged, and roaded without modern best management practices. Tax-delinquent and abandoned lands reverted to county ownership and then were deeded to the state.

Table 1. Acquisition, management, and fire history of Board of Forestry lands.

District	Acres Owned by BOF	History	Acquisition
Astoria (Clatsop State Forest)	134,837	1910 and 1940: privately owned, logged	1936 – 1964: Clatsop County deeded lands to BOF
Forest Grove and Tillamook (Tillamook State Forest)	359,817	1933, 1939, 1945, and 1951: burned, salvage logged, extensively roaded 1948: State bond issued to fund unprecedented massive reforestation that continued on through 1970s	1942 – 1973: Columbia County deeded lands to the BOF 1939 – 1964: Washington County deeded lands to BOF 1940s – 1970: Tillamook County deeded lands to BOF
North Cascade (Santiam State Forest)	46,586	1880 through 1930s: Logged and fires had burned large areas	1939 – 1953: Linn, Marion, and Clackamas Counties deeded lands to BOF
West Oregon	29,903	Great Depression	1938 – 1948: Benton, Lincoln, and Polk Counties deeded lands to BOF
Western Lane	24,324	1910, 1917, 1922, 1929: large fires and salvage logging	1940s – 1950s: Lane County deeded lands to BOF
Western Lane District: Coos Unit	8,898	1868: Burnt and largely cut over	1930s – 1940s: Douglas and Coos Counties deeded lands to BOF
Western Lane District: Southwest Unit	9,350	Historic fire ecology: low intensity high frequency burns. Effective fire suppression shifted fire behavior resulting in today's high intensity burns	1930s – 1940s: Josephine and Douglas Counties deeded lands to BOF

Beginning in the 1920s, the state sought to ensure forest land management by responsible stewards who would restore, reforest, and manage over the long-term for forest crops, recreation, watershed protection, erosion control, and other uses. In the 1940s, the multiple use management mandate "to secure the greatest permanent value of these lands to the state" was codified in Oregon law. Over time, other property was acquired through land exchanges, direct donations, or purchases that consolidated ownership (Table 1).

Tillamook State Forest (TSF)

The fire and reforestation history of the TSF provides a particularly good example of how fire shaped state forests. Much of the area that is now TSF burned in a series of wildfires. The first and most significant Tillamook Fire burned 240,000 acres of mostly old growth forest in August 1933. In what seemed to be a six-year jinx, fires burned the area in 1939, 1945, and 1951. Some areas reburned two or three times. By the end of 1945, 355,000 acres had burned and 13.1 billion board feet of timber had been destroyed. Salvage logging started after the 1933 fire and accelerated to meet the lumber demands of World War II. By 1948, 4 billion board feet of dead timber had been salvaged. An additional 3.5 billion board feet of timber was salvaged from 1949-1955.

Following the fires and subsequent salvage operations, the Tillamook Burn was heavily roaded with steep slopes covered in snags and brush. In several places, the soil was so severely burned that nothing grew for years. Many streams and fisheries were likely severely affected by the loss of forest cover and erosion.

Before 1933, almost all of the land that became the Tillamook Burn was privately owned. After the fires, many landowners stopped paying taxes and the properties were foreclosed and transferred to the counties. The counties began to deed these burned-over, salvage-logged, low-value lands to the BOF in 1940 and about 255,000 acres eventually came under state ownership.

In 1948, Oregonians approved a bond to finance rehabilitation of the Tillamook Burn. ODF carried out an unprecedented massive rehabilitation project from 1948-1973. Tree-planting crews planted 72 million Douglas-fir seedlings and 36 tons of Douglas-fir seeds were spread through aerial seeding, pioneering the first use of helicopters in aerial seeding. In June 1973, Governor McCall dedicated the former Tillamook Burn as the new TSF. The forest includes 255,000 acres from the Tillamook Burn and other unburned forest lands (ODF 1993b).

As a result of the severity and extent of the Tillamook Burn and the many challenges associated with the conifer reseeding effort, red alder rapidly colonized vast areas. Approximately 65,000 acres are still dominated by red alder and approximately 50,000 acres are past the age of 50, approaching the age in which the species begins to suffer crown loss and mortality. This is the largest area of red alder stands and presents unique management challenges if it is to be converted to a productive resilient conifer forest.

In recent decades Swiss needle cast (SNC), a native foliage disease, has increasingly affected Douglas-fir stands near the coast. The causes are not well understood, but one possible reason is that the Tillamook Burn was reforested with Douglas-fir from areas poorly adapted to coastal conditions. SNC has stagnated tree growth across the landscape, decreasing both timber and wildlife value.

Clatsop State Forest

The Clatsop State Forest is 98% Board of Forestry lands. These lands were privately owned, logged between 1910 and 1940, and then became tax-delinquent. Many landowners went broke and lost their land during the Great Depression. Clatsop and Columbia Counties foreclosed when landowners didn’t pay their taxes and ownership reverted to the county. Many landowners went bankrupt and lost their land during the Great Depression. Eventually, the counties deeded these cutover and unmanaged forest lands to the Board of Forestry to manage as a state forest. According to the agreement, the Department of Forestry would replant the lands, protect them from fire, and manage the new forest. Then, as timber was harvested, the counties would receive two-thirds of the net revenue. The remaining 2% of the Clatsop State Forest is Common School Fund land.

Today, Clatsop State Forest has mostly second growth Douglas-fir, from 30-70 years old. The forest has been progressively consolidated through a land exchange program that began in the mid-1940s.

Santiam State Forest

Much of the land now in the Santiam State Forest used to be owned by large timber companies, who typically owned railroad interests also. Some individuals and families also owned forest land. From about 1880 until 1930 most lands were logged. These lands were of little value to the owners once the timber was removed. Forest fires burned large areas. During the Great Depression, many landowners allowed their forest lands to be foreclosed by the county in place of back taxes. Marion, Clackamas, and Linn Counties suddenly owned thousands of acres of timberland.

The counties eventually deeded these lands to the Board of Forestry. Santiam State Forest land in Linn County was acquired by the Board of Forestry between 1939 and 1949. Marion County lands were acquired between 1940 and 1953 and Clackamas County lands between 1942 and 1950. Some land was also acquired from individuals through both charitable donations and purchases between 1943 and 1952.

Natural regeneration successfully reforested most of the Santiam State Forest. However, a fire in 1951 burned nearly half the forest. The Department of Forestry replanted the most damaged areas. In the early 1950s, the Department of Forestry's management activities were conducted by foresters working out of the Salem offices. In 1968 the current office was built in Mehama. The Santiam State Forest was dedicated in 1974.

Purpose and Scope

The Western Oregon State Forests Management Plan (FMP) provides management direction for all Board of Forestry Lands (BOFL) west of the crest of the Cascade Range. Common School Forest Lands are not managed according to the direction provided by this FMP. This plan supersedes and replaces the 2010 Northwest Oregon State Forests Management Plan, the 2010 Southwest Oregon State Forest Management Plan, and the 2011 Elliott State Forest Management Plan. This plan remains in effect until it is replaced by a new FMP. The Board of Forestry (BOF) is required to review the FMP no less frequently than every ten years (OAR 629-035-0030). The FMP includes a description of each forest resource and information about current management programs for these resources.

Taking a comprehensive, multi-resource approach to forest management, the resource management goals and strategies are intended to achieve a proper balance among multiple forest resources and achieve the greatest permanent value (GPV) to the state through a system of integrated management.

The lands covered by this management plan include both large blocks and isolated tracts of state forests. The large blocks include the Tillamook State Forest, Clatsop State Forest, and Santiam State Forest. The smaller, isolated tracts are not named and are referenced as “scattered state forest lands.”

The Long-Range Forest Management Plan

The FMP presents goals and strategies and provides direction for a broad, integrated resource approach to managing state forests. The FMP advances a specific set of strategies designed to integrate the management of key resources (e.g. timber, fish and wildlife, recreation, and forest health) and informs operational policies and implementation standards that will be evaluated and improved through adaptive management. The FMP assumes that integrated forest management requires resource trade-offs to achieve multiple benefits.

FMP goals and strategies are guided by multiple legal and policy mandates and information sources:

- Statutory and administrative rules for management of BOFL
- Oregon Supreme Court rulings
- Advice from Oregon’s Attorney General
- Policies of the Board of Forestry and the State Forester
- Agency obligations under the state and federal Endangered Species Acts (ESAs) and Clean Water Act
- Guiding principles for the *Western Oregon State Forests Management Plan*
- Resource assessments and available resource data
- The most current scientific information available
- Consultation with the Forest Trust Lands Advisory Committee (required by statute)
- Consultation with the State Forests Advisory Committee
- Advice and recommendation from other state and federal natural resource agencies
- Input from comprehensive public involvement in the planning process

The statutory mandate for forest planning (ORS 526.255) requires the State Forester to report to the Governor and legislative committees on "long-range management plans based on current resource descriptions and technical assumptions, including sustained yield calculations for the purpose of maintaining economic stability in each management region." In 1998, the BOF adopted the Forest Management Planning rule (OAR 629-035-0030), which provides further direction for State Forests management:

> "In managing forest lands as provided in OAR 629-035-0020, the State Forester shall develop Forest Management Plans, based on the best available science, that establish the general management framework for the planning area of forest land. The Board may review, modify, or terminate a plan at any time; however, the Board shall review the plans no less than every ten years. The State Forester shall develop implementation and operations plans for forest management plans that describe smaller-scale, more specific management activities within the planning area."

The planning rule also requires the following elements to be included in the FMP:

- Guiding principles — These principles include legal mandates and Board of Forestry policies. Taken together, these principles shall guide development of the management plan.
- Resource descriptions — Resources on both state forests and surrounding land are considered to provide a landscape context.
- Forest resource management goals — The goals are statements of what the State Forester believes is desirable to achieve for each forest resource within the planning area, consistent with OAR 629-035-0020.
- Management strategies — These strategies describe how the State Forester will manage the forest resources and identify management techniques the State Forester may use to achieve the plan's goals.
- Asset management guidelines — States general guidelines for asset management, which provide overall direction on investments, marketing, and expenses.
- Implementation, monitoring, research, and adaptive management guidelines — Provides general guidelines for these items.
- Measurable outcome[1] – Measurable outcomes are the quantifiable results of strategies that can be used to assess progress towards achieving goals and evaluate alternatives and trade-offs. They form the basis for adaptive management because they can be used to monitor resource status and trends that are responsive to strategies and management standards. A measurable outcome may apply to multiple strategies.

The administrative rules also specify that the following stewardship principles shall guide the State Forester in developing and implementing FMPs:

- FMPs shall include strategies that provide for actively managing forest land in the planning area.
- FMPs shall include strategies that:
  - Contribute to biological diversity of forest stand types and structures at the landscape level and over time A) through application of silvicultural techniques that provide a variety of forest

[1] The Planning Rule does not require measurable outcomes.

conditions and resources and B) through conserving and maintaining genetic diversity of forest tree species.

- Manage forest conditions to result in a high probability of maintaining and restoring properly functioning aquatic habitats for salmonids and other native fish and aquatic life. As well as protecting, maintaining, and enhancing native wildlife habitats, recognizing that forests are dynamic and that the quantity and quality of habitats for species will change geographically over time.
- Provide for healthy forests by A) managing forest insects and diseases through an integrated pest management approach and B) utilizing appropriate genetic sources of forest tree seed and tree species in regeneration programs.
- Maintain or enhance long-term forest soil productivity.
- Comply with all applicable provisions of ORS 496.171 to 496.192 and 16 USC § 1531 to 1543 (1982 & supp. 1997) concerning state and federally listed threatened and endangered species.

- FMPs shall include strategies that maintain and enhance forest productivity by:
  - Producing sustainable levels of timber consistent with protecting, maintaining, and enhancing other forest resources.
  - Applying management practices to enhance timber yield and value, while contributing to the development of a diversity of habitats for maintaining salmonids and other native fish and wildlife species.
- FMPs shall include strategies that use the best scientific information available to guide forest resource management actions and decisions by:
  - Using monitoring and research to generate and apply new information as it becomes available.
  - Employing an adaptive management approach to ensure that the best available knowledge is acquired and used efficiently and effectively in forest resource management programs.

Planning

Management planning includes three planning levels, as well as fiscal and biennial budgeting. Planning begins with broad-scale, long-range planning (Figure 10). Intermediate level planning is conducted by ODF administrative/field districts and is documented in Implementation Plans (IPs). Operations Plans (OPs) and budgets (biennial and fiscal) support IP objectives over the short-term (i.e. one to two years).

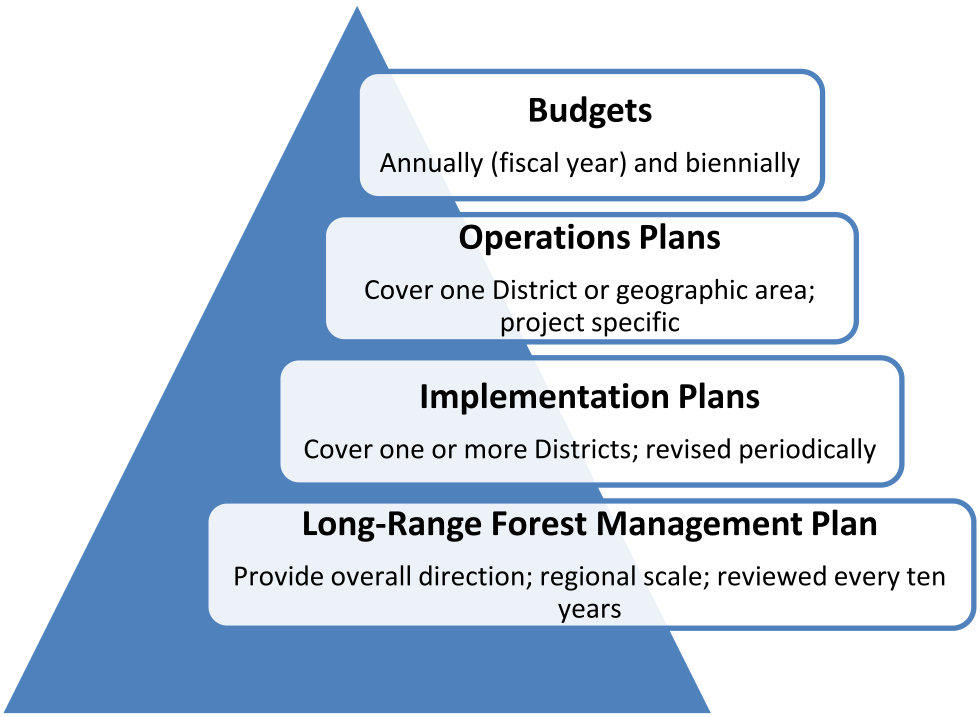

Figure 10. Planning levels used for State Forests management.

Implementation Planning

The FMP provides management direction and establishes strategic approaches for meeting resource management goals (Figure 11). Operational policies provide detailed standards to guide the development of the Implementation Plans. Implementation Plans (IPs) are developed to detail how management strategies that are outlined in the FMP will be applied for smaller management units (e.g. district geographic area). IPs describe forest management activities for a predetermined period and will be revised either at the end of the period, or sooner if circumstances warrant.

Operations Planning

Operations planning is the most detailed level of planning. An Operations Plan is prepared for each district, or geographic area, that shows the location and nature of management activities that are proposed for a given fiscal year.

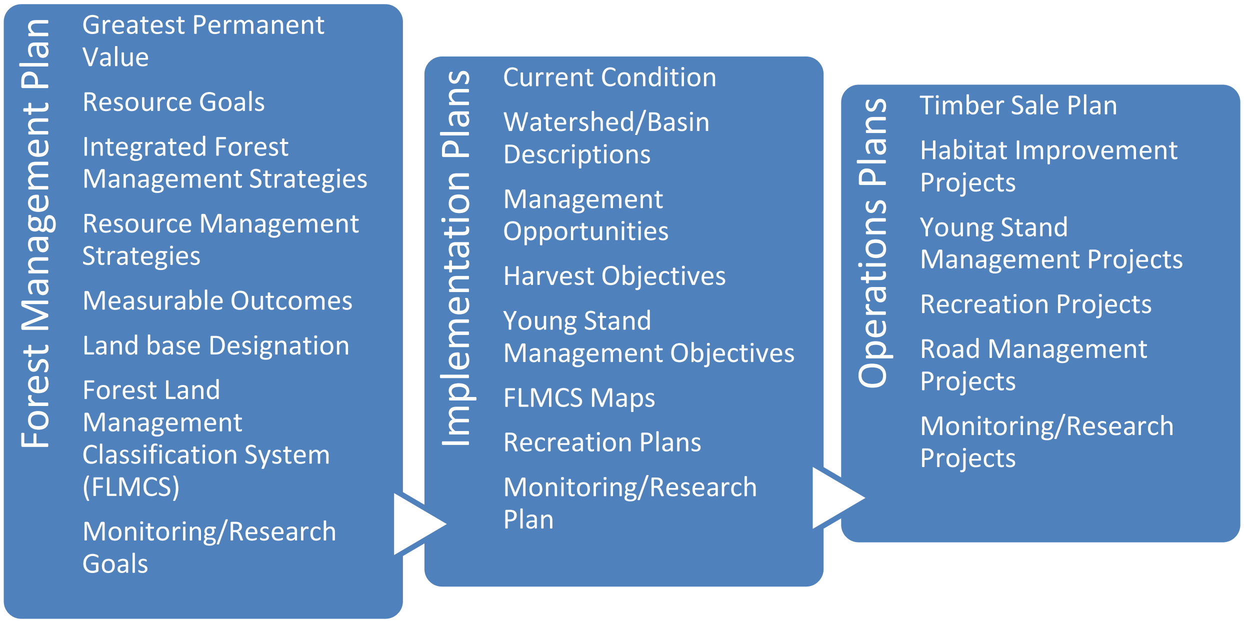

Figure 11. State Forests plans and policies: planning hierarchy and key products.

Budgeting

Budgeting is accomplished at two levels: biennial (two-year) and annual. Biennial budgets are prepared every two years and submitted to the Oregon Legislature through the Governor's Office for legislative approval. Biennial budgets provide spending authorization only and authorize the department to spend money for FMP Implementation. Fiscal budgets are used by ODF to manage State Forest Division income, so it is expended in alignment with the biennial budget and on priority projects.

Because the Division is almost wholly self-supporting, careful financial management is imperative. On Board of Forestry Lands (BOFL), 63.75% of the gross revenues is returned to the county and local taxing districts where the revenue was generated. The remaining 36.25% goes to a fund dedicated to forest land management (ORS 530.110).

Annual budgets may fluctuate with timber markets. Periodic revenue estimates are used to project the activities that can be supported in a given fiscal year within biennial budget authorization.

Financial management of the program is accomplished in two primary ways:

- Revenue and expenditure planning accomplished with revenue forecasts and biennial and fiscal budgets.
- Revenue and expenditure monitoring accomplished on both a fiscal and biennial basis.

The FMP and District IPs are the primary mechanisms for financial management planning since they identify the appropriate activities and service levels that accomplish the legal mandates for managing the lands. Through biennial budgeting, specific activities are translated into resources required to implement the FMP. Detailed annual operations are then reflected in the fiscal budgets. Biennial and fiscal budgets are prepared by staff in Salem, Area offices, Districts offices, Tillamook Forest Center, and the South Fork Camp.

Revenue forecasting is done periodically to ensure adequate revenues to support planned activities. Expenditures and accomplishments are monitored at district, area, and Division levels on a monthly and quarterly basis to ensure actual revenues and expenditures align with fiscal and biennial budgets.

All resources have been assessed for their revenue potential as part of FMP development. Timber remains the largest revenue source for the foreseeable future. Recreational fee revenues are expected to increase as facilities are upgraded or added. Alternative revenue sources continue to be examined but are currently not considered viable for planning purposes. Water resources, fish and wildlife habitats, and diverse recreational opportunities continue to produce revenue and income for local and regional communities.

Description of Forest Resources

Social Resources

Recreation, Education, and Interpretation

Demand for outdoor recreation, forest education, and interpretive opportunities in Oregon is increasing, and growing fastest near population centers (e.g. Portland metro, southwest Washington). Popularity of specific recreation activities changes over time due to changes in user demographics, technology, the economy and outdoor recreation trends.

Recreation, Education, and Interpretation (REI) are fundamental components of the legal mandates established in GPV. State forests comprise a significant percentage of public forest lands in northwest Oregon. In several counties, they are the largest ownership open to the public for recreational use. Most of these lands are less than a two-hour drive from a major urban area and most are near other recreation attractions (e.g. coastal beaches, Cascade Mountains). State forests positively impact local economies and provide diverse REI opportunities for both residents and visitors.

In support of REI on the Tillamook State Forest (TSF), the most popular State Forest for recreation, the Oregon Legislature passed House Bill 2501 (1991). This called on the Oregon Parks and Recreation Department (OPRD) and ODF to:

- Prepare a comprehensive recreation plan for the Tillamook State Forest.
- Interpret the forest's history.
- Provide for diverse outdoor recreation on the forest.

In response to this legislation, OPRD and ODF:

- Published the TSF Comprehensive Recreation Management Plan in January 1993 to provide direction for recreation management (ODF and OPRD, 1993).
- Finalized and published the TSF Interpretive Master Plan in March 1995 and began implementation in 1996.
- Established a network of opportunities across the forest to encourage learning about TSF history and current management starting in 1998.
- Began a ten-year fundraising effort that resulted in the award-winning Tillamook Forest Center (TFC) opening in 2006. The TFC is a staffed visitor and interpretive center on the Wilson River Highway between Forest Grove and Tillamook.

Oregon state forests use educational and interpretive programs and volunteer projects to link the public to forest management. There is a widening gap between the public's direct contact with forests and the everyday use of forests and forest products. The goal of education, interpretation, and public involvement is to close that gap and improve understanding of resource issues by cultivating an awareness of how forest management balances demands on resources and how these resources are relevant in the lives of all Oregonians.

As participation in outdoor recreation grows, the positive economic impacts at the local and national level are evident. The Outdoor Industry Association reports that outdoor recreation's contributions are now counted as part of the United States gross domestic product. Communities adjacent to state forests benefit from the increased demand for products and services and provide additional services when forest recreation facilities are at capacity.

Current Condition

State forest recreation facilities fall into three categories (Table 2):

- Semi-primitive motorized
- Semi-primitive non-motorized
- Roaded natural setting (the most common)

The heaviest use of recreation facilities occurs in the Astoria, Forest Grove, and Tillamook Districts, with more limited opportunities in other districts. Developing and maintaining investments in infrastructure (e.g. interpretive centers, campgrounds, trails, trailheads, and other facilities) add to the GPV of the forest.

Motorized (Off-Highway Vehicle) Use

The Tillamook and Clatsop State Forests fill an important recreation niche by offering trails and gravel roads for off-highway vehicle (OHV) use in a region where these are otherwise lacking. OHV use is heaviest in the TSF, but lower levels of use occur throughout the region (e.g., Clatsop State Forest, Santiam State Forest, West Oregon District). Most OHV use occurs in cooler weather, especially spring and fall. Summer use is less popular because of dusty conditions and the availability of other riding areas open seasonally in the Cascades and eastern Oregon. OHV use during fire season may be curtailed due to public fire restrictions (i.e. Regulated Use).

Zoning has introduced designated OHV areas on state forest land based on historical use patterns and resource considerations. There are currently 461 miles of designated trails for motorcycles, quads, side-by-sides, and 4 wheel-drive vehicles on state forests. Even in areas not designated as OHV zones, forest road driving is a popular form of recreation. The OHV community is actively engaged in managing and maintaining the OHV trail system by informing and educating their peers and promoting positive trail use. There are several OHV staging and camping areas which allow OHV users to congregate.

Table 2. Recreation opportunity spectrum setting definitions.

Recreation Opportunity Spectrum Setting Definitions	
The U.S. Forest Service developed the Recreation Opportunity Spectrum (ROS) to use in recreation planning. It is now widely used by other land management agencies. ROS provides a framework for understanding and defining various settings of recreation environments, activities, and experiences. State forest facilities generally fall into one of the setting definitions given below.	
Setting	**Definition**
Semi-primitive motorized	The area is generally 2,500 acres to 5,000 acres in size and 1/2 mile from Level 3 or better roads. There is strong evidence of roads and motorized use of roads and trails. The natural setting may have moderately dominant alterations, but would not draw the attention of motorized observers. Structures are rare and isolated. The social setting provides for a low to moderate contact with other parties. On-site controls are present, but subtle. Interpretation is through limited on-site facilities along with the use of guide maps, brochures and guide books.
Semi-primitive non-motorized	The area is 1/2 mile from all roads or trails with motorized use and generally exceeds 5,000 acres in size. The area can include primitive roads and trails if they are usually closed to motorized use. The natural setting may have subtle modifications that would be noticed but would not draw the attention of an observer in the area. Structures are rare and isolated. The social setting provides for 6 to 15 parties encountered per day on trails and 6 or less parties visible at campsites. On-site controls are present but subtle. Interpretation is through self-discovery with some use of maps, brochures and guide books.
Roaded-natural	The area is 1/2 mile or less from roads and trails open to motorized use. Resource modifications and utilization practices are evident but are harmonious with the natural environment. The social setting provides for moderate to high frequency of contact on roads and low to moderate frequency on trails away from roads. On-site use controls are noticeable, but are harmonious with the natural environment.

Non-Motorized Trail Use

Non-motorized trail activities include hiking, horse riding, overnight backpacking, and free-ride and cross-country mountain biking. There are currently about 143.5 miles of multi-use non-motorized trails, as well as developed trailheads and equestrian staging facilities. Two free-ride mountain bike areas are popular with a segment of the mountain bike community. An interagency group, the Salmonberry Trail Intergovernmental Agency, has formed to convert a rail-banked railroad line into a recreation trail from Banks through the Salmonberry River corridor and ending at the Oregon Coast. This is a long-term project that includes public-private partnerships, multiple ownerships, and interagency collaboration.

Camping

State Forests have 22 developed campgrounds and designated campsite fee areas. Most campsites are available on a first-come first-served basis. Camping facilities fall into the roaded-natural setting, with low density and limited, rustic amenities. Dispersed free camping takes place throughout the forest, with several dispersed camping areas receiving concentrated use. Camping activities are most popular during late spring to early fall and many developed facilities are only open seasonally. Some developed campgrounds and designated campsites include facilities specifically designed and designated for OHV and equestrian use.

Day-Use Activities

State forests are popular destinations for day-use activities (e.g. swimming, sun-bathing, barbecuing, and picnicking), particularly in the summer. Day-use facilities provide parking, toilets, and, in some cases, picnic tables and cooking grills. These facilities are generally rustic and most coincide with major recreation attractions (e.g. rivers). There is one designated day-use building in the TSF (Smith Homestead) available by reservation for functions and events through the TFC. There are 30 developed facilities for day-use (e.g. trailheads, day-use areas, target shooting sites, demonstration forest).

Aquatic Activities

Forest rivers are a destination for trout, salmon, and steelhead fishing. ODF manages several primitive drift boat launches. Some boat launches are managed in partnership with Oregon Department of Fish and Wildlife (ODFW). The most popular fishing seasons are the fall Chinook, winter steelhead, and spring cutthroat trout seasons.

During the summer, rafting, swimming, and water play are popular. There is increasing dispersed day-use along rivers adjacent to highway corridors. Whitewater river recreation is small, but growing, and is most popular during high water in winter and spring. Lakes in the Santiam and Clatsop State Forests provide opportunities for swimming, angling and non-motorized boating.

Hunting

Hunting may be the longest-standing recreation activity in state forests, particularly with local users. Hunting occurs throughout the year. It is most popular in the fall deer and elk seasons, beginning with the opening of bow season in late August and extending through the end of November. Hunting is concentrated near timber harvests and big game forage areas. ODF works with ODFW and hunting organizations to better manage hunting access through the use of Travel Management Areas and selected road closures. This provides walk-in hunting experience and improves bull and buck escapement by reducing harassment from road hunting.

Target Shooting

Target shooting occurs year-round, most often in rock quarries, borrow pits, log landings, road cuts, and dispersed campsites. It is growing in popularity in areas near the Willamette Valley and Portland metro areas. It has been a mostly informal activity, but, as popularity increases in some districts, efforts are underway to monitor and manage for public safety, fire risk, and user conflicts. These efforts include the development of the North Fork Wolf Creek Road Target Shooting Lanes in the Forest Grove District.

Interpretive and Educational Programs

ODF has supported interpretive and education programs since the mid-1990s. The ODF interpretation flagship, the Tillamook Forest Center (TFC), was constructed in the TSF in 2006. It is a popular stopping off point between the valley and the coast on Highway 6 and is one of the region’s largest forest-based learning centers. The TFC provides a variety of interpretation and education opportunities, including interpretive displays, a movie theater showing an award-winning film about the Tillamook Burn, ADA-accessible trails, seasonal presentations, rotating exhibits, education programs for school groups, and facility rentals for functions and events. Other interpretive offerings on state forest lands include wayside signs and markers, self-guided nature trails, and educational brochures available at district offices.

District Information and Challenges

North Coast

The Tillamook, Forest Grove and Astoria Districts contain the majority of developed recreation facilities and trails. State forests are becoming urban forests that serve the recreation needs of an expanding populous. Recreation use is year-round with the heaviest use in the summer along highway corridors. Camping is popular for users transitioning from tents to trailers and motorhomes. Day-use and river activity surges in the summer, creating challenges for parking, fire risk, and sanitation. OHV activity is the primary trail use activity, but hiking, mountain biking and backpacking are increasing.

With high use and proximity to the urban areas, social issues from the city are migrating to the forest. Vehicle break-ins, incidents of fee theft, user conflicts, car accidents, injuries, illegal dumping (including household trash, cars, RVs, and boats) and the number of people attempting to use the forest as a domicile are increasing and straining limited staff and emergency service resources. Use levels far exceed facility and resource capacity in both developed facilities and dispersed areas. Funding and program staff capacity has not kept pace with the increase in use, recreation trends, and operations and maintenance needs.

Tillamook Forest Center (TFC)

The TFC is the ODF visitor center. It is an important public face, providing education and interpretive programs to help ensure ongoing public support to actively manage state forests. With increasing use in all aspects of outdoor recreation, the TFC is experiencing growing demand for services and programs. Use levels at the TFC, Smith Homestead Day-Use Area and the surrounding trails and public areas have rapidly increased (up 40% from July 2017 to July 2018). Both funding and staffing are challenged to meet demand for school programs, visitor services, maintenance, and volunteer recruitment and support, while also providing education and interpretation for a wide range of visitors. The new Forest Education Pavilion provides additional space for programs, facility rentals, and exhibits. Currently the TFC is open five days per week for nine months each year. Prior to 2017, the TFC was open seven days per week in June, July and August.

Santiam State Forest

The Santiam State Forest provides opportunities for a variety of outdoor recreation. Developed recreation includes campground and motorized and non-motorized trails. Recreational use in the Santiam continues to increase as local communities grow. The District is experiencing an increase in long-term camps and target shooting conflicts around nearby homes. Additionally, OHV use is increasing, but with limited developed trails, users create their own. The Santiam State Forest is challenged with mitigating user conflicts with limited recreation staff and funding.

West Oregon District

The West Oregon District has two developed recreation areas: Black Rock and Mt. Baber. Black Rock Free Riders started developing a trail system in the 1990s. The Black Rock Mountain Bike Association was organized in the mid-2000s and an adopt-a-trail agreement was developed with ODF. Use is active with daily riders, monthly trail maintenance work parties and two to four organized events per year.

The Mt. Baber ATV Club adopt-a-trail agreement went into effect in the 2000s, although riding in the area began in the 1960s. Most trails are on private ownership. The area is used primarily on weekends and once a month for organized events held outside of the marbled murrelet nesting season due to adjacency with trails.

Challenges include conflicts with adjacent private landowners, lack of dedicated funding and staffing for recreation, and competing uses.

Western Lane District, Coos Unit and Southwest District

These areas offer limited recreation opportunities. Ownership is mixed with private industrial and federal forests with few continuous blocks of ownership, limiting access to state lands.

Cultural Resources

Cultural resources are defined as archaeological and historical in nature. They may include objects, structures, buildings, districts, or sites used by people in the past and are valued for numerous reasons. Archaeological sites provide important information about past cultures. Many sites also have religious, historic, or associational values for American Indian communities. Historic sites have important interpretive, recreational, and heritage values, which are lost when artifacts and information are removed or destroyed. These resources are fragile and irreplaceable, especially objects still in their original locations. These undisturbed objects are vital in telling of the culture that created them, how long ago they were made, and what the landscape was like at the time. Cultural resources provide a meaningful record of past cultures, events, and ecological conditions in Oregon.

Western Oregon state forests have not been fully surveyed for cultural resources. However, the work so far has identified potential Native American sites and over 400 European-American sites.

Timber sales are prescreened with the help of an Oregon Department of Transportation (ODOT) archaeologist. This review ensures that ODF preserves and protects archaeological sites or objects in accordance with state law (ORS 97.740 to 97.760; 358.905 to 358.955; and 390.235) and conserves historic artifacts and real property of historic significance in accordance with state law, in consultation with the Secretary of State and the State Historic Preservation Office (ORS 358.640 and 358.653). ODF will also make a reasonable effort to cooperate with tribes in the development and implementation of programs that might affect tribes in accordance with state law (ORS 182.164).

Scenic Resources

The 2013-2017 Statewide Comprehensive Outdoor Recreation Plan (SCORP) found that sightseeing and driving for pleasure was the third most popular outdoor activity in Oregon, with 58% of Oregonians participating in that activity (OPRD 2012). Like many states, Oregon's population is aging (the growth rate of residents 65 or older exceeds the general population growth rate) and, because of this, sightseeing is becoming more important since it is a common activity for residents aged 42-80.

Northwest Oregon state forests are near Oregon's major cities and are crossed by several major highways. Thousands of people travel these highways on their way to the Oregon coast or to the Cascades and central Oregon. State forest lands are a major part of the view (e.g. Highways 6 and 26 in the Coast Range, river corridors, areas near campgrounds). Scenic value contributes to the quality of experience in other outdoor activities (e.g. sightseeing, camping, fishing).

In many places, state forest lands blend with the general forest landscape and are not generally recognized as state lands by sightseers. The Clatsop and Tillamook State Forests are exceptions, being the largest consolidated blocks of state forest land, and are the state lands most likely to dominate viewsheds and to be recognized as state forests by the public as they drive through the area. Signs have been installed along some roads to identify to the public when they are entering or leaving these forests.

Current Condition

Along major highways, the immediate visual foreground is protected either by scenic buffers owned by ODOT or by statute. Many highways in northwest Oregon are designated as scenic for the purpose of visual corridor management (ORS 527.755) and are adjacent to state forests in the districts indicated.

- Highway 6 — Forest Grove and Tillamook Districts
- Highway 20 — West Oregon District
- Highway 22 — North Cascade District
- Highway 26 — Forest Grove and Astoria Districts
- Highway 30 — Astoria District
- Highway 36 —Western Lane District
- Highway 101 — Tillamook and Astoria Districts
- Highway 126 — Western Lane District

Areas with visual sensitivity are categorized as having high, moderate, low or no visual sensitivity. The visually sensitive corridor is defined as the area within 150 feet (measured on the slope) of the outermost edge of both sides of the highway. Special rules apply to timber harvest in this corridor. ODF balances goals for retaining scenic buffers while maintaining motorist safety. Lands with visual sensitivity include:

- Lands with established, high public use vistas, viewpoints, or significant natural features
- Lands immediately adjacent to campgrounds
- Lands highly visible from urban centers

State Scenic Waterways Program

There are two designated state scenic waterways on state forest lands in the planning area: the Nestucca River Scenic Waterway in the Forest Grove and Tillamook Districts and the Nehalem River Scenic Waterway in the Astoria and Tillamook Districts.

Administrative rules that apply to all scenic waterways are found in OAR 736-040-0025 (Public Use of Scenic Waterways), OAR 736-040-0030 (Improvements and Changes in Use of Related Adjacent Lands) and OAR 736-040-0035 (Rules of Land Management).

Administrative rules for the Nestucca Scenic Waterway are found in OAR 736-040-0041. State forest lands within this scenic waterway extend from the river's confluence with Ginger Creek downstream to the lower end of Alder Glen Campground. Timber harvest is permitted by OPRD only when it is substantially screened from view from the river by topography or existing vegetation. Projects may be permitted if vegetation is established that substantially screen the project in a reasonable time (e.g. four to five years). Developments necessary for public outdoor recreation and resource protection or enhancement may be visible from the river, but must blend into the natural scene.

Administrative rules for the Nehalem Scenic Waterway are found in OAR 736-040-0120. This scenic waterway is a 17.5 mile stretch that flows predominately through state forest lands, beginning at Henry Rierson Spruce run campground to the confluence with Cook Creek.

Economic Resources

Forest Condition

Based on 2018 forest inventory estimates, the total standing volume for the planning area is approximately 17 billion merchantable board feet[2]. There are constraints on much of that volume due to a variety of factors, including:

- Physical limitations related to logging systems and road building
- Regulatory protections stemming from the Oregon Forest Practices Act (FPA) and the Federal Endangered Species Act (ESA)
- Current Internal State Forest Division policies

As of 2019, approximately 8 billion board feet are not constrained by these factors. Per-acre volume varies considerably between stands. The average standing volume is roughly 27.4 Mbf per acre.

As a result of their history of large fires, extensive logging, and intensive forest management, the age distribution of state forests lands is not uniform (Figure 12). Stand age has a major influence on forest condition and this non-uniform age distribution has significant implications for forest management planning. Forest stands in the 50-79 year-old range are the most common, accounting for half of the acreage and more than 60% of the standing volume. These acres coincide with periods of aggressive salvage logging and subsequent reforestation efforts that occurred after the Tillamook Burn. Stand age is not the only factor that influences a stand's current condition. Site productivity, past management practices, and disturbance and disease history are all contributing factors.

Stands can be grouped into forest types based on species composition to facilitate the observation of natural patterns across a complex landscape. These forest types provide information about a stand's potential future condition. Then stand age and management history can reveal where a stand lies on its developmental curve. Douglas-fir (*Pseudotsuga menziesii*) is the predominant species, accounting for more than two-thirds of the standing volume. However, a variety of other conifer and hardwood species are prevalent in state forests. Overall, less than half of the area in state forests acreage are Douglas-fir dominant stands (Figure 13).

[2] Volume estimate is measured in net Scribner volume using 40 feet log lengths

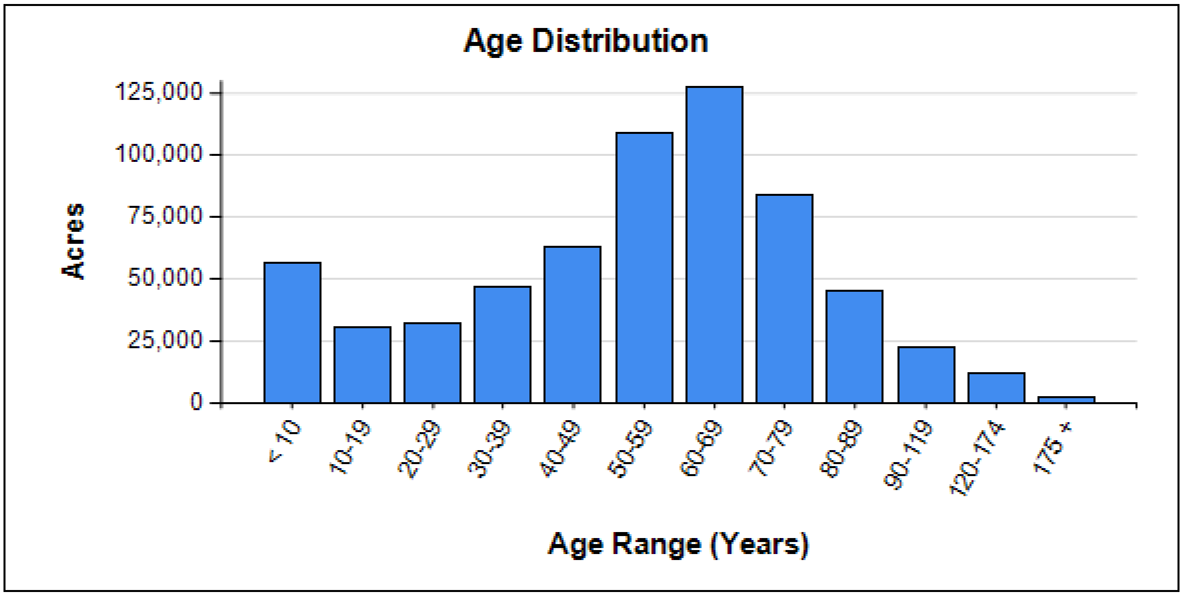

Figure 12. State Forests age distribution.

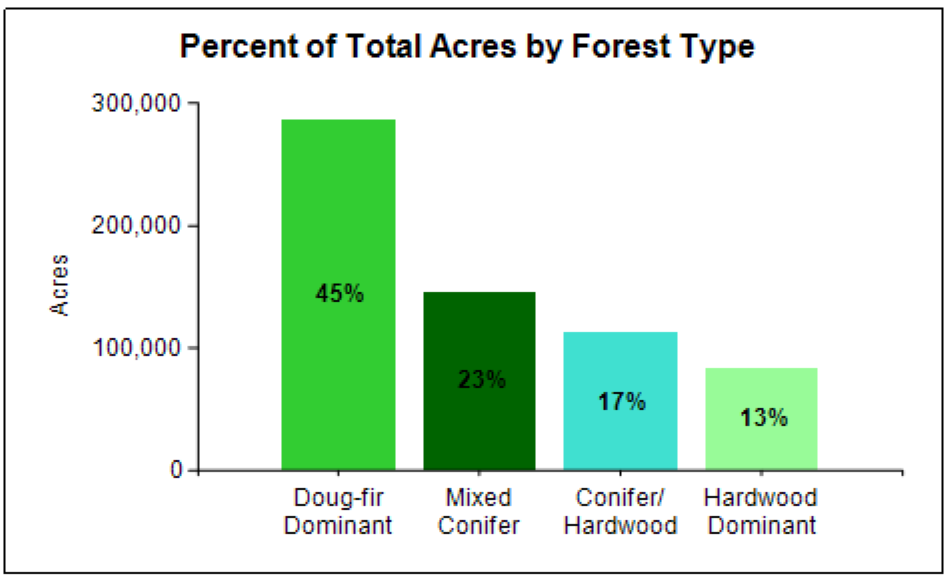

Figure 13. Forest types in State Forests.

On state forest lands, mixed conifer stands typically include a combination of western hemlock (*Tsuga heterophylla*), Douglas-fir, western redcedar (*Thuja plicata*), Sitka spruce (*Picea sitchensis*), and noble fir (*Abies procera*). Hardwood dominant stands are typically either red alder (*Alnus rubra)* or bigleaf maple (*Acer macrophyllum*). Conifer-hardwood mix stands are commonly Douglas-fir or western hemlock mixing with red alder. Each forest type presents distinct silvicultural challenges, offers differing economic opportunities, and provides unique habitat potential. “Complex habitat” is beneficial for native wildlife and is provided in forest stands with a diversity of tree species; an understory of trees, shrubs, and herbs; and ample amounts of snags and downed wood provide.

The mixed conifer forest type represents just a quarter of the total land-base, yet it provides half of the total acres that provide complex habitat. Roughly 25% of the mixed conifer acres have complex habitat as compared to less than 10% of Douglas-fir dominant acres. By definition, mixed conifer stands and conifer/hardwood mix stands tend to be multispecies stands more likely to develop a layered canopy. Hardwood dominant stands typically do not develop structure, but instead senesce and allow shad tolerant species, such as western hemlock and western redcedar, to develop into the new forest. These four forest types vary with respect to their potential for timber production. Characterizing the forest condition in the context of timber production, net Scribner board volume per acre was analyzed for forested stands in the 50-80 year old age range. For three of the four forests types (Douglas-fir dominant, mixed conifer, and conifer-hardwood mix) the median volume per acre hovers around 30 Mbf per acre. However, there is a wide range of variability among stands. For both the Douglas-fir dominant and mixed conifer forest types, 90% of stands are between 10-60 Mbf per acre. These two conifer types have the greatest potential for timber production, with stands regularly producing 40 Mbf per acre.

Douglas-fir dominant stands produce the highest value timber sales for multiple reasons (e.g. single bid species, high stumpage, straightforward silviculture, high volume), though SNC can reduce stumpage prices for Douglas-fir. Mixed conifer stands typically have less Douglas-fir volume, multiple bid species, lower bid prices, and more complicated silviculture.

Due to a variety of geographic and historic factors, these four forest types are not distributed evenly across the landscape (Figure 14). District coverage by the Douglas-fir dominant forest type ranges from one-third of the area in the Tillamook District to two-thirds of the area in the Forest Grove and West Oregon Districts. The mixed conifer forest type is common on the Astoria, North Cascade, and Southwest Oregon Districts, but the species mixes tend to vary between districts. The conifer-hardwood mix forest type is common in the Tillamook and Western Lane Districts, but once again the species mixes are not necessarily the same. The hardwood dominant forest type is most common in the Tillamook District, which contains three times as many hardwood dominant acres as all other districts combined.

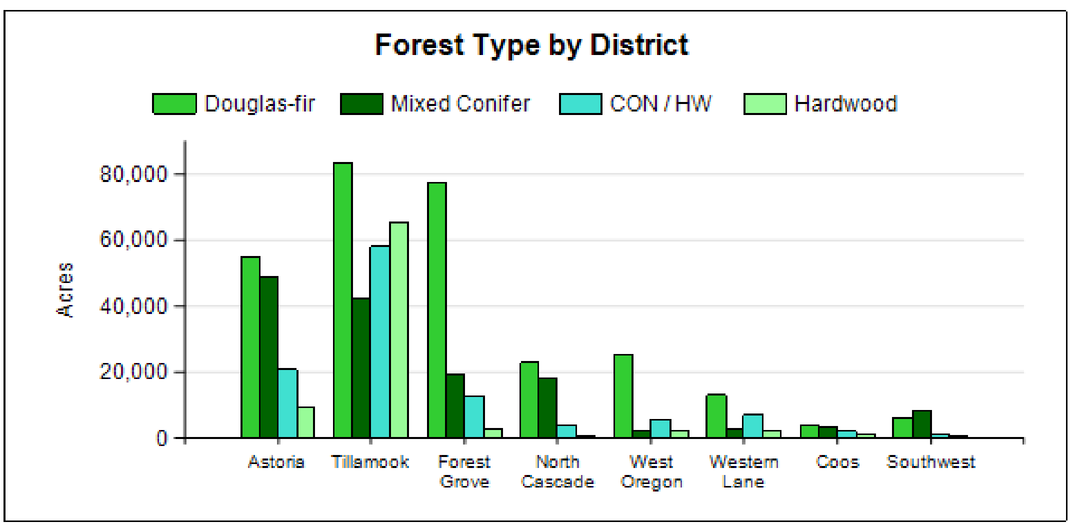

Figure 14. State Forests forest type distributions.

The age distribution of hardwood stands on the Tillamook District is revealing (Figure 15). Forest management since the Tillamook Burn has focused on conifer stands. This has yielded a pronounced age distribution for hardwood stands and is complicated by the expected life cycle of red alder, which starts declining at 60-80 years and rarely lives past 100. About 65,000 acres of the Tillamook District is hardwood dominant stands, typically red alder within the perimeter of the historic Tillamook Burn. Crown dieback is projected to outpace new growth in the next 20 years.

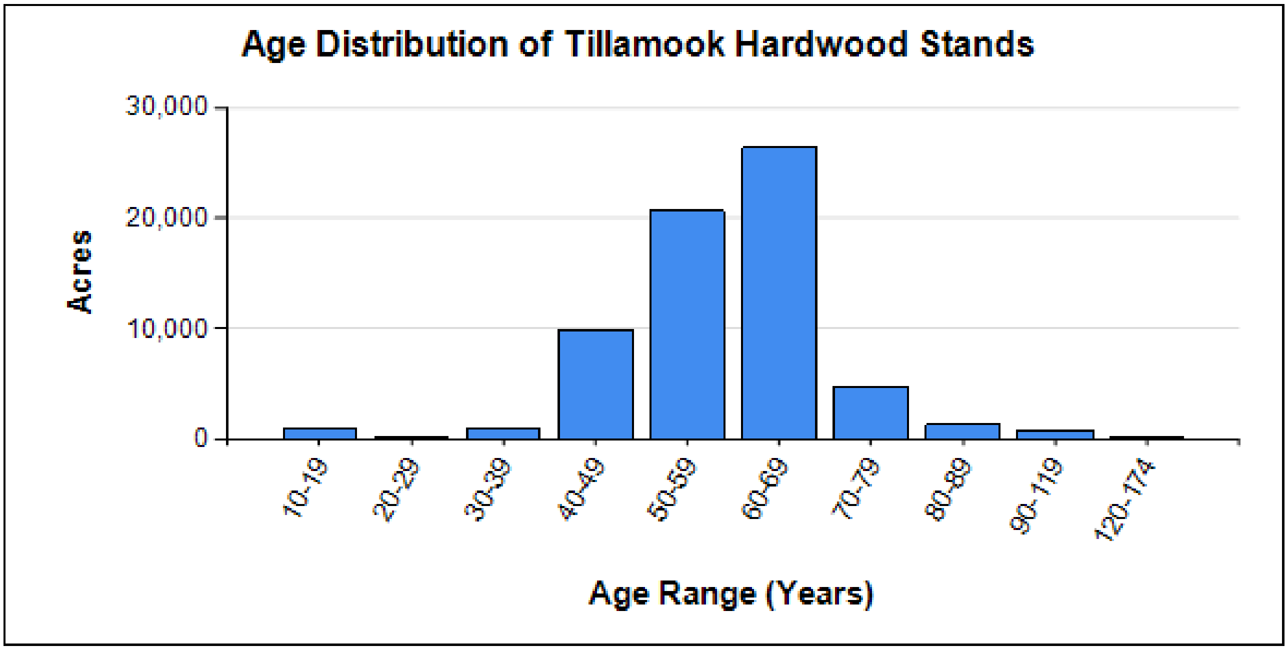

Figure 15. Age distribution of Tillamook hardwood stands.

Timber Production

Timber Harvest

The GPV Rule requires State Forest lands to be managed to ensure a reliable and sustainable flow of timber while maintaining and conserving wildlife habitat and providing social benefits to the people of Oregon. ODF is guided by the FMP in addition to other state and federal regulations, including the FPA and the ESA. State rules and internal policy also provide guidance for contracting and administrating timber sales.

Timber harvest revenues are split between State Forests and local governments, which include counties and local taxing districts. The majority of harvest revenues (63.75%) are distributed to local counties and taxing districts (Figure 16). This revenue eventually makes its way to local community services, including education, law enforcement, and community health. Revenue from State Forests' timber harvest is a significant contributor to local budgets and is magnified for counties and taxing districts in the North Coast area (Figure 17). Timber harvest also provides social benefits, especially for local rural communities. Timber harvest directly impacts local jobs and mills and indirectly impacts other jobs in those communities. The remaining 36.25% of timber revenues go to State Forests for management, fire protection, and supporting the agency mission. Timber harvests contribute nearly all (over 98%) of the revenues that fund State Forests operations.

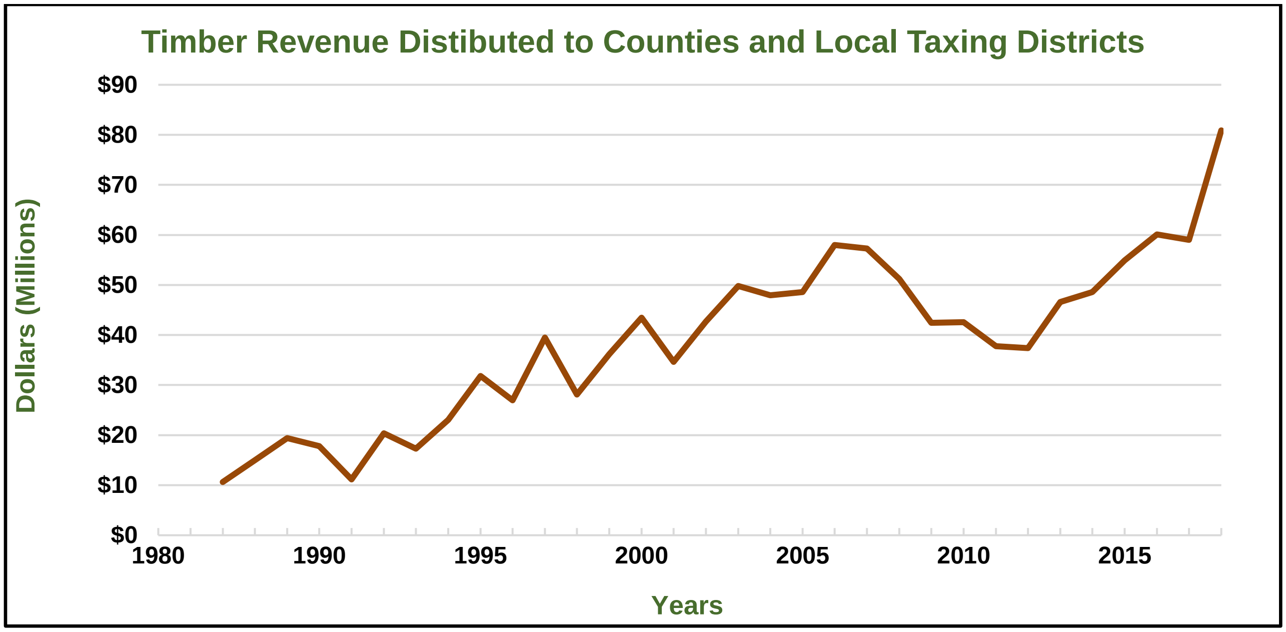

Figure 16. Net timber revenues distributed to counties and local taxing districts.

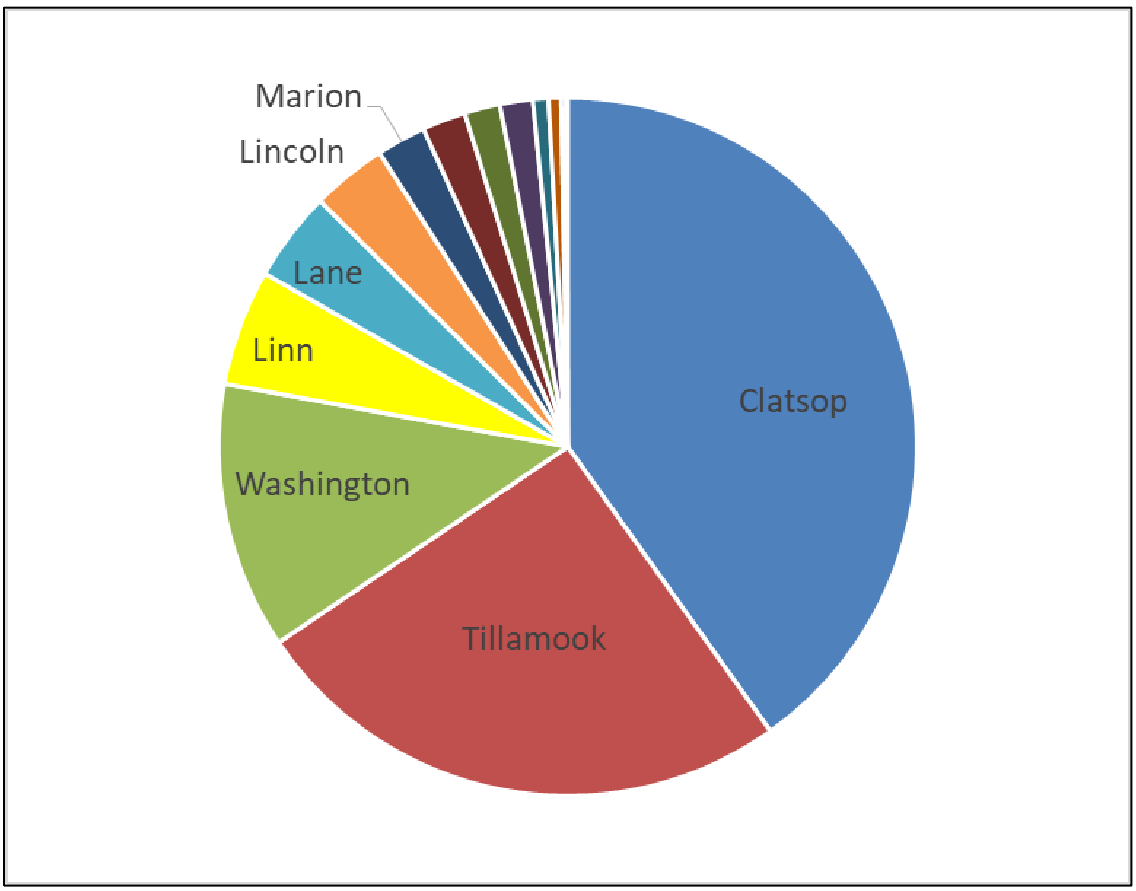

Figure 17. Percent of revenue distributed to individual counties over fiscal years 2016-2018.

Oregon law prohibits raw logs from Board of Forestry land from being exported to other countries. Most of the timber sold from state forests is processed in Oregon, the remainder is processed in neighboring states. There are a large number of local bidders (over 45) for timber from state forests lands. However, 60% of the timber volume goes to three large local purchasers and 80% of the timber volume is sold to 10 purchasers (Figure 18).

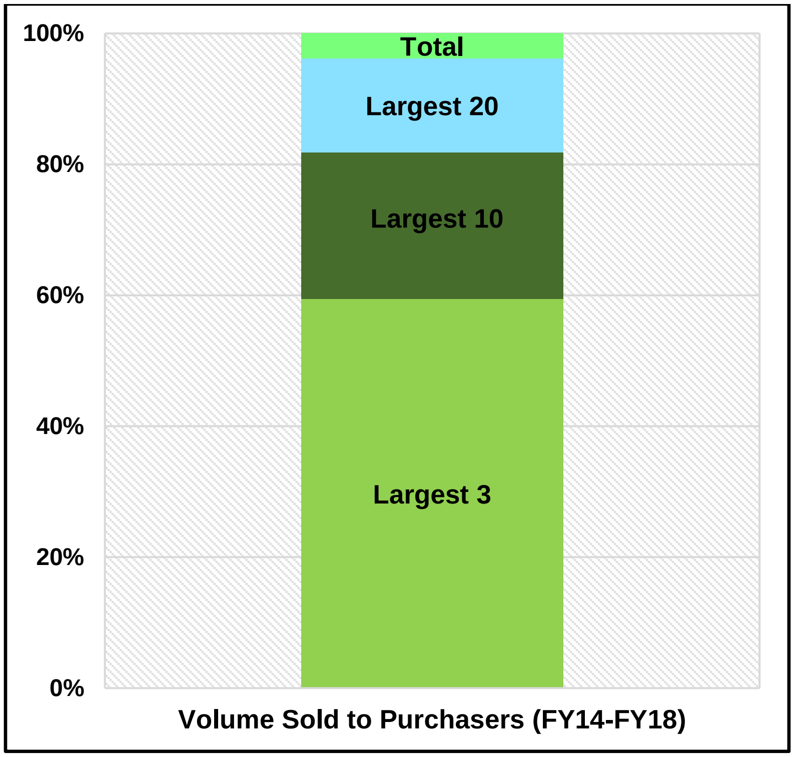

Figure 18. Percent of volume sold to each purchaser over the last five years. Over this time period there were over 45 purchasers of state forest timber sales.

Stumpage prices are influenced by local market fluctuations and global timber products demand. Actual timber price trends varying significantly (Figure 19). Timber value is primarily affected by tree species, followed by topography, natural disturbance events, and past management actions.

The timber program is guided by FMPs. Implementation on BOFL in Western Oregon during the early 2000s (2000-2009) resulted in an annual harvest average of 232 mmbf. Harvests focused on thinning mid- to late-seral stands in order to promote structural diversity and stand complexity (Figure 20). These partial cut harvests were in stands typically aged 45-65 years with some up to 70-90 years that originated from natural regeneration. Timber harvested from these commercial thinnings averaged around 15 Mbf per acre.

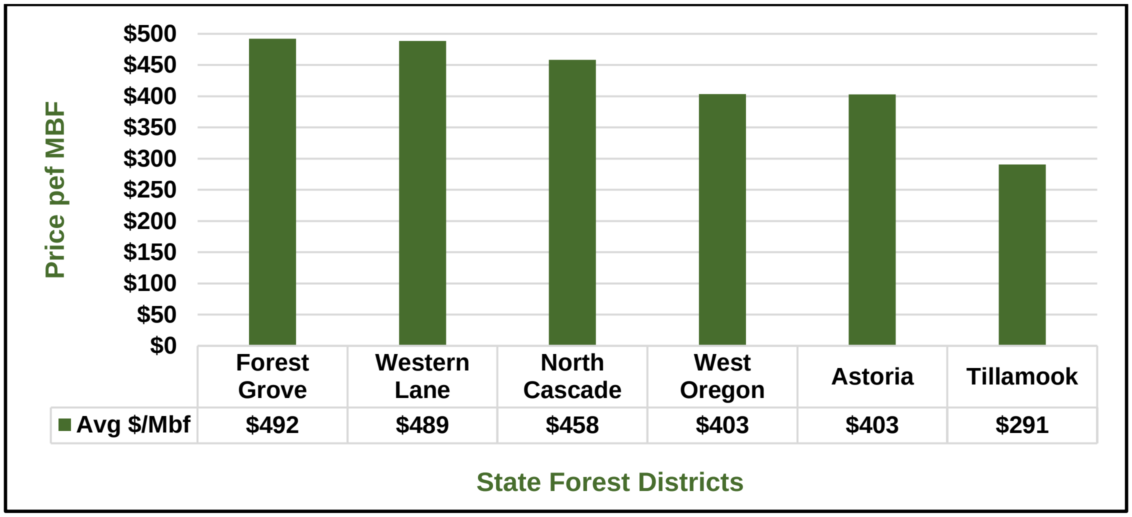

Figure 19. Five-year average (2014-2018) of timber prices made by purchasers for state forest sales (MBF – thousand board feet).

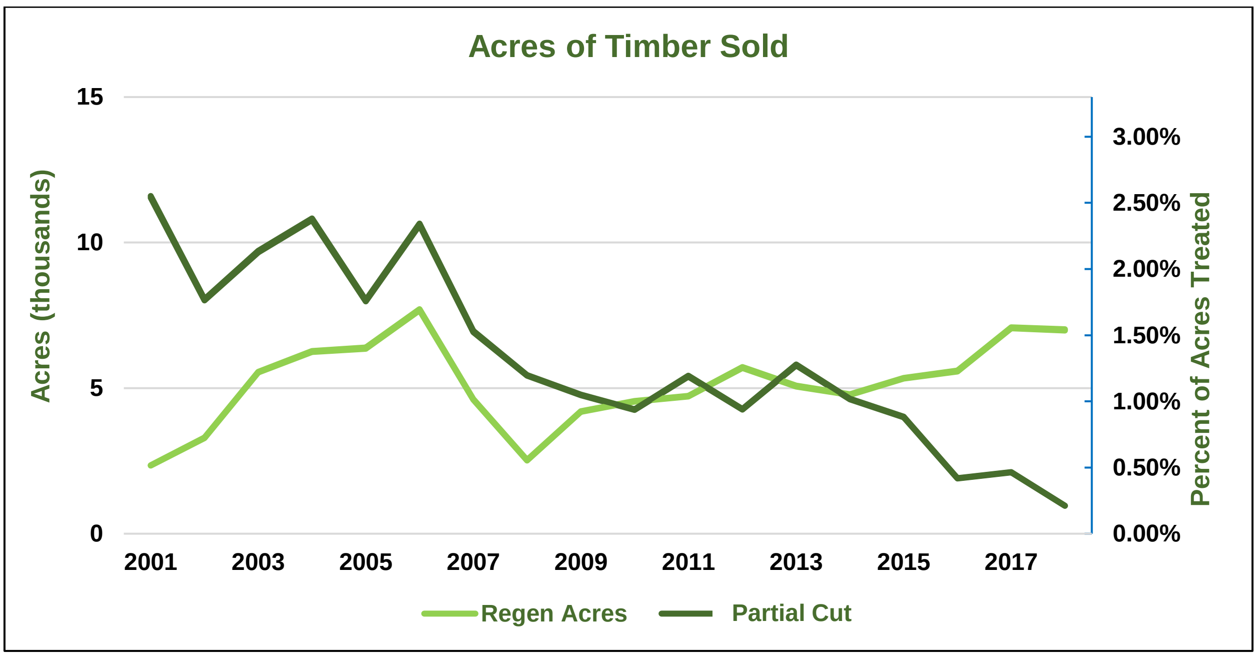

Figure 20. Partial cut harvests and regeneration harvests of Board of Forestry lands since the beginning of the FMP.

During the past ten years of implementation (2008-2018), there were fewer opportunities for thinning older stands and focus gradually shifted to increased regeneration harvests. Implementation during this recent period has resulted in an annual harvest average of 239 million board feet per year. Thinning occurs on younger, more uniform stands that were reforested by planting in the 1970s and early 1980s. These thinnings result in harvests of around 7 MBF per acre and require multiple entries to produce more complex forest conditions since these stands started as plantations. To increase financial viability, there has been a slight increase in regeneration harvests and a significant decrease in thinnings on the landscape (Figure 20).

Products & Markets - ODF Westside Forests

Most lumber products in 2017 were saw logs with smaller amounts of pulp and utility poles. Douglas-fir is the preferred species for most local mills. Prices and competition for Douglas-fir are stronger than any other species grown in significant volume on ODF forests. Some niche species and products provide price premiums compared to Douglas-fir (e.g. western red cedar, utility pole products). Red alder, while variable, is currently almost as valuable as Douglas-fir. Competition is strong on the north coast because the capacity of local mills is greater than the supply. Conversely, red alder competition is weaker in southern districts due to mill locations. Utility pole products are grown primarily in the Forest Grove, North Cascade, and Western Lane Districts with a smaller concentration in the Astoria and Tillamook Districts.

Purchasers are hesitant to deal with pulp due to low prices or if fuel costs increase. This translates into a reluctance to remove pulp from timber sales. There may be opportunities to increase pulp revenue and utilization. In a pilot project on the four sort sales from 2017-2018, ODF received two to seven times the pulp stumpage compared to conventional timber sale contracts. This demonstrates a potentially profitable pulp market, but it may be challenging due to logger reluctance to handle pulp on regular timber sales. The Division does not sell to local chip and saw markets due to concerns over selling saw logs at a lower pulp rate.

Young Stand Management

Young stand management is integral to any future timber harvest and is a critical part of forest management. Reforestation is required after any regeneration harvest, and is a critical investment to ensure a productive working forest over the long-term. Planted seedlings will be genetically adapted to the reforestation site, and where appropriate a mixture of species will be planted to increase diversity across the planning area. Site-preparation and spring release treatments help control competing vegetation and increase reforestation success. Protection from mountain beaver, deer, and elk are utilized where expected damage will reduce stocking levels to below acceptable standards. As the stand ages, hardwood release and pre-commercial thinning, where appropriate in regard to silviculture, will be utilized to enhance timber production and improve forest health. Additional silviculture treatments are implemented as needed to ensure seedlings grow into merchantable timber.

Special Forest Products

Special forest products are those products other than timber that are collected for personal and commercial uses. The special forest products industry is growing nationally and internationally and makes an important contribution to Oregon’s economy.

Special forest products include beargrass, evergreen boughs, cascara bark, cedar products, cones, ferns, firewood, moss, mushrooms, vine maple for transplants, poles, Oregon grape root, salal, and yew bark. The quantity and quality of products varies among districts. For most products, the number of requests to harvest is low and does not produce a large amount of revenue. However, ODF does have a harvest permit program for special forest products to meet the demands for these products.

Roads and Access

The road system on State Forests' lands is an integral part of achieving GPV. The road system facilitates timber harvest and other forest management activities as well as providing access for a wide range of recreational activities. Substantial investments have been made in constructing, surfacing and maintaining the road system. There are approximately 3,900 miles of road on state lands, and approximately 88% are surfaced. 89% of acres are within 0.25 miles of a road.

In addition to the roads on state lands, roads on other ownerships are used to access State Forests. Control, permitted uses, and maintenance responsibilities can vary widely for these roads. Management complexity increases when the road system crosses multiple ownerships. For larger blocked-up parcels, ODF controls a greater portion of the entire road system as compared to scattered parcels. For example, the Astoria District averages one easement per 1,021 acres managed as compared to the Western Lane District average of one easement per 167 acres managed.

While the road system provides the needed access to achieve the management objectives of the plan, it also has the potential to impact natural resources and public safety. Applicable laws for the management of the road system include the Federal Water Pollution Control Act (commonly referred to as the Clean Water Act) as administered by the federal Environmental Protection Agency (EPA), Oregon Department of Environment Quality, and the ODF though the Oregon FPA; as well as the federal Endangered Species Act as administered by the United States Fish and Wildlife Service, National Oceanic and Atmospheric Administration - Fisheries, ODFW and ODF through the Oregon FPA. Safety laws for forest operations and quarry operations as administered by the Oregon Occupational and Health Administration and the Mining Health and Safety Administration respectively. The road system on state forests is located, constructed, used and maintained in accordance with the State Forests Road Manual, the Oregon FPA and other applicable laws.

Road locations near streams and on steep slopes have a higher potential to impact water quality and aquatic habitat. Nearly one third of the land base has slopes greater than 60%, but only 2.3% of the road system is on slopes greater than 60%. Approximately 17% of the road system on State Forests' lands is within 100 feet of perennial and/or seasonal streams. While the overall percentage of the road network near streams is small, these road segments require higher investments for implementing Best Management Practices (BMP) to protect water quality and maintain aquatic habitats. Project work reported to the Oregon Watershed Enhancement Board as part of the Oregon Plan for Salmon and Watersheds is representative of some of these investments from 1995 through 2017. The Division removed or replaced 288 fish barriers with fish passable structures or open channels, restoring fish access to 229 miles of stream habitat. ODF also closed or vacated 155.4 miles of road, installed 2,289 relief culverts, and improved 2,287 Type N stream crossings.

Energy and Mineral Resources

The mineral, oil, and gas potential of state forests is largely unknown. According to the Department of Geology and Mineral Industries, few systematic surveys have been conducted for most commodities. Additionally, no regional geochemical studies have been made to define or eliminate areas of possible metal mineralization. However, there may be potential for production of natural gas, industrial minerals, economic metals, and geothermal resources.

ODF does not own most of the minerals on state forests. The Division may use soil, clay, stone, sand, and gravel for the purpose of constructing or repairing roads or other state facilities, or may sell those same materials (ORS 530.050). All other mineral and geothermal resources are owned by the State of Oregon and managed by the DSL. Revenues derived from the sale of those mineral resources accrue to the CSF (ORS 273.780).

State forests have provided high quality rock for local road surfacing and ballast rock. This rock is an important resource for road construction and maintenance of roads for hauling timber and recreation. Without a local source, the costs associated with construction and maintenance would be greatly impacted, which makes management of this finite resource quite important.

Grazing

State forests have limited grazing potential. Although state laws permit agriculture and grazing on state forests as long as they are compatible with other forest resources, the topography of the state forests is generally not suitable for most agricultural uses. Historically, all the districts in western Oregon allowed grazing on burned or logged areas under the open range laws. As forests were reestablished, grazing diminished. Open range grazing ended in the early 1980s.

Environmental/Conservation Resources

Wildlife

Wildlife Habitat – General

Environmental gradients, underlying geology, species distributions, and natural disturbances provide variability in habitat types and conditions across state forests in western Oregon. Large-scale disturbances (e.g. fire, windstorms) continue to influence habitat conditions across the landscape. Smaller scale disturbances (e.g. insect and disease outbreaks) create habitat patches and increase spatial heterogeneity within and between individual stands.

State forests have a legacy of repeated, large-scale wildfires and/or had already been extensively logged prior to State acquisition. Most state forests are young, created from natural regeneration and early reforestation efforts. On large parts of state forests, structurally complex natural forest stands were replaced with more simplified even-aged stands. In more recent history, a massive reforestation and restoration effort was implemented. Managing for multiple values (e.g. timber production, forest health, aquatic systems, wildlife habitat) has produced a complex mosaic of stand types and ages and within-stand habitat features.

The variety of stand types resulting from ODF's management of state forests provides diverse habitat types well dispersed across the landscape at regional scales and broad connectivity to and between older forests on federal lands, as well as older forest habitats where comparatively little other public forest lands exists (e.g. Clatsop State Forest). Young stands and associated early-seral habitat characteristics are important for diverse game and non-game species, including many of state or federal concern. Older stands on the landscape foster and support a variety of late-seral associates (e.g. northern spotted owls, marbled murrelets, red tree voles). Forests in mid-seral stages (30-80 years old) enhance broader landscape function and provide habitat for most native forest species, including early- and late-seral associates.

Additional variation in stand composition and structure due to stand development, management history, site productivity, topography, region, and other factors contribute to diversity across spatial scales. Riparian areas, wetlands, and other aquatic habitats along with rare or unique habitats (e.g. talus slopes, caves) add to diversity and to a broader ecological function and associated resilience. Individual species utilize different stand types and habitat features at varying spatial scales. Thus protecting, maintaining, and enhancing native wildlife habitats requires consideration of all species present on the landscape and their individual habitat needs.

Wildlife Habitat – Current Conditions

Stand age can be used as a surrogate for seral stage and thus habitat type, though many other factors also influence habitat conditions. Species composition, structural elements, and other vegetation characteristics are influenced by site productivity, past management practices, disturbance and disease history, and landscape context. Whether a given stand provides complex or highly suitable habitat for a certain species depends on the combined influence of these factors on current conditions and how well those conditions align with the specific habitat requirements of the species.

Nonetheless, ODF forest inventory data document the age class distribution and provide insight into the range of habitat types available on state forests. Across districts, approximately 37% of stands are less than 50 years old. Over half of the forest is 50-80 years old. Only 13% of the stands are 80 years or older and 2% are stands greater than 120 years old.

There is considerable variation both within and among districts in the relative proportions of age classes and associated habitat types on the landscape. Regional variation and other environmental gradients (elevation) add to variation associated with stand age and contribute to the broader diversity across state forests. Harvest strategies, practices, and prescriptions in young stands promote relatively complex, early-seral habitat compared to nearby public and private industrial forest lands. Mid-seral stands are highly variable in habitat structure and function depending on natural disturbance, management history, and other factors. But all provide some degree of habitat to meet various life history needs of native wildlife species as well as connectivity between other habitat types and across basins.

The data suggests state forests may be lacking habitat to support late-seral species (e.g. northern spotted owls, marbled murrelets). Approximately 87% of state forests are less than 80 years old. In general, districts in the central and southern Coast Range and the Santiam State Forest have a greater area proportion of older stands. The Tillamook and Clatsop State Forests have comparatively little older forest, largely due to extensive fires and logging that occurred prior to state acquisition. Despite large improvements in habitat diversity and quality, the state forests habitat story largely remains one of restoration, rehabilitation, and enhancement in a young forest landscape.

Wildlife – General

State forests have habitat suitable for most native species found in forests of the Coast Range and West Cascades. It is estimated that there are 270 vertebrate species that are found on, adjacent to, or downstream of state forests in both aquatic and terrestrial environments, of which 63 are mammals, 147 birds, 32 amphibians and reptiles, and 28 fishes. This list generally excludes species of marine fishes, birds, and mammals that may be found in nearby estuaries unless they require state forests for some portion of their life history.

A range of mammals (e.g. deer, elk, bear, cougar, and bobcat) use habitat in and near state forests. Forest stands are host to most native weasel species, skunks, squirrels, voles, mice, and other forest floor small mammals. The full native assemblages of forest resident and migratory songbirds and raptors, including rare and sensitive species, are present on state forests lands. Upland game birds (e.g. grouse, quail, turkey) are present but elusive to most hunters and wildlife observers. Resident and migratory waterfowl and other aquatic birds are dependent on riparian, aquatic, and wetland habitats within state forests.

Mammals (e.g. river otters, beavers) make almost exclusive use of these habitats. Many amphibians are associated with aquatic habitats (e.g. tailed frog, torrent salamanders), yet others utilize terrestrial habitats and are tied to abundance and quality of downed wood (e.g. plethodontid salamanders). Many birds, reptiles and some mammals utilize rocky habitats, including caves, for a variety of life history needs. Bats forage over aquatic habitats and use forests for denning and roosting.

Wildlife – Current Conditions

ODF has an extensive survey history for species listed in the ESA (e.g. northern spotted owls and marbled murrelets). It continues to conduct annual surveys driven by proposed operations and monitor activity. ODF has supported research of habitat relationships of numerous species (e.g. deer, elk, owls, murrelets, early seral birds, tree voles) and wildlife responses to forest management practices (e.g. songbirds, small mammals, amphibians). However, because relatively little inventory or monitoring work has been conducted on state lands for non-game species, some species may be present but not yet detected or documented (e.g. coastal marten). Other species on the lists are not known to be present but could become reestablished as a result of habitat improvements, regional population recovery, or potential re-introductions (e.g. Pacific fisher, Oregon spotted frog).

Threats to wildlife on state forests include poaching, illegal dumping, disease and pest outbreaks, catastrophic fire and wind events, and habitat destruction or modification from management activities or public misuse. Many of these issues can be addressed via forest planning and management in collaboration with other agencies and stakeholders.

Climate change effects on wildlife habitat and populations are difficult to assess and address in a management context. It is anticipated that changes in temperature and precipitation regimes will alter patterns and abundance of habitat and resources, resulting in gradual migrations of habitats and associated wildlife species north and to higher elevations. Species that cannot migrate or shift their range quickly enough in response to climate change are at risk. Damage by insects and plant pests will increase with warmer temperatures and may result in alterations to the species composition of native ecosystems. Increased frequency and severity of fire or wind events can cause large-scale catastrophic damage to habitats and local populations with long-term consequences. Rare and sensitive habitats may be lost at and near latitudinal and elevation range extents.

Under GPV, the overarching goal for wildlife on State Forests is to protect, maintain, and enhance habitat for native wildlife species. Restoration and enhancement requirements remain where fire and subsequent salvage logging or reforestation have reduced habitat elements or hindered their development (e.g. the Tillamook Burn). Diverse and complex habitat conditions (e.g. late-seral habitat features), will take decades to develop through both passive and active management approaches. While moving the landscape toward more diverse habitat conditions, there are expected to be individual species, referred to as “species of concern,” and associated habitats that require special consideration.

Species of Concern

Species of concern (SOCs) are fish and wildlife species that have been identified as at risk for various factors (e.g. declining populations, limited range). Some are thought to be largely extirpated from forests in the region (e.g. coastal marten, Pacific fisher). Numerous public and private entities designate wildlife SOCs for conservation and management, from local to global scales. At the federal level, the U.S. Fish and Wildlife Service (USFWS), U.S. Forest Service (USFS), and Bureau of Land Management (BLM) all publish relevant lists for the Coast Range and Cascade Mountains Districts. At the state level, ODFW and the Oregon Biodiversity Information Center publish statewide and county lists (ORBIC 2019).

ODF's SOC list (Appendix B: Species of Concern) was developed using federal and state lists of threatened, endangered, and candidate species, as well as the Oregon Conservation Strategy and ODFW's sensitive species list (ODFW 2016). These resources are appropriate because they identify species that need immediate and focused conservation effort. The list is a component of the ODF's SOC operational policies and is updated semi-regularly as state and federal lists are updated or new data or science is available. SOCs identified on the list are either present or have the potential to be present on state forests. There are 48 wildlife species that meet these criteria including 14 amphibians, 4 reptiles, 17 birds, and 13 mammals (Appendix B: Species of Concern).

Threatened or Endangered Species

Forest management activities must comply with all federal and state laws, including those that protect and conserve wildlife populations and habitat (e.g. state and federal ESAs, federal Bald and Golden Eagle Protection Act, federal Migratory Bird Treaty Act, Oregon FPA). Although many laws apply to state forests management, legal requirements for protection of threatened or endangered species can have some of the most significant impacts on planning and operations.

The federal and state listings of species as threatened and endangered is always in flux with some changes occurring after this plan was drafted. When the plan is finalized the discussion of threatened and endangered species will be updated to reflect listing status at that time. Of the many wildlife species potentially found on state forest lands, three terrestrial species are listed as threatened or endangered under the federal and state Endangered Species Acts (discussed below, fish are discussed in the Aquatic Resources section). The statuses of a few other species are federal under review (e.g. red tree voles, coastal marten).

Northern Spotted Owls on State Forests

The northern spotted owls (NSO) is a state- and federally-listed threatened species. The status of the species under the federal ESA is due for review and the USFWS will make a determination whether an uplisting to endangered status is warranted.

In the northern Coast Range, surveys for NSOs began in the late 1970s and early 80s. These surveys found relatively low densities of NSOs in what was then an area with extensive forests of young Douglas-fir stands (less than 60 years old) and few remnant stands of old growth or mature forests. More systematic surveys began on state land after the U.S. Fish and Wildlife Service listed the NSO as a threatened species in June 1990. ODF has surveyed timber sales and other suitable habitat for NSOs in state forests since 1992, covering 80% or more of each district per year at an average cost of $1.4 million/year over the 5-year period from 2014 to 2018.

Currently there are 28 active sites on BOF lands, including 18 pairs, and an additional 97 sites on adjacent lands, that fall within the purview of State Forests NSO policies (Table 3). Occupancy patterns vary across districts. On the Tillamook and Clatsop State Forests (Astoria, Forest Grove and Tillamook Districts), there are relatively few sites on or adjacent to state forests, compared to smaller districts like Western Lane (including the Coos and Southwest Units).

Table 3. Northern spotted owl sites on or adjacent to state forests, 2018 (GIS Acres).

District	Number on BOF Lands		Number on Adjacent Lands		BOF Lands in NSO Sites (acres)	Percent of BOF Lands in NSO Sites
	Pair	Single	Pair	Single		
Astoria	2	0	0	0	7,765	6%
Tillamook	2	6	4	1	30,097	12%
Forest Grove	2	0	1	0	8,648	8%
North Cascade	4	1	9	1	7,625	16%
West Oregon	1	2	3	1	6,872	23%
Western Lane	2	0	35	7	13,863	57%
Coos Unit	2	0	15	1	6,494	73%
Southwest Unit	3	1	18	1	6,868	73%
All Districts	18	10	85	12	88,234	14%

Approximately 88,000 acres of BOF lands fall within active NSO sites. Tillamook has the most acres in NSO sites but smaller districts tend to have a greater proportion affected (Table 3). On the Tillamook and Clatsop State Forests, NSO sites cover under 10% of the total acres (46,500), with some variability across the three districts, compared to 57% on Western Lane and 73% of the Southwest and Coos Units.

Drivers of NSO occupancy differ between districts. Historically, extensive logging and the Tillamook Burn reduced habitat across ownerships on the North Coast. While some habitat has since developed in the Tillamook and Clatsop State Forests, barred owls have become a major driver of NSO occupancy patterns in the region (Figure 21). Astoria and parts of Forest Grove and Tillamook Districts have large populations of barred owls. In general, NSO sites on the North Coast have shifted from the Clatsop to the Tillamook State Forest as barred owl densities have increased.

Over the past 10-15 years, most NSO sites on Astoria and Forest Grove have gone inactive, while a few new sites have been established on the Tillamook District. The high number of abandoned NSO sites is consistent with patterns elsewhere, in that NSO territories fall apart and individuals drop out or become hard to detect. Four recently established sites are in the Tillamook Burn, where NSO were largely absent for decades and where barred owl detections map less densely (Figure 21). It appears that barred owl competition is driving NSO into marginal sites where habitat is low quality or still developing. ODF has not observed evidence of NSO breeding on the Tillamook or Clatsop State Forests in 15-20 years.

NSO populations appear to fare better on state forests in the central and southern Coast Range and West Cascades. This is likely due to the presence of suitable habitat on adjacent federal lands. There are more NSO sites in and adjacent to state forests and evidence of successful breeding (e.g. a pair with juveniles) has been observed in the Santiam State Forest, Western Lane District, and Southwest and Coos Units within the past few years.

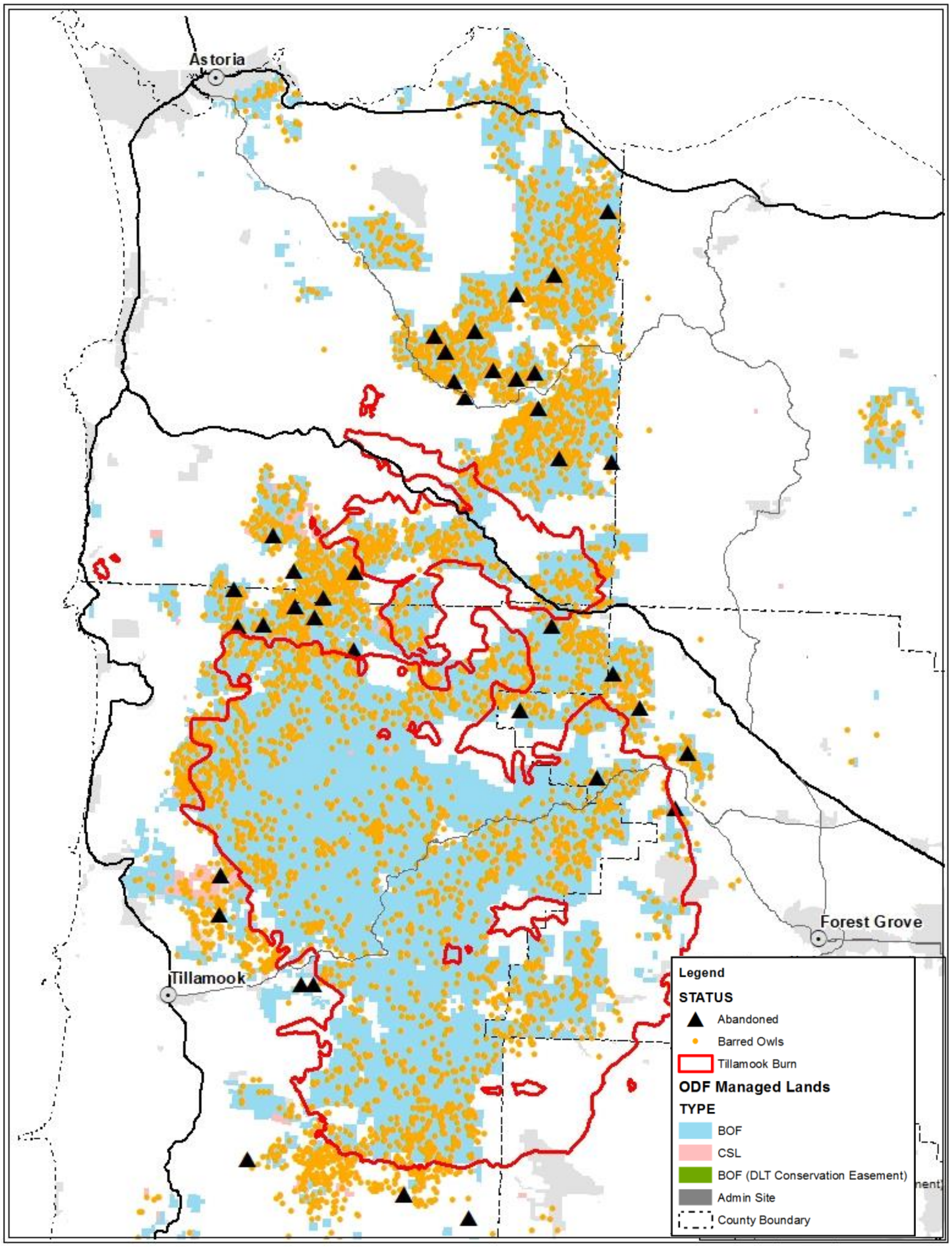

Figure 21. Barred owl detections on the Tillamook and Clatsop State Forests, 2001 - 2017.

Marbled Murrelets on State Forests

The marbled murrelet is a seabird that nests inland on large tree limbs or other suitable structures in coniferous forests of the Coast Range. It is listed as a threatened species under the state and federal ESAs. The species was petitioned for uplisting to endangered status under the state ESA in 2016, but, after a status review in June 2018, the ODFW Commission declined to do so. In August 2018, the Commission adopted Advisory Survival Guidelines for Marbled Murrelet (OAR 635-100-0137). The survival guidelines encourage voluntary actions to protect the seabird on state-owned or leased lands, such as state forests.

Because it is difficult to observe nesting murrelets or find nests, surveys utilize an occupancy-based approach that does not provide an estimate of number of murrelets nesting on state forests. When surveys detect occupied behavior from murrelets, ODF establishes a marbled murrelet management area (MMMA) to designate, buffer and protect occupied habitat. ODF has a long history of conducting surveys for marbled murrelets to help ensure that the timber sale program does not violate "take" restrictions detailed in Section 9 of the ESA. Since 1992, ODF has conducted over 33,000 individual surveys at more than 1,300 unique sites. This represents the largest survey efforts for marbled murrelets by any land manager in Oregon, Washington, or California. As a result of these surveys, ODF has designated over 16,000 acres in 107 MMMAs on state forests lands, including 11,800 acres of designated occupied habitat and 4,400 acres of buffers (Table 4).

Table 4. MMMAs on state forests, updated in 2017 (GIS Acres).

District	Number of MMMAs	Designated Occupied Habitat (acres)	Buffer (acres)	BOF Lands in MMMAs (acres)	Percent of BOF Lands
Astoria	18	1,988	1,401	3,390	3%
Tillamook	37	4,911	511	5,422	2%
Forest Grove	0	0	0	0	0%
North Cascade	0	0	0	0	0%
West Oregon	24	1,895	1,413	3,309	11%
Western Lane	16	1,852	925	2,777	11%
Coos Unit	12	1,195	138	1,332	15%
Southwest Unit	0	0	0	0	0%
All Districts	107	11,842	4,388	16,230	3%

Marbled murrelet occupancy patterns vary across districts. Sites on Astoria and Tillamook are limited to the west side of both districts, outside the Tillamook Burn. As with NSO sites, many known murrelet sites on the North Coast are in state forests. Where sites occur, they tend to have disproportionate effects on local planning and management activities. West Oregon and Western Lane Districts (including the Coos Unit) are the most affected by marbled murrelet sites, which occupy 10-15% of both districts (Table 4).

Disturbance history is a large driver of occupancy patterns for both NSOs and murrelets on the North Coast. Ownership patterns are bigger drivers in other districts. Where there is little other public land and relatively little habitat, NSOs occur at lower densities and are mostly on state forests. In West Oregon, where private lands predominate, both species seem to key in on habitat in state forests and NSO tend to occur where federal lands are nearby. In Western Lane, occupancy patterns are more related to spillover effects from adjacent federal lands. Smaller districts are disproportionately affected by NSO and murrelets, particularly where federal lands are adjacent. NSO sites represent over 20% of the West Oregon District and over 50% of the Western Lane District. Many murrelet areas fall outside NSO sites, compounding management constraints.

Gray Wolves on State Forests

Gray wolves were removed from the state ESA in 2015. ODFW's Wolf Conservation and Management Plan was updated in 2019 (ODFW 2019a). Gray wolves remain listed as endangered under federal ESA in western Oregon.

In 2018, there were 16 known packs and 137 wolves in the state (ODFW 2019b). Most packs are located in the northeast Oregon, though there are at least three established packs in the Cascade Mountains. Recent sightings in the Coast Range have been confirmed, but to date none have occurred on state forest lands in western Oregon. It is difficult to predict future wolf distribution, but reasonable to assume continued expansion and eventual overlap with ODF-managed lands in the region.

Other Species of Concern on State Forests

Several other species are either candidates for listing under the federal ESA or due for a status review within the next few years (e.g. red tree vole, Oregon slender salamander, coastal marten, fisher). These and other future listing decisions would have differential effects on districts and likely be additive to the ESA compliance measures for owls and murrelets.

Red tree voles occupy coniferous forests at low to mid-elevations in western Oregon. The population in the Coast Range north of the Siuslaw River is considered a Distinct Population Segment and a candidate for listing under the federal ESA. A positive listing decision would affect planning and operations on the majority of acres.

The Oregon slender salamander is a terrestrial salamander associated with downed wood and large diameter logs in particular (Garcia et al. 2019). The species' range is limited to the west side of the Cascades from the Columbia River into Lane County. A listing decision would affect operations on the North Cascade District.

Coastal marten are thought to be limited to two small populations in the Oregon Dunes and Siskiyou Mountains (Linnell et al. 2018, USFWS 2018). A listing decision restricted to those areas would have little effect on state forests due to a lack of overlap, but a broader designation could affect West Oregon and Western Lane Districts.

The range of fisher in Oregon is currently limited to Curry, Josephine, Douglas and Klamath Counties. However, future conservation and management efforts could entail reintroduction elsewhere in the Coast Range and Cascade Mountains (Hiller 2015). Survey efforts for all four species have been limited in state forests and tied to external research. They provide little insight into current or potential distribution in relevant districts.

Many other SOCs are not yet proposed for listing, including many birds, bats, and aquatic amphibians. Not all are associated with late-seral habitats. Several bird SOCs (e.g. olive-sided flycatchers, MacGillivray's warblers, rufous hummingbirds) are associated more with complex early-seral habitats. Bats are tied to more discrete habitat elements (e.g. suitable nest, den, roost structures). Aquatic amphibians (e.g. torrent salamanders) are largely restricted to specific aquatic habitats. Little or no work has been done to assess these species' distributions and habitat associations in state forests, thus an assessment of current status is not possible.

Riparian and Aquatic Resources

Aquatic resources include surface waters (e.g. rivers, streams, lakes, springs, seeps, wetlands) and subsurface waters contained in aquifers or sub-soils. The legal directive for managing aquatic resources in state forests is that it should "result(s) in a high probability of maintaining and restoring properly functioning aquatic habitats for salmonids, and other native fish and aquatic life" (OAR 629-035-0010 6(b), OAR 629-035-0020 1(b) and 2(a)).

Many laws and programs apply to water resources and the protection of aquatic organisms (e.g. ESA, Clean Water Act, Oregon water law, water rights, the Oregon Plan for Salmon and Healthy Watersheds, Oregon Fish Passage Laws, and the FPA). Several state and federal agencies manage specific aspects of aquatic resources. SOC lists, including threatened and endangered, are compiled by the National Marine Fisheries Service, USFWS, and ODFW. Water quality issues are overseen by the EPA and Department of Environmental Quality. Maintaining navigable waterways, issuing removal and fill permits, and managing wetlands falls primarily under the guidance of US Army Corps of Engineers and Department of State Lands.

Aquatic ecosystems interact closely with the surrounding terrestrial systems, both at the landscape scale and at the scale of stream reaches and riparian zones. Major disturbance events (e.g. floods, landslides) are normal processes that can add key elements for properly functioning stream ecosystems (e.g. wood, boulders and gravel). Therefore, the resilience of the aquatic system depends upon forest management practices that protect, maintain, and enhance the functions and processes that compose these terrestrial-aquatic interactions at a variety of scales.

Conceptually, the riparian area is the zone of influence between the terrestrial and aquatic environments. Riparian forests can have a profound influence on the aquatic environment, such as influencing water temperature, and provides inputs that benefit aquatic ecosystems (e.g. wood and other organic matter). Conversely, the structure and composition of riparian forests can be influenced by the aquatic environment, such as the influence of floods on forest dynamics and the deposition or erosion of material in the floodplain.

ODF's Ownership in a Watershed Context

The United States Geological Survey has adopted a scheme to classify water resources over the continental United States. This scheme defines a nested series of hydrologic units that range from region (21 total in the US) to subwatershed. Each is identified by a unique hydrologic unit code (HUC) that ranges from a 2-digit code (the largest area, region) to a 12-digit code (the smallest area, subwatershed).

Using this scheme, the planning region falls within four sub-regions (6-digit HUCs): Lower Columbia, Northern Oregon Coastal, Southern Oregon Coastal, and the Willamette. Streams within these sub-regions drain directly into either the Pacific Ocean, the Columbia River, or the Willamette River. These sub-regions are relatively distinct in both the physical template and the biological communities.

District and sub-region boundaries generally do not coincide and districts with multiple sub-regions contain highly diverse aquatic resources. Three districts (Tillamook, Coos Bay and Southwest Oregon) are completely within a sub-region where all streams flow to the Pacific Ocean. North Cascade District is mainly in the Willamette sub-region, with a smaller portion in the Lower Columbia sub-region. Astoria District is in two sub-regions with streams that drain either into the lower Columbia or the Pacific Ocean. West Oregon and Western Lane Districts are both in the Northern Oregon Coastal and Willamette sub-regions. Forest Grove District is in three sub-regions, containing streams that flow into the lower Columbia, Willamette, and Pacific Ocean.

The subwatershed (HUC-12) is the finest resolution, with a median area of 17,000 acres in the planning region. The HUC-12 is a convenient scale to manage aquatic resources (e.g. protect, restore, enhance), provided enough of the HUC-12 is in State Forests' ownership. There are 232 HUC-12 areas that contain at least one acre of state forests.

State forests comprise a small proportion of the landscape. Ownership by HUC-12 is only 3%. Most state forests are concentrated in the Astoria, Forest Grove, and Tillamook Districts where the median percentage of State Forests' ownership by HUC-12 is 26% (range <1% to 100%) (Figure 22). These are the subwatersheds where ODF can influence protecting, restoring, and enhancing aquatic resources. Some HUC-12s in other districts have a relatively large proportion of state forests (e.g. up to 77% for North Cascade, 36% for Western Lane/West Oregon, and 28% for Coos Bay/Southwest Oregon). ODF ownership within the remaining districts by HUC-12 is low (<2%) (Figure 22).

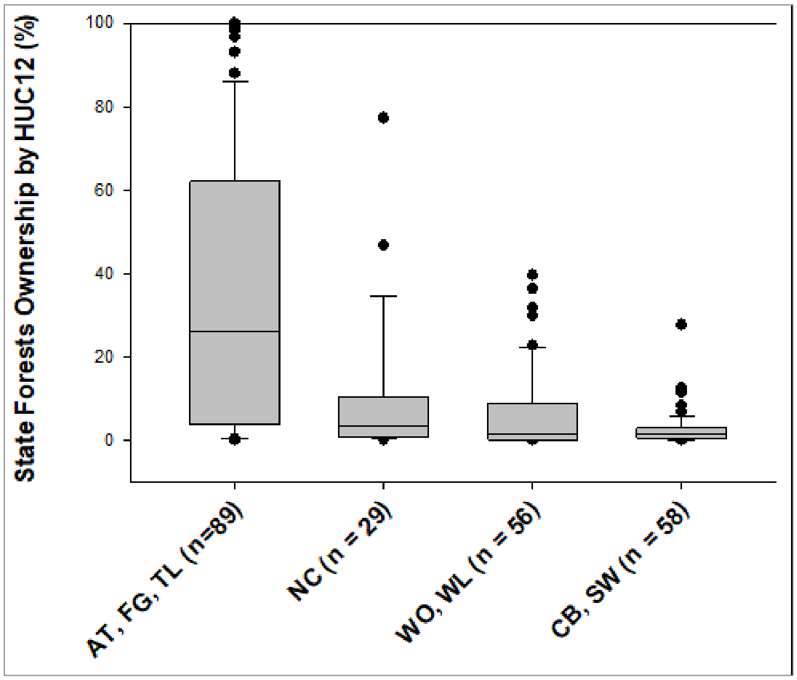

Figure 22. Percentage of state forests ownership in HUC-12 by district group. Shaded portion of the box plots show the 25th to 75th inner quartile range with the median represented by the solid line within the box. Whiskers are the 10th and 90th percentile and the outliers represented with filled circles. District abbreviations: AT = Astoria, FG = Forest Grove, TL = Tillamook, NC = North Cascade, WO = West Oregon, WL = Western Lane, CB = Coos Bay, SW = Southwest Oregon.

Stream Classification and Abundance

Streams are classified by the presence of fish or absence of fish, domestic water use, persistence of flow, and stream size using the following criteria:

1. Fish presence or Absence:
   a. Type F streams are waters that are inhabited at any time of the year by anadromous or game fish species, or by fish species that are listed as threatened or endangered under either federal or state Endangered Species Acts. The FPA designates streams as having salmon, steelhead, or bull trout (SSBT). SSBT streams are subset of Type F streams as designated for this FMP. On State Forests- Type F streams include streams with other native fish such as cutthroat trout in addition to the SSBT streams.
   b. Type N streams are uninhabited by native or game fish.
2. Domestic Water Use (Type D): These streams are designated as a source for domestic water use.
3. Stream size:
   a. Three size classes are defined in Oregon based on average annual daily flow in cubic feet per second (cfs):
      i. Small (≤ 2 cfs),
      ii. Medium (> 2 cfs, and < 10 cfs)
      iii. Large (≥10 cfs)
4. Persistence of flow:
   a. Perennial Type N streams are expected to have summer surface flow after July 15.

   b. Seasonal Type N streams only flow during portions of the year; these streams are not expected to have summer surface flow after July 15.

5. Potential debris flow prone: Some seasonal non-fish-bearing streams are further classified as having a high probability of delivering woody debris to a Type F stream. The following criteria must be met.
   a. The seasonal stream reach must initiate at or below a high risk site. High risk sites include:
      i. Active landslides (slopes with tension cracks, unvegetated soil scarps, or trees in a jackstraw pile caused by slope movement).
      ii. Slopes steeper than 80 percent, excluding competent rock outcrops.
      iii. Headwalls or draws steeper than 70 percent.
      iv. Abrupt slope breaks, where the lower slope is the steeper and exceeds 70 percent, except where the steeper slope is a competent rock outcrop.
      v. Incised channels (hill slopes adjacent to the channel and steeper than the upland slope) with slopes steeper than 60 percent.
      vi. Any other site determined to be of marginal stability by a Department of Forestry geotechnical specialist.
   b. The path of a potential debris flow and the likelihood that a debris flow will reach a Type F stream. If any one of the following three conditions is present along the path from the high-risk site to the Type F stream, then a debris flow is likely to stop and the stream reach would be determined to have a low probability of woody debris delivery:
      i. The presence of a channel junction that is 70 degrees or more, provided the channel downstream of the junction is less than 35 percent gradient.
      ii. The presence of a stream reach which is less than 6 percent gradient for at least 300 feet.
      iii. An average slope from the high-risk site along the potential landslide path to the stream that is less than 20 percent.

There are 8,239 miles of streams. Nearly 60% of streams are seasonal non-fish streams and approximately 17% of the streams are fish-bearing (Table 1Table 5). Tillamook District has almost half of all the streams by length.

Table 5. Estimated stream length and percent within each district by stream type.

District	Fish Miles	Non-fish miles	Seasonal Non-Fish miles	Total Miles (percent)
Astoria	422	387	1,261	2,070 (25.1%)
Forest Grove	155	292	417	864 (10.5%)
Tillamook	511	885	2,715	4,111 (49.9%)
North Cascade	93	185	78	356 (4.3%)
West Oregon	125	58	167	350 (4.2%)
Western Lane	59	35	128	223 (2.7%)
Coos Bay	30	12	67	109 (1.3%)
Southwest	14	52	91	157 (1.9%)
Total	1,408 (17.1%)	1,906 (23.1%)	4,925 (59.8%)	8,239

Riparian Habitat

The current conditions of the riparian forests are a product of both the natural and anthropogenic disturbance regimes. Natural disturbances (e.g. fire, windthrow, disease) can be influenced by land use practices. For example, the Tillamook Burn was a series of large fires that occurred from 1933-1951 over much of state forests. These fires often left riparian areas and uplands with little vegetation to hold soil in place and shade streams. In the Tillamook Burn rehabilitation, salvage logging was done before new trees were planted. Many snags were removed that could have provided large wood to the streams.

Extensive logging occurred on most of the lands prior to becoming state forests. Historic logging and road-building practices did not protect streams and riparian areas. Riparian forests were usually harvested with upland forests and large logs were frequently removed from streams. Timber harvest practices did not attempt to maintain large conifers and fallen trees in riparian and aquatic habitats.

As a result of historical logging practices, fires, and natural disturbances, many streams have limited mature conifer forest in their riparian areas and few large logs in the streams. Instead, riparian areas often have 60-70 years old conifers, alder, and other hardwoods.

According to recent studies by ODFW of Oregon's coastal streams, there is a lack of large wood in streams and large conifers in riparian areas. The area's history of large fires and historic logging practices resulting in an abundance of young riparian forests. Habitat attributes (e.g. large wood abundance, large wood key pieces) can be addressed on a short-term basis through stream habitat enhancement. However, riparian areas must be managed to provide the full complement of riparian functions, including the long-term supply of wood to streams. This requires riparian buffers of sufficient widths be maintained as no-harvest areas and managed to obtain mature to old growth conditions.

Domestic Water Sources

There are some domestic water supply sources on state forest land (Table 6), but the number and type varies greatly by District.

Table 6. Registered domestic water sources by type in each District.

Districts	Total Registered Points of Diversion
Astoria	**45**
Spring	9
Stream	30
Well	6
Tillamook	**77**
Spring	14
Stream	63
Forest Grove	**8**
Spring	2
Stream	6
North Cascade	**16**
Spring	4
Stream	12
West Oregon	**4**
Spring	2
Stream	2
Western Lane	**5**
Spring	3
Stream	2
Coos	**6**
Spring	2
Stream	4
Southwest	**5**
Spring	1
Stream	4
Grand Total	**166**

Other Aquatic Features

Other aquatic features include wetlands, lakes, ponds, estuaries, bogs, seeps, and springs. Wetlands are often near streams or have trees, but they are ecologically distinct from streams and forests. The FPA identifies three major types of wetlands: significant wetlands, stream-associated wetlands, and other wetlands. Significant wetlands are defined as bogs, estuaries, and both forested and non-forested wetlands larger than eight acres.

For state forests, most wetlands are along stream channels and are forested with red alder. Other wetlands are identified as seeps and wet areas under the forest canopy and are usually associated with red alder, devil's club, and skunk cabbage. Many wetlands have conifers (e.g. Sitka spruce wetlands in the coastal spruce zone). A few Cascades wetlands have sedges and tag alder stands.

Fish and Other Aquatic Biota

The stream/riparian forest network is a prominent feature of a watershed that commonly has the highest diversity of species within the landscape. Streams, rivers, lakes, and other water bodies that compose the stream network provide habitats for a variety of aquatic species. At least 28 species of fish use habitats in the plan area for part or all of their life history or use habitats downstream from state forests that may be influenced by state forest management. Native salmonid species in state forests include fall and spring races of Chinook salmon, coho salmon, chum salmon, winter and summer steelhead trout, resident populations of rainbow trout, and both anadromous and resident races of cutthroat trout. Other native fishes include species of lamprey, sculpin, dace, chub, sucker, and more.

The riparian forests support a diverse array of plants, birds, mammals, and insects. At least 32 species of reptiles and amphibians occur on state forests. Approximately half of these species (e.g. giant pacific salamander, coastal tailed frog) depend on an aquatic environment for at least part of their life cycle. In addition to vertebrates, aquatic systems support a diverse array of organisms (e.g. algae, higher plants, insects, mollusks, crustaceans, invertebrates).

Threatened and Endangered Fish Species

Several salmon and trout species listed under the ESA occur in state forests (Table 7). The salmon listings are based on evolutionarily significant units (ESUs) within a species, which can result in multiple listings for the same species. For example, there are three listed Coho ESUs in the planning region: Oregon Coastal, Lower Columbia, and Southern Oregon/Northern California. The most prominent listed fish species in state forests is the Oregon Coastal Coho Salmon, which occurs in 447 miles of stream. This accounts on BOF lands, accounting for 7% of the total Coho streams of the ESU (Table 7). There are multiple examples of occurrences in state forests:

- Lower Columbia Steelhead were found on a small parcel on the North Cascade District within Clackamas County along Boulder Creek, a tributary of the Salmon River.
- Bull trout had two occurrences on the Western Lane District: a 660-acre parcel near Dexter Reservoir and a 40-acre parcel along the Blue River tributary.

Table 7. Miles of stream habitat (https://www.streamnet.org/) for listed salmon species within the planning region by land ownership. This analysis includes all fish distributions for any sub-watershed (HUC-12) that was at least partially within a State Forests district.

Federally Listed ESUs	BOF Miles	Federal miles	NFPL miles	Private miles	Total miles (% of miles on BOF lands)
OR Coast Coho Salmon	446.7	1451.9	198.1	4328.7	6,425.4 (7.0%)
L. Columbia Coho Salmon	23.9	185.1	31.2	518.5	758.6 (3.1%)
S.OR N. CA. Coho Salmon	<0.1	482.1	13.9	706.9	1,202.8 (0%)
L. Columbia Chinook Salmon	5.9	133.8	40.1	194.2	374.1 (1.6%)
U. Willamette Chinook Salmon	3.9	442.7	12.3	659.0	1,117.9 (0.4%)
U. Willamette Steelhead	23.0	141.0	14.3	815.8	994 (2.3%)
L. Columbia Steelhead	<0.1	307.1	30.9	213.1	551.1 (0%)
Columbia Chum Salmon	0.3	0.0	0.0	2.3	2.6 (11.6%)

Stream Restoration on State Forests

State Forests has participated in the Oregon Plan for Salmon and Watersheds since its inception in 1995. Activities in state forests that contribute to the recovery effort of Coho, (as defined by the Oregon Water Enhancement Board (OWEB), include projects that directly improve in-stream habitat and road-related projects that remove salmon migration barriers, decouple road drainage systems, and reduce sediment delivery to streams (Table 8).

Table 8. Selected in-stream and road projects reported to OWEB, 1995-2017, by district groups. Abbreviations for districts are as follows: AT = Astoria, FG = Forest Grove, TL = Tillamook, NC = North Cascade, WO = West Oregon, WL = Western Land, CB = Coos Bay, SW = Southwest.

Enhancement Projects	District			
	AT, FG, TL	NC, WO	WL, CB, SW	Total
No. In-stream Projects	98	29	65	192
No. Trees Donated	3,590	1,037	2,582	7,209
Miles of Stream Enhanced	80	27	60	168
No. Fish Barriers Removed	227	45	51	323
Miles of Fish Access Restored	167	41	50	258
No. Type N Crossing Fixed	1,590	589	113	2,292
No. of Road Relief Culverts Installed	3,567	668	188	4,423
Miles of Road Closed or Vacated	104	11	43	158
Miles of Road Improved or Relocated	1,001	80	67	1,148
ODF In-kind Contribution	$38,454,479	$3,744,474	$3,242,462	$45,441,415
Other Contributions	$4,560,853	$791,949	$4,791,080	$10,143,882

Forest Health

State forests provide a variety of benefits (e.g., clean water, recreation, wildlife habitat, timber, ecosystem services). Forest health is directly related to the forest's ability to increase or maintain productivity while maintaining resistance to biotic and abiotic stressors. Fire, windstorms, ice storms, people, insects, and diseases can impact forest health, injuring or killing trees and other living things. Disturbances are natural and necessary processes of the forest ecosystem. However, if disturbance effects are more severe and widespread than what is considered acceptable, the forest is often described as unhealthy.

A comprehensive assessment of ecosystem health is beyond the FMP scope, but several key indicators of forest health can be evaluated. Key indicators include levels and trends of damage from insects, disease, animals, and abiotic stressors such as fire and weather extremes. The effects of disturbance agents are described as: number of acres affected, number of trees killed, degree of damage, and/or reduction in tree growth rates. All of these are measured through survey techniques.

Because they have a unique history, many state forests are now at a critical point in terms of forest health. Much of the Tillamook Burn was planted or seeded with Douglas-fir from non-local seed sources, with unknown long-term consequences. The recent dramatic upswing of SNC damage is a warning that the Tillamook and Clatsop forests may not be as healthy as once thought.

For state forests, the current condition can be ascertained by long-term trends in damage from major disturbance agents. Although state forests in western Oregon do not have the widespread deterioration of forests that has occurred in eastern Oregon, several diseases have reached noticeable levels of damage in recent decades. Swiss needle cast, the highly visible foliage disease of Douglas-fir in the Coast Range, is causing serious growth decline over a large area on the west side of the Coast Range, especially in the Tillamook District. Growth reduction is severe enough on some sites that the future of many stands is uncertain.

Douglas-fir has been grown and harvested repeatedly on sites infested with the fungus *Phellinus weirii*, often increasing the amount and severity of laminated root rot. However, current management practices should stabilize or reduce unwanted effects of this disease. Black stain root disease was largely unheard of before 1969. Since then, it has reached epidemic proportions in southwest Oregon and now can be found at low levels throughout young Douglas-fir stands in northwest Oregon.

Relatively few insect problems occur in the early- to mid-successional Douglas-fir and western hemlock stands that are common on state forests. The most significant pest is the Douglas-fir bark beetle, whose outbreaks follow major wind storm events or root rot pockets. The Sitka spruce weevil continues to limit Sitka spruce planting by altering tree form and reducing its merchantable volume. However, with climate change scenarios predicting hotter drier summers and inconsistent precipitation, drought stressed trees will provide more favorable conditions and hosts for insect outbreaks.

Bear damage is a significant problem in some young Douglas-fir stands. Tree mortality in any year or specific area is usually low, but cumulative mortality over many years at the same site can be significant. Damage to the lower bole of the tree may not always cause mortality, but certainly effects productivity and defect of the tree. This is especially true when damage occurs in pre-commercially thinned (PCT) stands. Since current management practices for young stands produce favorable bear habitat, the problem of bear damage is likely to persist.

Invasive species, including exotic weeds, insects, and pathogens, currently create problems. Scotch broom and Himalayan blackberry, the state's costliest weeds at nearly $80 million annually due to lost timber revenue and direct control measures, are prevalent through most of the region (Oregon Department of Agriculture). European and Asian Gypsy moth, while not established in Oregon, have the potential to have long lasting negative impacts on state forests if they were to establish. Emerald ash borer has caused significant damage to ash trees across the United States. If it invades Oregon, it would cause local extinction within 10-20 years, likely causing changes in stream temperatures and associated changes in plant animal communities in riparian areas below 2000' elevation. Increasing popularity of recreational activities in state forests increases the likelihood of new invasive species being introduced, which, in turn, could affect long-term forest health.

There is no question that management has altered ecosystems for state forests. However, foresters do not yet fully understand the effects of management on forest health and tree susceptibility to pests and abiotic stresses. Continued monitoring using aerial and ground surveys and detection trapping should provide early warning of new problems and gradually improve our ability to maintain a healthy forest.

Forest Diseases

Swiss Needle Cast

Swiss needle cast (SNC) is a native foliage disease of Douglas-fir that has intensified on coastal lands managed by ODF since 2010 (Figure 23). It affects trees of all ages and causes premature loss of needles, especially in the upper crown. This reduces tree growth and vigor across affected acres. The growth reduction, especially if sustained, will not only decrease yields but will also affect our ability to manage stands into desired future conditions. While native throughout the range of Douglas-fir, SNC is most prevalent on the west slopes of the northern Coast Range from the coastline to 28 miles inland. There are approximately 531,000 acres of forests affected across all ownerships in the coast range.

2018 SNC Survey Results

The 2018 SNC aerial survey detected approximately 53,000 acres of moderate to severe SNC infection (roughly 90% of infected acres being moderate), however it should be noted that the aerial survey is an approximation, and does not capture the full extent of SNC on state forests. The majority of acres are concentrated on the Astoria and Tillamook Districts (48,000 acres), followed by West Oregon (5,000 acres), and the remaing acres split evenly between Forest Grove, Coos, and North Cascade Districts (Table 9). In 2016 and 2018, SNC was detected in the North Cascade District for the first time, well outside the traditional 28 mile infection zone. Conversion of infected stands is the best management option. Conversion removes maladapted Douglas-fir and replaces with species unaffected by SNC. SNC management costs typically exceeds ODF's share of the revenues, further increasing the difficulty of managing these stands.

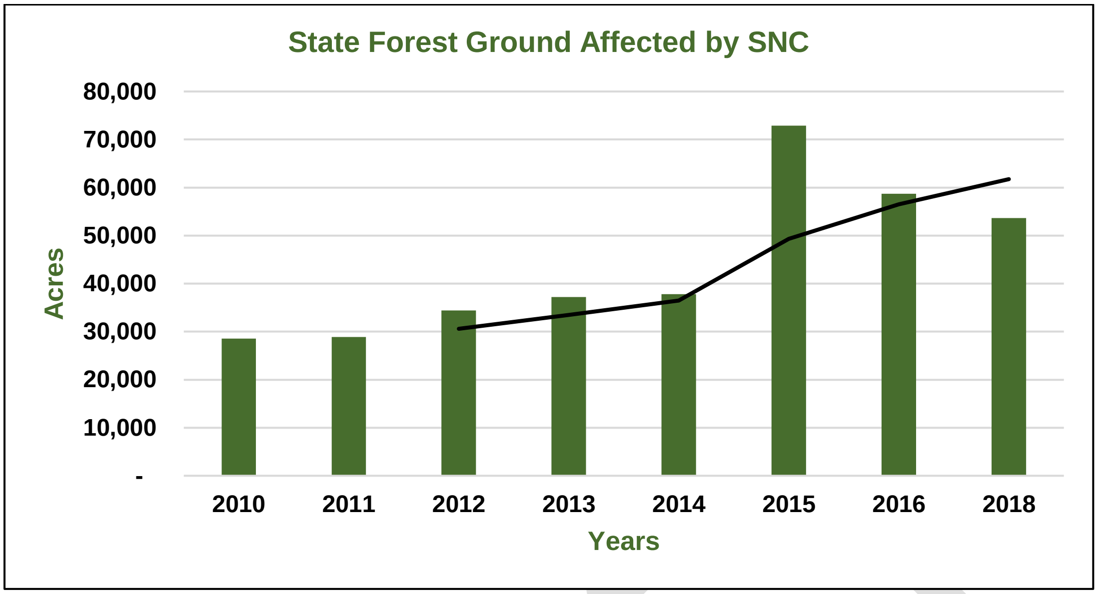

Figure 23. SNC infected acres across state forest ownership since 2010, with a rolling three-year average.

Table 9. Aerial survey results of SNC affected acres on Board of Forestry lands from the 2018 aerial survey.

District	Acres Affected
Astoria	12,319
Tillamook	35,909
West Oregon	4,196
Remaining Districts	1,478

Laminated Root Rot

Laminated root rot (*Phellinus weirii*), a native fungal disease that affects many conifer species, is the most widespread and destructive root disease of Douglas-fir in the Coast Range and western Cascades. On average, it affects about 5% of the Douglas-fir forest land. However, it is distributed unevenly. Surveys show that in northwest Oregon state forests at least 10% of the Douglas-fir type is affected. The area affected in individual stands ranges from 0% to over 75%. The most susceptible hosts are Douglas-fir, grand fir, and mountain hemlock. Western hemlock and noble fir have intermediate susceptibility, pines and cedars are resistant, and hardwoods are immune. Trees killed by the disease provide snags and down logs which benefit certain wildlife species. The increased diversity and benefits to wildlife partially offset the large volume of timber lost to this disease.

Armillaria Root Disease

Armillaria root disease is far less abundant and damaging than laminated root rot, but occasionally causes significant damage in young Douglas-fir plantations. Root disease surveys have shown that in the northwest Oregon state forests armillaria is widely scattered and occurs in small patches, usually affecting only a few trees. Scattered dead trees from armillaria have a positive value for wildlife habitat.

Black Stain Root Disease

Black stain root disease, caused by the fungus *Leptographium wageneri*, was largely unrecognized in the Pacific Northwest before 1969. Since then, the disease has been detected in many areas, but is thought to be more localized in southwest Oregon. In recent years, reports of black stain in young, intensively managed Douglas-fir stands have increased dramatically in the northwest Oregon, especially around Hagg Lake outside Forest Grove. Under severe infection, mortality can be as high as 50% in 10-30 year old stands.

Annosum Root Disease

Annosum root disease affects western hemlock, mountain hemlock, grand fir, and noble fir. The most significant damage occurs on western hemlock. Most decay is associated with wounds and is confined to woody tissues present when the trees are wounded. Losses due to annosus butt decay in hemlock stands tend to be small unless trees are older than 120 years or are badly wounded.

Hemlock Dwarf Mistletoe

Hemlock dwarf mistletoe (*Arceuthobium tsugense*) is the only dwarf mistletoe that occurs on state forests. The principal hosts are western and mountain hemlock, each having its own subspecies of dwarf mistletoe, but several true firs also can be damaged. Dwarf mistletoes are flowering seed plants that parasitize conifer trees by growing root-like structures directly into tree branches. They extract nutrients and water from host trees and cause mortality, growth loss, deformation of tree form and crown structure, and reduced seed production.. In heavily infested stands, hemlock dwarf mistletoe can reduce wood volume by as much as 40%. Infected trees are predisposed to damage from other stressors (e.g. drought, bark beetles). Hemlock dwarf mistletoe can also provide food and habitat for certain wildlife species. For example, marbled murrelets have been observed nesting on hemlock branches deformed by dwarf mistletoe.

White Pine Blister Rust

White pine blister rust is caused by the invasive fungus *Cronartium ribicola* that was introduced from Europe into British Columia in 1910. Western white pine has been decimated throughout its range. Special management considerations (e.g. pruning, planting resistant seedlings) are necessary to increase survival chances.

Stem Decay

In old growth stands, decay organisms cause tree death or breakage, creating gaps in the canopy and providing rotten wood and hollow logs for wildlife. In areas with younger stands, the main concern may be the lack of decay and defect and its probable effect on wildlife and ecosystem processes.

Forest Insects

Douglas-fir Bark Beetle

In western Oregon, the Douglas-fir bark beetle is the most significant insect pest to western Oregon state forests. They usually infest windthrown, diseased or droughted Douglas-fir trees. When a major windstorm occurs, the large supply of Douglas-fir breeding logs allows beetle populations to increase tremendously. Unless the large (more that 12” in diameter) windthrown Douglas-firs are salvaged rapidly, a bark beetle outbreak can occur when the emerging brood attacks nearby standing green trees. Outbreaks typically last two to four years, though can be prolonged when conditions are favorable.

Spruce Weevil

The Sitka spruce weevil is a significant pest of Sitka spruce regeneration in coastal Oregon. It can severely damage young, open-grown Sitka spruce. The most severe damage occurs 10- 25 miles from the coastline, along the eastern edge of the Sitka spruce range. On these eastern sites, it is recommended that other appropiate species be planted (e.g. SNC tolerant Douglas-fir, western hemlock, western redcedar, grand fir, red alder). Research suggests that a combination of higher planting densities, resistant seed, and site selection may reduce the impact of infestations. In 2018, a spruce weevil outbreak occurred, severly impacting young Sitka spurce stands along the Oregon coast.

Balsam Wooly Adelgid

The balsam wooly adelgid is an invasive species introduced from Europe that has caused significant mortality in true fir species in western forests. The adelgid infests branches and gradually reduces tree growth and vigor, eventually causing tree mortality. In more serious outbreaks, the adelgid attacks the main bole of the tree in large numbers, girdling the tree and causing death in two to three years.

Ips Beetles (Ips spp.)

The pine engraver and California five-spined ips are significant pests for pine in Oregon. Outbreaks usually last one year. However, in severe drought years, outbreaks can last for two to three years as trees become more stressed. Populations can be increased by having large amounts of their preferred host, fresh pine slash, from harvest or a disturbance event. Populations build up in slash then spread to standing green trees.

Western Pine Beetle

The western pine beetle can cause significant mortality in ponderosa pine trees greater than 12” in diameter. Infestations commonly occur in dense, overstocked, even-aged stands. During outbreaks, western pine beetle can cause forest cover change at the landscape level.

Spruce Aphid

Spruce aphid is an invasive species that causes premature loss of older needles in Sitka spruce and eventually kills branches or the entire tree. Much of the spruce decline visible along the Oregon coast is attributable to the spuce aphid.

Emerald Ash Borer

The emerald ash borer is an invasive species that was introduced to North American in 2002 and has since killed over 50 million ash trees across the country. While not currently in Oregon, it is reasonable to believe that it will appear in the near future. The Oregon ash, an important riparian species in the cascade and coast range, is highly succeptable to infestation. A widespread outbreak of emerald ash borer has the potential to radically alter riparian forests and impact native bird and fish populations.

Gypsy Moth

Gypsy moth is an invasive species whose caterpillars feed on 500 tree and shrub species, including hardwoods and conifers. There are two subspecies that threaten forest resources. The European gypsy moth (EGM) is native to temperate forests of Western Europe and was introduced to the eastern U.S. in 1869. It has spread to 20 states and four Canadian provinces. The Asian gypsy moth (AGM) is native to southern Europe, northern Africa, Asia and parts of the Pacific, but is not established in the United States. Both EGM and AGM would cause long-lasting effects on Oregon's forest economy and ecology if they were to establish in the state.

Plants

Noxious Weeds

Noxious weeds are terrestrial, aquatic or marine plants designated by the State Weed Board under ORS 569.615 as among those representing the greatest public menace and as a top priority for action by weed control programs. Depending on the classification, ODF is responsible for developing and implementing an eradication plan. Currently, there are roughly 120 species of noxious weed across Oregon; many of these species occur in state forests. The most common (e.g. Scotch broom, Himalayan blackberry, Canada thistle, bull thistle, Japanese knotweed) are well established in state forests. Other exotic species on the state's noxious weed list are expanding in state forests (e.g. false brome, English ivy, garlic mustard, exotic geraniums). While not on the noxious weed list, a number of exotic weeds can impact reforestation and harm wildlife (e.g. foxglove, woodland groundsel, oxeye daisy, English holly).

The most common way for new exotic or noxious weeds to be introduced is through recreation, logging equipment, or worker transportation. With increased activity across state forests, new threats will surely be introduced, which could have long-term negative impacts.

Other

Drought

Droughts can take a huge toll on Oregon's conifer trees. Often, it is the primary cause of dead branches, tree tops or whole trees. Trees may respond to drought stress by reducing root and stem growth, dropping more needles, or by producing an abnormally high number of cones (stress crop). Symptoms of summer droughts are not typically visible until the following spring, although recent droughts have been severe enough for symptoms to appear in late summer or fall. Many trees being affected have survived previous droughts, even on marginal sites. But past stresses and increasing water requirements due to their large size have reduced their resiliency. Drought stressed trees are often subsequently attacked by secondary agents (e.g. insects, pathogens).

Firewood

With increased recreation, there is increased potential for non-native pests to be introduced via firewood transport. Both native and non-native pests and diseases can be transported via firewood and has the potential to dramatically alter the landscape. There are many non-native and native insects and fungi that should be prevented from infesting state forests, including exotic emerald ash borer (*Agrilus planipennis*), Asian long-horned beetle (*Anoplophora glabripennis*), gypsy moth (*Lymantria dispar*), and the pathogen responsible for sudden oak death (*Phytophthora ramorum*) (Jacobi et al 2011).

Plants

State forests have hundreds of understory plant species that fill many roles in the forest ecosystem. They provide organic matter to forest soils, influence micro-climate and are used as cover and forage by many animals. In addition to their ecological functions, some plant species (e.g. beargrass, sword fern) are harvested commercially or for cultural uses. Commercial uses of understory plants are discussed in the Special Forest Products section.

There are six plant species listed under Oregon's ESA as threatened, endangered, candidate, or rare: Coast Range fawn lily, Nelson's checkermallow, Saddle Mountain bittercress, cold-water corydalis, Chambers' paintbrush, and frigid shooting star. Most of these species occur in non-forested areas (e.g. high elevation rocky areas, open meadows, bluffs, coastal areas). ODF is not aware of other federally-listed threatened or endangered plant species on state forests lands.

There is no comprehensive assessment or basic systematic survey for threatened and endangered plants on state forests. The Oregon Biodiversity Information Center provides the species and known locations of rare, threatened, and endangered plants that may be found on state forests. In the late 1980s, surveys were done specifically for the Nelson's checkermallow (*Sidalcea nelsoniana*) in the TSF (Forest Grove District) in cooperation with propagation studies sponsored by the city of McMinnville.

Current Management

ODF protects listed plant species in accordance with state and federal ESAs. ODF has identified listed species that occur or are suspected to occur in state forests and updates these lists in consultation with the Oregon Department of Agriculture. During plan implementation, districts determine if listed species occur or are likely to occur on lands where management activities are planned. If so, the district determines if the proposed action is consistent with the conservation program for the listed species established by the Oregon Department of Agriculture and whether specific protection or mitigation measures are warranted.

Air Quality

Timber harvest results in a large quantity of debris material (e.g. limbs, tops, non-merchantable material). Leftover debris can be a barrier to tree planting, a fire hazard, and increase potential for pest infestations. To eliminate the fire hazard and prepare the ground for tree planting, fire can be used as a tool to remove this material. This burning can affect air quality and is regulated under the federal Clean Air Act, the primary law regulating air quality. Under the law, the federal EPA sets National Ambient Air Quality Standards.

The authority to implement the law is delegated to the states. In Oregon, the state's Department of Environmental Quality develops and carries out programs to meet the national air quality standards. Two air quality plans affect forest management directly: the Oregon Smoke Management Plan and the Oregon Visibility Protection Plan. The Smoke Management Plan (OAR 629-048) is intended to comply with the Oregon Visibility Protection Plan (OAR 340-200-0040, Section 5.2).

The Oregon Smoke Management Plan regulates prescribed burning on all forest lands in Oregon, including federal, state, and privately owned lands. Some of its objectives are to protect public health, minimize smoke intrusions into designated population areas, reduce emissions from prescribed burning in western Oregon, and protect visibility in Class I areas. Class I areas include National Parks and certain wilderness areas (OAR 629-048-0005(5)). Appendix D has more information on laws and programs affecting air quality.

Burning is much less common than it was historically. The average annual amount of fuels burned on state forests from 2000-2013 is about 25% of the amount burned annually in the 80s and 90s. Current annual levels of burning on state forests represent less than 10% of the total burning annually in the six districts. It is estimated that prescribed burning on state lands is currently responsible for much less than 1% of the air pollution in northwest Oregon cities.

There are a number of reasons for the decline in burning on state lands:

- Lower quantities of slash are associated with second- and third-growth forest.
- More small-diameter wood is now utilized, reducing the amount of slash.
- Machinery is often used in place of burning to prepare for tree planting.

With less slash, most units are not burned at all. When burning is used on state forests, slash is typically piled on a landing or in areas within the harvest unit and burned. On other units, spot burns treat just the pockets of heavy slash concentrations. Most broadcast prescribed burns are generally scheduled during spring-like conditions when fine fuels are dry but mid-sized fuels do not burn completely.

Forest Carbon

Forest carbon is atmospheric carbon dioxide that is absorbed by trees and other vegetation through the process of photosynthesis and released during respiration and decomposition (Figure 24). When a forest absorbs more carbon than it releases through harvest, decomposition, and respiration it is considered to be a carbon sink. Conversely, if a forest releases more carbon than it absorbs, it is considered to be a carbon source. Mature forests provide long-term in-situ storage of sequestered carbon in large trees, snags, down wood, vegetation, and soils. Harvesting shifts a portion of the sequestered carbon from the living biomass of trees to harvested wood products and other carbon pools. Harvest residues can be burned for energy or left on-site to decay. Regenerating decadent, poorly-stocked, or under-productive stands may improve forest carbon stores over time as relatively vigorous replacement stands accumulate carbon.

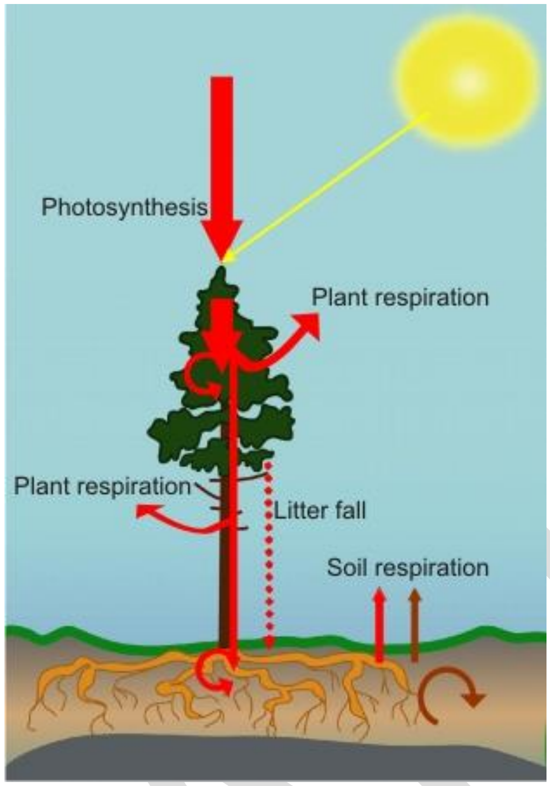

Figure 24. The forest carbon cycle. Source: http://www.hiilipuu.fi/articles/carbon-cycle.

State Forests allocates forest carbon stocks into five categories, or pools (Table 10). A sixth pool is recognized to account for harvested wood products. The carbon in each pool is typically estimated and tracked using forest inventory variables. Changes can be predicted with forest growth projection models. Carbon flows, or fluxes, describe the transitions among pools and atmospheric carbon. Stocks and flows vary by stand type, ecoregion, and management history.

Table 10. Forest Carbon Pools.

Forest Carbon Pools	Description	Proportion
Live Trees	Roots, bole, branches, bark, and foliage of live trees	38%
Standing Dead Trees	Roots, bole, branches, and bark of snags	3%
Fallen Dead Trees	Logs and large branches on the forest floor larger than 3 inches diameter	7%
Forest Floor	Litter, duff, and low vegetation	7%
Soil	Organic material, excluding coarse roots	45%
Harvested Wood Products	Lumber, panels, paper, containers, and landfill	--

Factors Affecting Forest Carbon

Species

Forest tree species vary in the rate and limits that carbon can be sequestered. Many factors affect the amount of carbon that is possible on a given acre of land (e.g. differences in bole form, branch position and foliage density).

The storage potential of carbon is also affected by species. The following example demonstrates why Douglas-fir stands store nearly double the carbon per unit area compared to red alder stands:

- **Life span:** A Douglas-fir is capable of living 500 years, while a red alder may live 90 years.
- **Decay rate:** Douglas-fir wood is more resistant to decay and persists as a snag or downed wood longer than red alder.
- **Tree height:** Douglas-fir is among the tallest tree species, capable of attaining heights over 300 feet, while alder is much shorter.
- **Volume per area:** Douglas-fir can achieve over 16,000 ft^3 per acre by age 80, while red alder on a productive site might grow to 10,000 ft^3 per acre by age 80.
- **Wood density:** On an oven-dry basis, Douglas-fir weighs 32 pounds per cubic foot: 14% more than red alder, which weighs 28.1 pounds per cubic foot.

As result of competitive advantages among species, mixed species stands may produce higher relative densities compared to single species stands, which can result in more carbon storage. Additionally, mixed species stands tend to be more resistant to insects and diseases. In the event of an outbreak that affects one species, the entire stand is not lost.

Site Productivity

Forest sites vary in their capacity to support forest growth and sequester atmospheric carbon. Site productivity is affected by many factors (e.g. ecoregion, slope, aspect, elevation, soil parent material, geology, local climate, management history). Generally, the moist forests of the Oregon Coast Range are among the most productive forests in the world and can accumulate vast quantities of carbon, though past disturbances reduced productivity on some state lands, particularly the Tillamook State Forest.

Conversely, forests in eastern Oregon persist in a climate with much lower annual precipitation, hot summers, and cold winters. This leads to a shorter growing season. Coupled with the prevalence of fire in the region, these forests accumulate and store a fraction of the carbon possible in coastal forests.

Stocking

Stocking refers to the number and size of trees per unit area. Generally stands with higher stocking capture and store more carbon. However, if a stand is overstocked, total growth could become limited due to competition for light, moisture, and other resources. Silvicultural practices (e.g. thinning) are designed to maintain individual tree vigor. In some cases a properly designed and executed density management regime may enhance forest carbon capture and storage.

Weather

Ice, wind, drought, and other weather related factors can affect a forests ability to sequester carbon. Trees, sometimes entire stands, can be toppled by wind and ice. Ice and wind can break tops out of trees, strip foliage, and break branches. While this may not immediately kill trees, it will likely reduce photosynthetic capacity and reduce carbon capture while the trees recover.

Drought reduces tree vigor. The stress of prolonged drought can leave trees vulnerable to secondary stressors (e.g. insects). In time, silvicultural practices (e.g. species composition, density management regimes) may need to be altered if drought or other adverse conditions persist due to climate change.

Wildfire

Wildfire results in carbon emissions, but research indicates that the effective release of carbon due to wildfire is much less than commonly assumed and depends greatly on fire intensity. Combustion varies by fire intensity and the size of the fuel component, which also affects the amount of carbon released. Duff, litter, low vegetation, foliage, and small branches, as well as small trees, snags, and down wood may be mostly or fully consumed. Large trees, snags, and down wood will often only be partially consumed, with the bulk of their biomass remaining intact. Trees damaged by fire may eventually die due to environmental stressors or attacks from insects. However, low to moderate intensity fires can have a regenerative effect on forests. Reforestation following wildfire can in some cases expedite the recovery of carbon sequestration capacity.

Harvest

All harvesting reduces forest carbon in the near term. Conversion of harvested trees into wood products results in long-term storage of some of the carbon. Residues left on site will decay or become incorporated into the soil. And some portion may be burned to prepare the site for planting or to reduce wildfire hazard. Waste material and byproducts of the milling and conversion process may be burned to generate heat or electricity, offsetting fossil fuel consumption for these purposes.

Thinning can potentially benefit forest health, reduce fuel hazards, and improve future product values, but can negatively impact forest carbon storage. It takes years following a thinning for a stand to return to pre-harvest forest carbon levels. A light thinning may take 15 years and a heavy thinning may take 50 years to return to pre-harvest forest carbon levels (Clark, et.al. 2011).

There is ongoing debate as to whether carbon stored in harvested wood products, substitution of fossil fuel intensive building materials, and biomass energy production from forest residuals is sufficient to offset the losses of in-forest carbon following harvest (OGWC 2018).

Climate Change

Climate change affects forest carbon in a variety of ways. Site-specific factors (e.g. temperature, precipitation, drought and other weather extremes) affect the ability of a forest to sequester carbon. While temperatures and drought may increase in Oregon during the summer, annual precipitation will likely increase and winter temperatures will be warmer, leading to a longer growing season. However, there is considerable uncertainty. It is also likely that insect and disease prevalence will increase, counteracting any gains in productivity. Shorter and warmer winters may also be detrimental to the physiology of tree species, affecting the timing of bud set and spring release.

Current Condition

Estimates of forest carbon stocks are derived from forest inventory data. There is a direct correlation between forest inventory and above-ground carbon. Dry biomass is 50% carbon. Empirical equations and ratios are used to estimate carbon in live trees, snags, and down wood from forest inventory data. Estimates of other forest carbon pools use standard methods that incorporate stand characteristics, forest type, and ecoregion. Estimates of forest carbon for State Forests are shown below (Table 11).

Table 11. Forest carbon estimates. Colors represent relative stocks ranging from low (red), moderate (yellow and orange), to high (green). Note: Values are preliminary. ODF is currently evaluating carbon accounting and reporting methodologies. Future carbon stock reports will use methods that represent best available science and will be consistent with methods developed by the USFS Forest Inventory and Accounting Program.

			Average Carbon Stocks (tons/acre)		
	Net Area	Total Stand	Above Ground	Merchantable	Below Ground
Astoria	131,959	101.6	48.0	35.7	53.6
Coos	10,754	86.2	45.8	34.3	40.5
Forest Grove	111,698	104.8	51.1	39.1	53.7
North Cascade	46,056	109.0	50.9	38.5	58.1
Southwest	16,391	75.1	45.6	31.6	29.5
Tillamook	246,195	97.4	43.8	31.5	53.6
Western Lane	24,698	116.3	60.8	46.7	55.5
West Oregon	35,505	93.3	49.7	38.0	43.6
Total	***623,256***	***100.2***	***47.6***	***35.3***	***52.6***

Geology, Soils and Slope Stability

The landscape upon which forest management of any scale occurs is controlled by historic geologic process and their resulting formations. Volcanic activity, sediment deposition, uplift, soil formation and erosion all provide the driving forces that give northwest Oregon its unique terrain. The soils, the most visible of the geologic materials, provide the bedding from which our forests grow. The success of this growth is determined largely by the soil character and slope aspect, both a function of the underlying formations and past geologic history. Soils and near-surface formations are moveable parts of the landscape. Landslides, part of the natural erosive process, are a testament to the changing nature of the terrain and can affect or be affected by forest management.

Geology

Volcanic activity below the ocean surface and offshore of an ancestral Oregon coastline, in conjunction with deposition of marine sediments derived from ancestral Cascades volcanism inland to the east, produced a submarine assemblage of volcanic rocks layered with marine siltstones, sandstones and mudstones.

Compression by tectonic activity uplifted and moved this assemblage of material east to be added to the ancient Oregon coastline. This uplift occurred later in the northwest portion of the planning area (north of the present day Tillamook Highlands) and, as a result, that area received deposition of much younger marine sediments as compared to other areas.

Concurrently, huge volumes of fluid basalt (flood basalts) flowed down the ancestral channel of the Columbia River Gorge into the developing low area of the Willamette Valley and made it to the present margin of the coastline throughout much of the northern planning area. These flood basalts seem to be absent in the area of the Tillamook Highlands and further south, indicating those areas were probably topographically higher at the time.

Erosion has modified this uplifted terrain to the highly dissected topographic expression that we observe today. Landslides, along with down cutting and transport of sediment by streams fueled by heavy rainfall, have produced the Coast Range. Concurrent tectonic activity produced periodic large earthquakes which may have triggered many of the largest, deep-seated ancient landslides observable today. Large swaths of land area in the north part of the planning area has been extensively altered by these mega, deep-seated landslides.

Concurrent with erosion along the coastal mountains, the high Cascade volcanic mountains were formed along the eastern margin of the planning area. After volcanism, major changes to topography in that area were not only affected by erosion processes similar to the coastal mountains, but also glaciation.

The net effect of geology, erosion and climate can be seen in the distribution of slopes steepness. Nearly one-third of the acreage is greater than 60% (Figure 25**Error! Reference source not found.**).

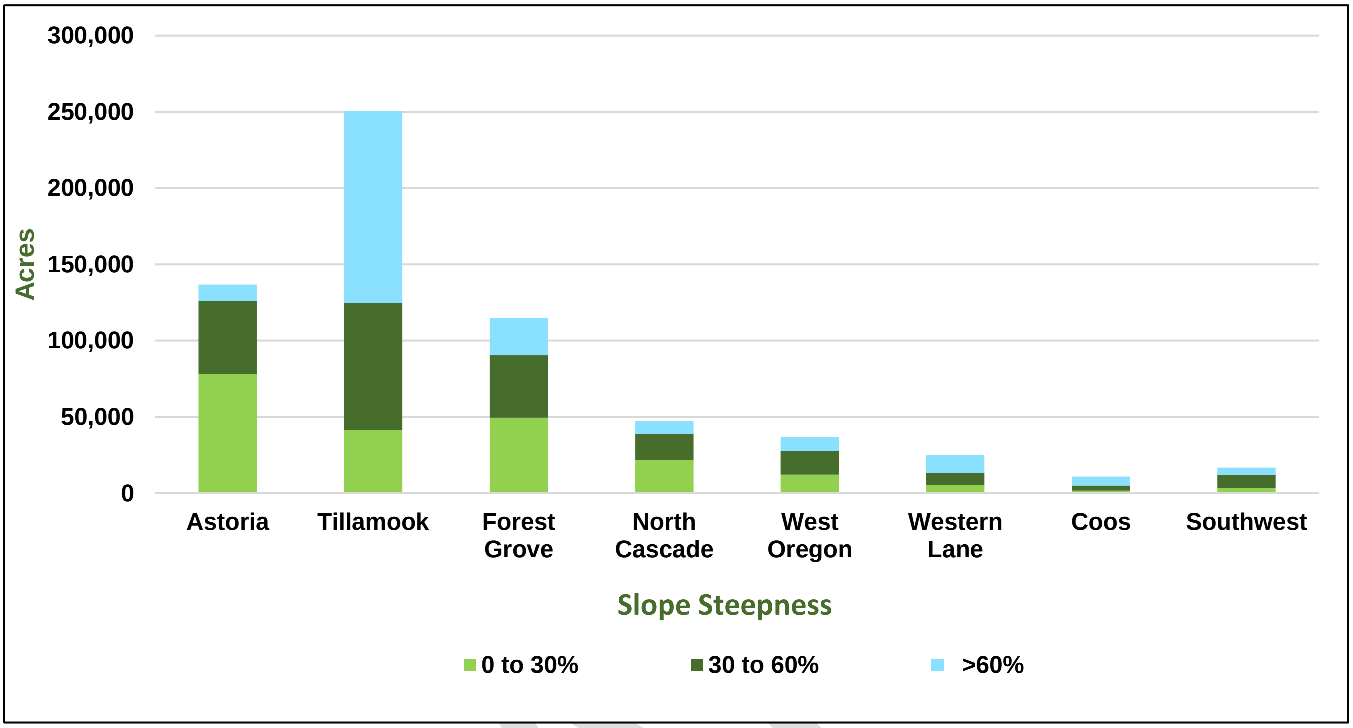

Figure 25. Slope steepness for each district.

Soils

From a geologic perspective there are three general soil types based on where they were formed. Soils formed from underlying volcanic formations, those formed from underlying marine formations, and those formed from alluvium (unconsolidated materials deposited by streams and rivers). Soils will almost always be thinner along ridgetops and thicker in swales due to faster and deeper weathering of underlying formations. This is because they are wetter for longer periods and also due to soil creep into swales. All soils contain varying amounts of organic and biological components in addition to the mineral fraction described below.

Soils formed on volcanic formations are classed predominantly as gravels with some sand and few silt-sized materials. These soils are well-drained, often occupy the steepest slopes, and tend to be thinner than soils formed from marine formations or alluvium. The highest concentration of volcanic soils are in the Tillamook Highlands, the Cascade foothills, and near the Columbia River.

Soils formed on underlying marine sedimentary formations are predominantly silts, sands and clays, with minor amounts of gravel. These are found in many areas outside the Tillamook Highlands. These soils are well-drained when occupying hillslopes but can be wet most of the year in low-lying areas. Permeability is much slower than the volcanic soils owing to their fine-grained nature. They occupy the more subdued topography.

Alluvial soils cover a minor percentage because ODF lands do not cover many floodplains, which are where these soils are located. By nature of being deposited by fluvial processes, they are on valley flats or thin terraces adjacent to streams. These soils show little variation in character from the underlying unconsolidated alluvial material, thus they can be predominantly gravelly or silty depending on the alluvium present. The alluvial soils will generally be poorly drained due to their topographic position next to water. They are also predominantly non-plastic and non-cohesive.

By aggregating the coarse- and fine-grained soils, it is evident that the planning area consists mostly of coarse-grained soils (Figure 26). Due to the influence of ancient volcanism, Forest Grove, North Cascade and Tillamook Districts have predominantly coarse-grained soils. The remaining District soils are fine-grained and derived from softer marine sediments.

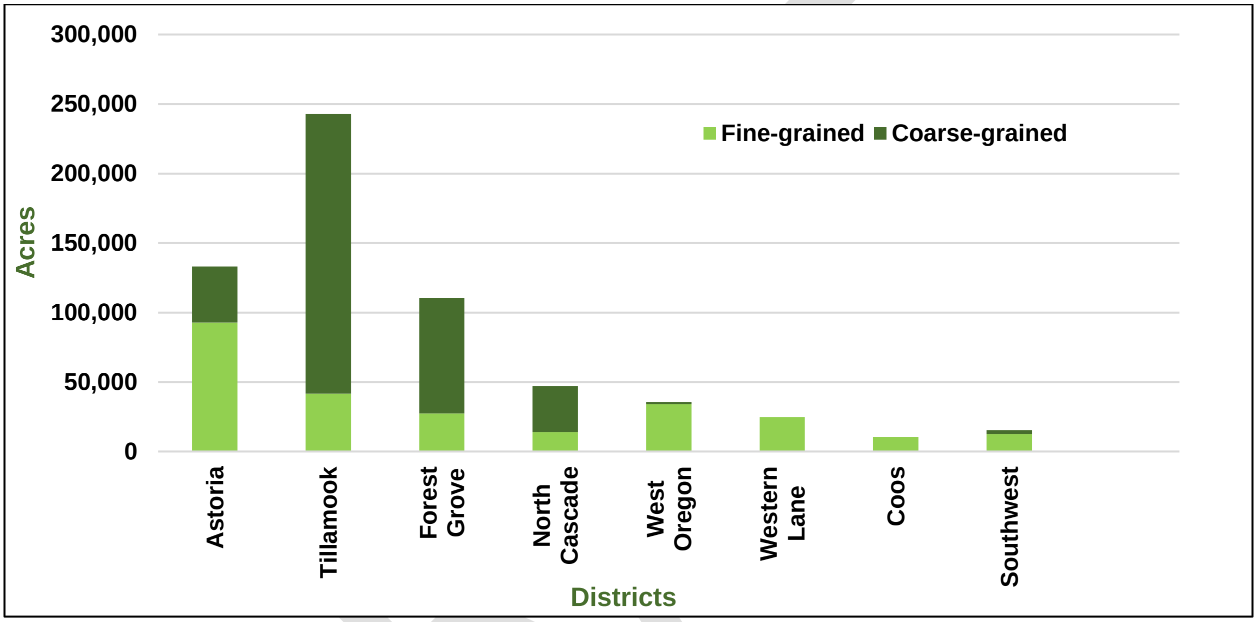

Figure 26. Fine- and coarse-grained soils by district.

Forest site productivity is controlled by a complex relationship between topography, slope aspect, soil depth, porosity, biology, and the availability of nutrients in the soil. Dynamic processes (e.g. forest succession, wind, and fire) affect the accumulation of organic matter in the soil. The amount and composition of organic matter affects soil fertility. Small materials (e.g. needles, twigs) have the highest concentration of nitrogen. Large materials (e.g. down trees) are important because they influence soil nutrient availability and soil moisture.

Most Coast Range soils vary from Site Class I (highly productive) for Douglas-fir to low Site Class III (limited in potential productivity). However, there are Site Class IV and V soils, many on or near steep rocky outcrops. Soils in the western Cascades vary from Site Class II to Site Class V for both Douglas-fir and western hemlock. Site class productivity depends largely on soil profile depth, gravel content, topographic position, and to some extent, soil parent material. However, in general, the parent materials of these soils all provide a potential basis for highly productive soils. Site class productivity distribution shows a more complex genesis than a simple relationship to geology and topography.

Slope Stability

Soil movement occurs on both managed forest and forested wilderness landscapes. Soil creep and landslides are observed in both mature forest land and recently harvested terrain. Sometimes in conjunction with anthropogenic influences (e.g. forest roads, harvest) and, other times, in their absence. Slides can deliver large wood, gravels, sands and silt-sized material to streams. These organic and inorganic components are requirements for long-term aquatic health and indeed have been recognized to have contributed positively to the aquatic ecosystem. Current discussions centered around slope stability often focus on whether landslides are anthropogenic or natural and to what extent forest management activities influence them.

Examples of soil creep and the mass wasting processes of rapid- and slow-moving landslides are easily identified across all areas and ownerships in northwest Oregon and southwest Washington. These are important considerations of any forest management scheme where resource protections must occur alongside economic goals. Slides are the dominant erosional process in the mountainous terrain of state forests.

Landslides, of which there are many varieties, involve different processes than soil creep. These involve a mass of soil, rock and debris that moves downward, generally together, at a similar rate. In forest management, it is useful to discuss two main categories: shallow rapidly-moving landslides and slow deep-seated slides.

Soil creep thickens soils in swales and can be a destabilizing factor for shallow rapidly-moving landslides. These slides usually only involve soils and remove them entirely from a steep slope, along with the vegetation they support. Underlying geologic formations usually form the base of these failures. Once the soil begins movement, the slide mass rapidly accelerates down-slope, often entering a stream and travelling through the stream gully for thousands of feet. As the debris passes it scours soil and entrains boulders and large wood, increasing in volume as it moves. These slides impart large forces when moving and can destroy, and sometimes completely remove, structures (e.g. homes, concrete road barriers, guardrails).

These slides will then deposit where the stream gradient lessens, where the gully widens, or where a stream junction becomes too sharp for the debris flow to make a turn. Often, the larger components of the resulting debris deposit may then never be moved downstream due to the size of the host stream. In cases of larger steams or rivers, the debris can be shifted and re-mobilized during subsequent high-water events, which will then scatter the debris downstream over time.

Shallow rapidly-moving landslides can be caused or affected by forest management activities. Poor road-building practices (e.g. placement of fills on steep slopes, ill-conceived culvert placement, poor attention to maintenance, failure to recognize and plan for landslide hazards during road alignment planning and construction) can have major influence on slope stability. Timber harvest can increase the rate of occurrence of these types of slides. For a limited period after canopy removal, an increase in frequency of slides has been noted in northwest soils. Slides originating or moving through harvested slopes may not have the same large wood component incorporated into the debris to be delivered to aquatic resources.

Another common type of creeping movement that often involves both the soil and underlying geologic formation are slow-moving deep-seated landslides. This type of movement occurs faster than soil creep described above and can translate portions of the ground surface up to 20 feet each year. These phenomena, commonly involving a thousand to tens of thousands of cubic yards of material, slowly disrupt drainage patterns, destroy road grades, and, in some cases, cause large forested areas to degenerate into a mess of scarps, downed wood and swept trunks.

Within the planning area, there are hundreds of examples of deep-seated landslides. A few are active and many more are ancient (prehistoric) and presently not moving. Almost all are naturally caused, many probably initiated by large off-shore earthquakes. However, some forest practices can affect the movement of these slides. They include large topographic modifying activities (e.g. quarrying, aggregate stockpiling, placement of large fills, construction of large road cuts), especially along the toes of these features. Since these anthropogenic activities are relatively rare, the potential for destabilization of slopes and initiation of a deep-seated slide occur infrequently in northwest forests.

Chapter 2 – Vision and Guiding Principles

The Oregon Department of Forestry is tasked with developing a vision for how Board of Forestry forests attain greatest permanent value (GPV) for the citizens of the state, as defined in statute and rule. Achieving GPV means providing a full range of social, economic and environmental benefits, and achieving a balance between short-term and long-term economic returns. The guiding principles presented here describe the rules, goals, and responsibilities that guide the planning process in order to achieve the described vision of the forest.

Greatest Permanent Value

The GPV Rule (OAR 629-035-0020) provides a management focus for the State Forester to maintain BOFL as forest lands and actively manage them in a sound environmental manner to provide sustainable timber harvest and revenues to the state, counties, and local taxing districts. This management focus is not exclusive of other forest resources, but must be pursued within a broader management context that:

- results in a high probability of maintaining and restoring properly functioning aquatic habitats for salmonids, and other native fish and aquatic life.
- protects, maintains, and enhances native wildlife habitats.
- protects soil, air, and water.
- provides outdoor recreation opportunities.

The GPV Rule also requires that management practices must:

- pursue compatibility of forest uses over time.
- integrate and achieve a variety of forest resource management goals.
- achieve, over time, site-specific goals for forest resources, using the process as set forth in OAR 629-035-0030 through 629-035-0070.
- consider the landscape context.
- be based on the best science available.
- incorporate an adaptive management approach that applies new management practices and techniques as new scientific information and results of monitoring become available.

GPV means healthy, productive, and sustainable forest ecosystems that, over time and across the landscape, provide a full range of social, economic, and environmental benefits to the people of Oregon (ORS 530.050).

Vision

Historical Context

Public forests across the nation were established for the benefit of the people and have always provided for multiple uses. The legal mandate may vary for these lands (e.g. the mandate for CSFL is to provide revenue to schools while the National Park Service mandate is to protect natural and cultural resources while simultaneously providing opportunities for public use and enjoyment). The mandate for BOF has remained the same since the 1941 legislation calling for the lands to be managed for the "greatest permanent value to the state." It recognizes the importance of recreation, agricultural, and watershed protection values in addition to timber production. On many public forests, management emphasis has shifted through time. First from a focus primarily on production and harvest of wood products, with other benefits considered secondarily or separately (e.g. recreation). Then to a greater emphasis on multiple use, with increased recognition of other important benefits and values (e.g. clean water, rare species, diverse recreation opportunities), but varying levels of integration. Finally, to a much broader definition and recognition of the types of uses (e.g. goods and services), associated benefits, and values that the public derives from forest ecosystems (Kline et al. 2013, Jaworski et al. 2018).

There is broad consensus that society is dependent on the function and flow of ecosystem services for healthy and prosperous communities. A majority of Oregonians continue to support the notion that forests should be managed for both environmental and economic values. And many support active management to improve forest health, productivity, and biodiversity, and reduce fire risk (DHM 2019).

As with many public forests, goals and management plans for state forests have evolved over time in response to shifting public values, changes in environmental conditions, and better understanding of forest management effects on ecosystem function and biodiversity. The Long Range Timber Management Plans for Northwest Oregon (1984) and Willamette Region (1989) State Forests set timber volume targets as the objective for forest management. Other resource values (e.g. ecosystem services) were considered mainly as constraints to timber management and revenue production for the counties and local taxing districts. By the mid-1990s, species listings under the federal ESA had raised significant public concern and caused substantial reductions in harvest objectives. Growing recreational use of the Tillamook also demanded attention and the Tillamook State Forest Comprehensive Recreation Plan was adopted in 1993.

In 1998, the Board of Forestry adopted a set of administrative rules (OAR 629-035) that were intended to provide clarity around the benefits that Oregonians derive from state forests and direction to the State Forester to pursue management practices that promote “compatibility of forest uses over time” and “integrate and achieve a variety of forest resource management goals.” In response to these revised rules, in 2001, the State Forests Division began managing under a new Northwest Oregon State Forests Management Plan. The plan took a much more comprehensive, multi-resource, ecosystem-based approach to forest management than previous long-range plans. It also used a system of integrated resource management to achieve a proper balance and greatest permanent value.

As provided in statute and administrative rule (ORS 530.050, OAR 629-035-0020), “greatest permanent value means healthy, productive, and sustainable forest ecosystems that over time and across the landscape provide a full range of social, economic, and environmental benefits to the people of Oregon.” Thus, since the very beginning of the 21st century, state forests management has sought to reflect public values and realize the full potential of these lands in providing for an ever-increasing list of recognized ecosystem services that a growing number of Oregonians demand for and depend on.

Greatest Permanent Value and Ecosystem Services

Oregon state forests are an asset of the people of Oregon and the counties and local taxing districts where the forests are located. These forests and their resources provide an ecological and economic foundation for local communities and the surrounding regions. They must be managed to ensure healthy, productive, and sustainable forest ecosystems continue to provide a full range of social, economic, and environmental benefits to the people of Oregon. As well as achieving balance between short- and long-term economic returns and the full range for future generations.

The administrative rules specify that the State Forester shall be guided by the following stewardship principles in developing and implementing forest management plans (OAR 629-035-0030).

The plans shall include strategies that:

- contribute to biological diversity of forest stand types and structures at the landscape level and, over time, a) provide a variety of forest conditions and resources through application of silvicultural techniques and b) conserve and maintain genetic diversity of forest tree species.
- manage forest conditions to result in a high probability of maintaining and restoring properly functioning aquatic habitats for salmonids and other native fish and aquatic life; and protecting, maintaining, and enhancing native wildlife habitats. Recognizing that forests are dynamic and that the quantity and quality of habitats for species will change geographically and over time.
- provide for healthy forests by a) managing forest insects and diseases through an integrated pest management approach, and b) utilizing appropriate genetic sources of forest tree seed and tree species in regeneration programs.
- maintain or enhance long-term forest soil productivity.
- comply with all applicable provisions of state and federal laws concerning state- and federally-listed threatened and endangered species.
- maintain and enhance forest productivity by a) producing sustainable levels of timber consistent with protecting, maintaining, and enhancing other forest resources and b) applying management practices to enhance timber yield and value, while contributing to the development of a diversity of habitats for maintaining salmonids and other native fish and wildlife species.

Under these principles, the societal benefits of managing for healthy, productive, and sustainable forest ecosystems include: sustainable and predictable production of forest products that generates jobs and revenue for the benefit of state, counties, and local taxing districts; properly functioning habitats for native species; protection against floods and erosion; productive soil, air, and water; and recreational opportunities on state forests. The diversity of forest stages and conditions is enhanced and maintained over time, providing for a broad range of social values important to Oregon citizens and contributing the range of fish and wildlife habitats necessary for all native species and to broad biodiversity.

The vision, goals, and strategies of the plan reflect complex social and ecological systems. These require integration of resources in space and time, as well as informed decision-making, to achieve the overall goal of sustaining integrity and resilience of systems and landscapes that support them. In this context, the forest is part of larger systems that collectively provide for all resources and related benefits (e.g. ecosystem services).

Incorporating Uncertainty and Change and Managing Risk to Resources

At all levels of planning and implementation related to integrated forest management decisions, the potential for social, economic, and ecological change and uncertainty is a constant. Conflicts arise when divergent benefits are desired from diverse stakeholders. Managing short- or long-term risk (e.g. ecological, operational, legal, political) entails consideration of the trade-offs associated with decisions regarding a specific resource of interest, including how other resources may be affected. With increased uncertainty often comes pressure to underestimate trade-offs or to rely heavily on modeled outcomes to frame decisions related to long-term planning. Model assumptions can be incorrect for many reasons, particularly in a changing world. Disturbance (e.g. fire, windthrow, disease) affects inventory in unpredictable ways. Sources of revenue can change as societies, economies, and technologies change over time.

Decisions are made in a careful, informed, well-structured framework tied to monitoring and evaluation of strategy performance, as well as modeling of alternative pathways, trajectories, and outcomes. Modeling can be a useful tool for evaluating potential long-term trajectories and trade-offs. But in the context of managing a forest ecosystem, a more robust (i.e. flexible and adaptive) approach to anticipating future conditions is to acknowledge uncertainty, provide options to reduce risk, and adjust strategies accordingly as information or conditions change over time.

Promoting resilience in systems is about creating and maintaining options (Franklin et al. 2018). Providing for resilience and options for the future (e.g. sustainability) is the very heart of what greatest permanent value is intended to achieve for forest resources and associated ecosystem services. Because these resources are interconnected, and in order to provide for these services in an ecosystem context, state forests must be managed in an ecological framework. Thus an ecological approach, one which frames the benefits we desire within the context of the systems that provide for them, remains the appropriate framework for state forests management.

An Ecological Approach to Forest Management

The ecological approach described in this section is an evolution of previous ecosystem-based approaches, built on new science and improved understanding of the ecological, social, and political systems that influence forest management in the Pacific Northwest.

Many of the findings and recommendations that are based on new science are reflected in the recent science conducted by the USDA Forest Service in support of anticipated plan revisions for several National Forests in the region (Spies et al. 2018). Franklin et al. (2018) summarize over 30 years of research and management in managed forests and issue a call to arms for “Ecological Forest Management” in a recently published article. Others have made similar or related recommendations including Carey (2007), Carey et al. (2005), Lindenmayer et al. (2012), Swanson et al. (2012), and Spies et al. 2018.

An ecological approach to forest management views resources and benefits within the context of societal values (e.g. social values, support for rural communities, natural resource-related economies) and the forest ecosystem (e.g. services, function, disturbance, resilience). Both of these are dynamic and hard to predict. Providing for sustainable environmental systems gives the social license needed for forest management activities and allows for economic and other benefits to continue to flow from managed forests (Franklin et al. 2018). The entire forest is a working forest, providing many services across the landscape and through time (e.g. conservation, production, restoration, carbon sequestration, recreation, non-timber forest products). The working forest management focus is set by OAR 629-035-0020(2): "To secure the greatest permanent value of these lands to the state, the State Forester shall maintain these lands as forest lands and actively manage them in a sound environmental manner to provide sustainable timber harvest and revenues to the state, counties, and local taxing districts."

This approach acknowledges and anticipates change and uncertainty in forest development and disturbances, in societal values and demands, and in future climate scenarios and effects on forest productivity and biodiversity. It addresses approaches and outcomes that reduce risk to resources and increase future options using an adaptive management framework. Adaptive management is a central tenet of an ecological approach to forest management given uncertainty and risks associated with long-term planning.

Core Ideas and Principles of Ecological Forest Management

General Principles and Management Planning

The overall goal of an ecological approach to forest management is to sustain and support the ecological integrity (e.g. structure, composition, and function) and productivity of the forest. Thereby improving resilience (ability to withstand and recover from disturbance) and capacity to adapt to change (Franklin et al. 2018). Healthy, diverse, productive, and resilient forests maintain and enhance ecosystem services, as well as the benefits the public derives from them, and are the foundation upon which a sustainable working forests model is built (Spies et al. 2018).

The goal for individual forest stands and landscapes is not to imitate the past or provide equal amounts of all stages and conditions (Franklin et al 2018). This historical context is used as a tool for evaluating balance and identifying stand types and conditions that may be rare on the landscape or provide other important services (Wimberly 2002, Wimberly and Ohmann 2004, Spies et al 2018). It is a guide for understanding changes in forest dynamics, patterns, and processes over time. This can then be used to better understand ecosystem needs and anticipate the effects of management activities or future change. For example, restoration activities are informed by the historic stand structures, but the focus is on improving forest health, biodiversity, productivity, and resilience (Franklin et al. 2018).

The distribution and diversity of stand types, stages, and conditions on the landscape are also driven by legal, economic, social, and land use contexts. It influences what is needed, limits possibilities, and constrains options. Economic considerations, in particular, are core to success and sustainability (Franklin et al. 2018). In an ecological framework, humans are part of the forest ecosystem and the health of local communities is of paramount concern. Jobs in the woods, logs for local mills, and a variety of recreation experiences support the diversity of rural communities and culture. Revenue from timber harvest on state forests not only supports county and local taxing district schools and infrastructure, but is almost exclusively how state forests operations are funded. Thus, timber harvest revenue provides the capital to manage for the full range of ecosystem services that the public desires from state forests.

While this can be a limitation on options for management and create pressures to underestimate trade-offs in planning and implementation, trade-offs should still consider the critical natural capital (i.e. important and irreplaceable functions) essential in ecosystem services (Franklin et al. 2018). Conventional timber appraisal is one tool for assessing the value of forests, but natural capital concepts extend to a full range of benefits, many of which are difficult to quantify and monetize. Thus, recommendations are to avoid adjusting outcomes for a single resource, as this will tend to affect outcomes for other resources and services, and to focus more on flow of income (i.e. revenue) over time, rather than rate of return on capital or net present value.

Adaptive management, tied to robust public planning processes, is a key principle of an ecological approach to forest management (Franklin et al. 2018). Adaptive management is intended to be a live, focused process, linked to planning and decision-making at all levels, in a structured and transparent manner (Minkova and Arnold, in press).

Principles of an Ecological Approach to Silvicultural Strategies

At the stand level, species composition, structural complexity (diversity and spatial distribution of structural features including dead wood and understories), and function create resilience and adaptive capability (Franklin et al. 2018). Prescriptions should maintain and restore complex and diverse forest of all types and stages and activities should be timed appropriately within the context of natural forest development. At larger scales, they should create and maintain heterogeneity to provide full ranges of stages and conditions, as well as to maintain function and biodiversity at landscape scales. Prescriptions should also specify retention (e.g. type, amount, distribution) and other protection or restoration measures if needed.

Prescriptions should recognize any places of high ecological or cultural value and other important features for biodiversity and ecosystem function. Examples include recreation sites, specialized habitat types or structures, rare species, features important for critical functions, travel corridors, and culturally significant areas. Other important habitat features such as riparian areas and wet meadows are identified and managed for integrity and resilience. Retention of structure and biological legacies (e.g. old-growth patches and trees, riparian areas) is key to providing continuity of ecosystem structure, composition, and function (Lindenmayer et al. 2012).

Landscape context should be considered including current conditions and ownership patterns. Stand-level strategies (e.g. multi-species planting, multiple cohorts represented, diverse understories, dead wood, legacy trees) contribute to landscape scale patterns and functions.

In this framework, all patches contribute to the functionality of the ecosystem and landscape (e.g. provision of habitat, regulating services) and sustainability of the working forest. Diversity and function allow for options in products, management pathways, and priorities that reduce risk and thereby support long-term economic productivity and many other societal benefits (e.g. carbon sequestration).

Alignment with State Forests Management Plan Goals, Strategies, and Measurable Outcomes

Relationship between Plan Goals and Strategies and an Ecological Approach to Integrated Forest Management

The Oregon Department of Forestry has developed an Integrated Forest Management Plan that offers flexibility in implementation for land managers through understanding of overarching goals and strategies and adaptive management based on results of monitoring measurable outcomes. This plan does not focus on a single objective, but considers several key social, environmental, and economic goals. Further, it is a plan that focuses on sustainable forestry in the face of a changing climate. It ensures we are meeting current needs, but with an eye towards the needs of future Oregonians and building in resiliency so those future needs will also be met.

State forests landscapes do not exist as discrete zones for conservation or production, but rather represent a range or continuum of emphasis. This range is from productive timber ground key to revenue over time to relatively fixed conservation areas key to local populations of rare, threatened, or endangered species. The core ideas and principles of an ecological approach to integrated forest management are reflected in many of the guiding principles and goals, strategies, and measurable outcomes of this plan.

The plan seeks to provide complex and diverse forest stands (appropriate to region, landscape, and associated conditions), other uncommon vegetation types and habitat features, and heterogeneity at the landscape scale to foster and maintain a full range of stand types, forest development (i.e. seral) stages, watershed processes and conditions over time. The diversity of forest types, stages, and conditions is enhanced and maintained as time passes, providing for a broad range of social values (including economic benefits) important to Oregon citizens and contributing the range of fish and wildlife habitats necessary for all native species and to broad biodiversity.

Strategies and standards for retention of live trees and dead wood in harvest units provide continuity in species and habitat, as well as carbon storage (sequestration). Older stands on the landscape provide important additional accumulation and storage. Healthy, young forests play an important role in sequestering carbon at faster rates than older forests.

The overarching approach the plan takes to address climate change is to acknowledge uncertainty and change, while managing for integrity and resilience to maintain ecosystem function (health and productivity), biodiversity and management options over time. This is not a static reserve approach to conservation, or traditional production-oriented forestry. The plan views the entire forest as a working forest in a dynamic landscape that functions as whole. And it is influenced by external social, economic, and environmental pressures that change in ways we cannot predict. The plan incorporates uncertainty by managing for options as a primary strategy to reduce risk.

The plan uses active management, across landscape and over time, to restore, maintain, and enhance options and reduce risk. Key planning principles include careful consideration of trade-offs and integrated management of resources to produce a variety of values, focusing on compatibility of uses. Approaches and emphasis will vary across landscapes to reflect current conditions (e.g. site-specific, environmental, economic, social) and changes over time.

The plan is intended to be more flexible and inclusive than past state forest management plans and employs an adaptive management framework to achieve objectives. This framework includes monitoring of strategies, targets, and standards. Additionally, it comprises an evaluation against goals of the plan in a transparent public process that is tied to decision-making at various levels of planning and implementation. It incorporates changing conditions on the landscape and in society (e.g. economic, policy environment, public values) and new science, with periodic public and peer review to provide checkpoints. Quantifiable targets and standards are tied to the adaptive management plan and policy to allow for more flexible adjustments to respond to change. This flexibility and adaptability promote the sustainability of timber production and flow of revenue and the sustainability of forest ecosystems and healthy watersheds.

Economic success is core to plan success. The intent of this plan, in part, is to produce sustainable and predictable forest products that generate jobs and revenue for the benefit of state, counties, and local taxing districts. Sustainable long-term management of state forests is contingent on the financial viability of the State Forests Division, as well as the level of financial benefits provided to counties and local taxing districts and other economic benefits that flow to local communities. An effective management plan must address these dynamics through time. An ecological approach to management places emphasis on the function of economic systems that support management and recognizes that specific approaches and the levels of commitment depend on economic goals and circumstances. Maintaining the strength of rural communities (and counties where state forests occur) is a primary goal, key to maintaining social license, and, thus, the sustainability of the plan.

Role of Timber Production in an Ecological Approach to Management

In state forests, timber revenue funds the vast majority of management activities, related staff, and infrastructure. It is also the primary vehicle for providing economic benefits. Revenue needs and constraints limit some options for silvicultural prescriptions and provisions of other services (e.g. distribution of age classes, pace of restoration activities, ability to provide recreation programs). In many ways, revenue represents the biggest constraint on management activities. The state needs to realize a high level of the forest product-producing potential off these lands, and, in turn, revenue to beneficiaries, in order to support continued management. Thus, a push for production-oriented goals and related silvicultural strategies will take priority on a significant portion of the landscape over time.

This differs from some trade-off related decisions on other public lands, where revenue from harvest is less of an issue and a break-even type investment strategy can be employed while still placing ecological resilience and options over time as goals. State forests management also differs from more streamlined approaches where enhancing the timber resource is the primary goal. The key is relating the production-oriented aspects of the landscape to others in functional ways, as well as incorporating elements to ensure overall ecosystem function, integrity, and resilience.

Thus, the framework of a regulated forest applies in two contexts. First, the forest is regulated to provide for the full range of age classes, seral stages, and conditions. In this context, the goal is not long-term sustained yield, but rather long-term landscape goals to enhance and ensure future options that support the flow of full benefits over time. However, those benefits include long-term timber production and a steady flow of revenue at levels that keep the agency solvent (given the revenue distribution formula and other sources of revenue). Therefore, within the portions of the forest managed primarily to produce timber, consideration must be given to how those lands might also be regulated over time in a way that supports long-term sustained yield and the revenue needs and goals of the agency. The interplay of these two frameworks is part of an integrated approach to a dynamic working forest landscape.

Production approaches to some landscape modeling are incorporated in plan development. They are used to make decisions around shorter implementation timeframes (e.g. one to ten year objectives) that are intended to contribute to longer term goals and associated targets. Calculations of harvest levels link to volume and area control and sustained yield. However, many other filters are also applied to address the interplay of the two frameworks mentioned above (ensuring both a full range of stand types and adequate flow of revenue over time). Production approaches are required for integration of plan goals for developing older stands and assessment of how management alternatives appear to affect long-term flow of goods and services. Traditional metrics, like rate of return and net present value, are important tools for evaluating alternatives and outcomes. Though from an operational and ecological perspective, cash flow may be a more pragmatic metric for state forests.

Harvest ages and timing of entries or interventions are determined by a number of factors related to long-term management goals for production and function at stand and landscape scales. Setting the general timing of desired harvest for production-oriented stands at or near the cumulative mean annual increment of growth (CMAI) in a regulated framework is intended to foster sustainable level of timber production, revenue for rural communities, and operating revenue for the department. It also provides for a wider diversity of mid-seral habitat types and conditions for wildlife and other enhanced services (e.g. carbon sequestration, maintenance of broader biodiversity) relative to shorter rotation intensive plantation forestry. Eventually, otherwise constrained stands (e.g. managed for older forest values, occupied by ESA-listed species, inoperable) will provide for older age classes at or near desired levels and above critical thresholds for function. This will be supplemented by stands that grow beyond CMAI due to other reasons (e.g. harvest scheduling, capacity, market fluctuations).

Individual stands and larger patches on the landscape are neither intensive plantations nor reserves, but rather part of dynamic and changing systems that provide many services at varying levels in any given spot. Decisions about trade-offs are based on analysis of existing conditions (e.g. services provided, limitations on potential services), revenue needs (short- and long-term), and ecological integrity (e.g. historical range of variation, threshold for function, desired future condition).

Most of the complex and older stand types and patches that develop are likely to come from the many parts of the landscape where there is a conservation focus. Those parts of the landscape where timber production is best suited, will be managed near CMAI with retention of legacy structures and other important habitat features, as well as buffers for riparian and aquatic areas and related upslope areas.

These strategies help to ensure continuity and future options for management. Decisions related to emphasis, at both stand and landscape scales, seek to incorporate and minimize impacts to other resources and balance desired outcomes. In this context there are no constraints. However, there are differences in the level of various ecosystem services provided at the stand or patch level and in the distribution of patches across landscape.

Role of Adaptive Management in Planning and Implementation

Adaptive management is key to an ecological approach to forest management in a changing world and society given the uncertainty and risks associated with long-term planning. It is also mandated under administrative rules, which specify that the plan "shall include strategies that utilize the best scientific information available to guide forest resource management actions and decisions by: a) using monitoring and research to generate and use new information as it becomes available; employing an adaptive management approach to ensure that the best available knowledge is acquired and used efficiently and effectively in forest resource management programs" (OAR 629-035-0030).

Many forest characteristics and benefits are not well defined or are difficult to measure (Jaworski et al. 2018). It can be a challenge to demonstrate how specific benefits are considered in planning, leading to a lack in understanding of benefits and shared values. Strategies and outcomes must be described in ways that increase understanding and transparency. Additionally, they should include a broad set of ecosystem services (and a subset for management decisions) and consider the relationships between desired or valued services and current conditions. They must acknowledge that demand and provision of services changes over time (Jaworski et al. 2018).

In an ecological approach to forest management, incorporation of trade-offs in ecosystems services is considered paramount to evaluation and revision of desired conditions and related strategies (Franklin et al. 2018). Considerations in trade-offs are included but not limited to: management emphasis (e.g. timber, aquatic and riparian function, wildlife conservation and habitat diversity, scenic, recreation); desired future condition; integration of resources; applicable policy restrictions; landscape context; and revenue goals. Plan goals and strategies related to social benefits and economic sustainability must be well integrated with components that provide for ecological sustainability (i.e. integrity and biodiversity).

In this framework, adaptive management is a core component of planning and management, and decisions around trade-offs achieve balance in a public and scientifically credible way (Franklin et al. 2018, Minkova and Arnold, in press). Decisions are made in a structured framework, at various spatial and temporal scales, with model support, alternatives analysis, and public input. As well as drawing from expert opinion and experience and outside review.

An adaptive management plan provides an active and flexible framework for addressing potential conflicts and trade-offs. The adaptive management process should identify and address key uncertainties and utilize hypothesis testing to evaluate actions and outcomes for a range of questions that vary in scope and scale (Minkova and Arnold, in press). A robust process entails engaging staff at all levels, a structured framework for evaluating and decision-making related to measurable outcomes and alternative management strategies, and a transparent process for stakeholder engagement.

A management plan is most likely to succeed in meeting its goals when decisions incorporate both ecological, economic and social considerations. Integrated strategies and related activities should seek to minimize trade-offs rather than optimize any singular one. Efficiency is the goal (Franklin et al. 2018). Efficiency entails giving up a minimum of one objective for the achievement of others, leading to less contention and easier decisions. Another aspect of efficiency is minimizing costs and revenue reductions. This is a constant process related to techniques and objectives (e.g. young stand management and site preparation, timing of harvest and marketing of products).

Under an adaptive management framework that incorporates change and uncertainty, this process of constant improvement and refinement requires tightening of plan targets to shorter, more flexible evaluation intervals and simulation periods (Franklin et al. 2018, Spies et al. 2018). Long-term goals are important for setting pathways and adjusting trajectories, but, given uncertainty and change, it may not be realistic or productive to look out beyond two or three decades (Spies et al. 2018). Trade-off estimation models should be incorporated as tools, as appropriate. But in general, less reliance on models and more on analysis, innovation, and adjustment is advisable under an ecological approach (Kline et al. 2016, Franklin et al. 2018).

Management Perspective

An Ecological Approach to Integrated Resource Management on State Forests: Consideration of Trade-offs in Planning and Implementation

The resources, values, and benefits that the public derives from state forests do not exist in isolation. They are linked and thus potentially in conflict with one another. At all spatial scales, the forest is managed not for any one resource but for each within the context of each other and the landscape. Examples include effects of timber harvest on recreation or ESA-listed species and recreation pressures on aquatic systems and functions.

Because forest resources coexist in space and time, often somewhat fragilely, thoughtful integration of goals and strategies can minimize conflicts, facilitate decision-making, and optimize returns on investments. Integrated strategies seek to improve habitats, forest biological diversity, and ecosystem function, in addition to producing revenue from harvest of forest products across the land base.

Timber and resource management strategies are expressed in managing for a full range of stand types, stages, and conditions, including complex young and old stands and other special places. They do so while also managing individual stands where harvest is desirable at or near CMAI (with inclusion of biological legacies, other habitat features, and additional coarse- and fine-filter strategies for function and biodiversity). Together with aquatic and forest health strategies, the integrated strategies provide for a full suite of benefits across the landscape and over time (e.g. biodiversity, diverse recreation opportunities) with incorporation of change, uncertainty, and risk in an adaptive management framework tied closely to decision-making and related public processes.

Planning teams have to evaluate effects and make decisions to allocate resources across uses (Jaworski et al. 2018). A well-structured decision-making process, tied to adaptive management, identifies resources of interest, priorities, associated risks and uncertainties, and criteria for informing tradeoffs. These include site-specific questions, such as the effectiveness of a specific prescription in a specific area for a specific objective, or the costs and outcomes associated with alternative site preparation strategies. And larger level planning questions tied to measurable outcomes of the plan that evaluate performance and interactions among resources of interest over time. Modeling can be used in this process as a decision support tool, so that trade-offs can be evaluated at various spatial and temporal scales.

Key considerations in an ecological approach to integrated management include how the balance and compatibility of goals vary with spatial and temporal scales (e.g. by region) (Spies et al. 2018). The goals and strategies of the plan often speak to desired conditions "across the landscape and over time". This is intended to highlight the spatial and temporal considerations inherent in forest management. Forested landscapes and individual stands are dynamic environments and many resources are brief in nature (e.g. disturbance affects timber and habitat, roads fall apart or grow in). Public values and beliefs related to forests change over time and this is reflected in changes in resource use and desired benefits from state forests. Integrated forest management requires not just consideration of multiple resources at the same time, but also incorporation of spatial and temporal dynamics that affect where resources are today and where they may be in the future.

Spatial Considerations

Forest management for many resources and services is typically implemented at two spatial scales: the individual forest stand and the broader landscape. A stand may be defined as an operational or functional unit to which a silvicultural prescription is applied or, in ecological terms, as an area of relatively uniform and distinct forest conditions (e.g. age-class distribution, composition, and function) (Franklin et al. 2018). Stand management largely defines composition and structure through time. Landscapes include the distribution of many stand level management units across larger areas, and the context in which they occur (e.g. other units, other landowners, array of types and conditions), and must be considered during planning to address appropriate ecological scale of actions.

For the Western Oregon state forests, coarse-filter/fine-filter planning provides the foundation and an operational approach to biodiversity management (Hunter 1999). Different wildlife conservation issues and landscape functions are addressed at each scale in landscape planning. The coarse-filter component is based on the premise that maintaining a range of seral stages, stand structures, and sizes, across a variety of ecosystems and landscapes will meet the needs of most organisms. Individual species or habitats that require special consideration, such as species with unique or limited distributions or highly specialized resource needs (not addressed using the coarse filter), are managed specifically under a fine-filter approach to ensure that overall biodiversity goals are reached (Marcot et al. 2018). Fine-filter management covers specific management actions in addition to those required under the coarse-filter management. Collectively, coarse- and fine-filter management maintain and enhance ecosystem diversity.

Coarse- and fine-filters are applied within and across areas of high conservation and production value. Establishing areas with a focus on conservation is a coarse-filter strategy intended to address the habitat needs of multiple species (e.g. Terrestrial Anchors), as are other broad-scale strategies like legacy retention in harvest units, and riparian buffers that provide or enhance habitat connectivity in areas with high timber production value. With this approach, the entire landscape supports this conservation goal, including those stands managed for timber production. Planning and subsequent management actions intended to protect, maintain and enhance wildlife habitat and populations occur in all areas of the forest, including areas with high production and/or conservation value. This integrated approach to resource management provides for the persistence of native species that inhabit the landscape.

Stand-level Considerations

Forest management activities such as timber sale operations, recreation management, and restoration efforts are often directed at the individual stand (or other site-specific) level. The goal for any given forest stand, in an integrated resource management context, is to determine best use and desired future condition.

Site-specific ecological, economic, and social considerations are numerous. Examples include:

- Site productivity;
- Current conditions (age class, composition, volume, and structure) and desired future condition;
- Forest health

- Presence of habitat elements and occupancy patterns for species of concern (including aquatic species)
- Proximity to haul route, mills, and population centers
- Operability
- Soil integrity and slope stability
- Costs of project work
- Market conditions
- Recreation conflicts/impacts
- Presence of cultural resources

Consistent with an ecological approach to integrated resource management, forests managers seeking to make balanced decisions at the stand level need to identify and evaluate the suite of ecosystem services that a given stand may provide (Franklin et al. 2018). This includes both value for timber production and attributes that contribute to ecosystem integrity and function. Forest stands with high production value include those with moderate to high site quality, high value wood products, gentle topography, and close proximity to haul routes and mills. Low production value stands may include those with low site quality, forest health issues (e.g. SNC), steep slopes, or other accessibility issues. Stands with high conservation value include those with attributes that make them important for ecosystem integrity and function (e.g. contains high quality habitat for species of concern, provides key connectivity between basins), and others of recreational, educational, or interpretive value. Relatively low conservation value stands might include young, densely stocked managed stands, with few legacies, in intensively managed landscapes.

In this somewhat oversimplified context, parts of the forest determined to have high production value and low conservation value can be prioritized for timber production, with consideration for continuity and function. Key to finding an appropriate balance, is identification and protection of rare or unique habitat types, features, or elements (e.g. patches of young or old forest with complex structure, rock outcrops and caves suitable for bat roosting, large legacy snags and old-growth trees, vernal pools and wet meadows, unburnt areas in the Tillamook Burn), and other important sites for nesting and denning activities (Franklin et al. 2018, Spies et al. 2018). Areas of known occupancy by species of concern should receive special emphasis, as should retention of biological legacies (e.g. large trees and dead wood, riparian buffers). Biological legacies provide continuity in important habitat structures for wildlife and refugia for important components of biodiversity including lichens, bryophytes, fungi, invertebrates, and aquatic species (in buffers).

The interplay of upland leave tree strategies, riparian buffers, and slope stability strategies will vary depending on best current use (i.e. emphasis), current conditions, desired future condition, and landscape context. For example, in a harvest unit where buffers associated with upslope type N streams or debris-prone areas provide adequate, well-distributed upland leave tree retention, there may be less need for additional scattering or aggregation. The extent to which retention and development of leave trees and dead wood is needed also depends on to what extent such structures are already present on the landscape.

In general, forest managers seek to identify and incorporate compatibilities among resources. Debris-prone areas that are likely to contribute wood to streams can be managed for large trees, which provides within stand values (production, habitat, carbon storage) and eventually contributes to enhancement of aquatic function when the slope fails. Other compatibilities are more directed at social benefits. Management activities near recreation sites, or along major highways, may seek to minimize scenic impacts or delays in access, or to highlight management options and benefits.

Some decisions around stand-level trade-offs are related to broad resource goals, as described above. Others are more operational or related to costs and constraints, with implications for subsequent management activities and stand development. For example, managers may decide a thinning is more appropriate than a clear-cut harvest due to stand development and related revenue goals (e.g. better long-term returns from two entries) or perhaps due to ecological concerns (e.g. part of a spotted owl home range). Managers must then decide what thinning prescription is appropriate, given stated goals, and evaluate whether the costs associated with the proposed management activity outweigh the benefits with all of the stated constraints. In some cases, it may make more sense to emphasize short-term return on investment. Yet in others, it may not make much sense to proceed at all, from a cost or risk perspective.

Young stand management activities are another area where cost- and effort-related considerations influence decisions around trade-offs in integration of resources. An example is how the amount and distribution of leave trees, dead wood, and buffers affect strategies for young stand management, including reforestation and use of aerial spraying for pesticides. In general, there are numerous trade-offs inherent in decisions around site preparation, choice of seedling stock, and timing of pre-commercial thinning or manual release. Managers must decide how much to invest in young stand management to achieve stand development goals and how to balance those activities with retention of structures for continuity and function.

Nowhere is the need for consideration of trade-offs more apparent than in the integration of restoration activities to achieve resource goals. Where active management for restoration is desirable, managers must decide what resources to emphasize (e.g. wood products, wildlife habitat, aquatic function). Where active management is a challenge (e.g. cost prohibitive, difficult to access, or otherwise constrained), there is still need for consideration of what services and benefits are maintained or promoted through passive management, as well as whether and when management intervention might be necessary.

Active management for restoration of production values often requires intensive management to reset pathways and trajectories. Converting SNC-infected stands or older alder-dominated stands to productive conifer plantations means removal of most standing trees, site preparation to clear growing space, and planting of SNC-tolerant or resistant species or stock. It takes foresight and careful administration of harvest operations to incorporate conservation values in stand conversion efforts. Returns may be limited or slow, relative to desired pace, if few attributes of conservation value are present initially. Active management to restore conservation values is generally less intensive and more focused on specific habitat attributes and functions of interest.

In some cases, it may be more cost effective to implement passive strategies. In other words, allow natural stand development processes (e.g. mortality, succession, disturbance) to restore services and benefits of interest, rather than attempt expensive and/or challenging restoration efforts. For example, some alder-dominated stands that are difficult to access or expensive to log (relative to revenue produced) may be best left alone to senesce and develop first into complex, early seral habitats and eventually into a productive conifer stands again. Such stands contribute various ecosystem services through their development (e.g. carbon storage, biodiversity) with little cost or effort directed at management and without sacrificing future options (e.g. future production potential).

Restoration activities must account for effects on other resources in an integrated, ecological management framework. Restoration designed to promote complex early-seral habitat conditions can negatively impact stocking, survival, and growth of high value conifers, thus impacting production value of the stand. Managers must weigh the long-term benefits of restoration against the potential short-term impacts to species of concern, scenic value, and other desired services and benefits.

Though it is more a landscape-scale issue, the pace of restoration activities is also of concern. Costs of restoration must be weighed against investments that could be made elsewhere (e.g. in young stands) and how overall expenditures affect revenue and financial viability. Balancing costs at the site level may impede some prescriptions, given that timber revenue funds the majority of management activities on state forests. At the landscape scale, a slowing of the pace of harvest may be desirable to both address forest health issues (e.g. SNC) and regulate age-class distribution to ensure long-term productivity and solvency. However, too much investment in restoration could jeopardize short-term revenue to the state, counties, and local taxing districts. Pace can also affect other resources, such as distribution of wildlife species in response to changes in habitat conditions. This may be positive for species that respond well to disturbance, but negative for those that do not.

Landscape-scale Considerations

Integration of resources at landscape scales requires consideration of broad goals for health, productivity, diversity, resilience, and function. Larger-scale contexts that must be incorporated include ownership patterns, distribution of habitat for species of concern and known occupancy, habitat connectivity, forest inventory, emphasis, and access. Strategies, targets, and standards for individual resources and integrated forest management will vary accordingly to account for regional variation in environmental conditions and disturbances, as well as in stakeholders and community values, economies, uses, and needs (Charnley et al. 2018, Spies et al. 2018b,).

Key Landscape-scale Ecological Considerations:

- Identifying important areas for each resource. A key strategy for maintaining ecosystem integrity and function is to identify priority areas and other special places of high value for each resource, including roads; recreation, education, and interpretive resources; aquatic systems; and timber (Spies et al. 2018a). Unique, rare, or otherwise important features should be protected, including aquatic systems and hydrologic function, caves and cliffs, wet meadows and other wetlands, important migration routes, forest remnants and old trees, cultural and recreational resources, and climate change refugia (e.g. cold water in-stream habitats and complex, older forest at higher elevations).

- Managing for function of processes and systems across seral stages, landscapes, and with consideration of ownership patterns. Many threats to forest ecosystems outrank ownership patterns and management boundaries and are beyond ODF's ability to control. Complex ecological and social systems require collaborative management across ownerships to ensure access, enhance resilience, and maintain social license. Many land managers have limited capacity to influence outcomes for local or regional populations of fish and wildlife species of concern (Spies et al. 2018a). Cross-boundary conservation efforts increase the effectiveness of individual efforts. Opportunities and strategies for conservation must consider landscape context.
- Creating, maintaining, and enhancing the heterogeneity of stand types and conditions to provide structural and compositional diversity at ecologically appropriate (i.e. functional) scales (Franklin et al. 2018). Management at landscape scales must consider the full suite of biodiversity on the landscape. At the stand level, management actions will retain at least some "ecological content." In other words, important structural features for terrestrial and aquatic species that allow for persistence within the stand or movement through it (Franklin et al. 2018).
- Designing strategies with consideration to fish and wildlife habitats. The Western Oregon State Forests Management Plan takes a coarse- and fine-filter approach to many aspects of fish and wildlife habitat management and ecosystem function (Hunter 1999, Marcot et al. 2018). Coarse-filter strategies are focused at ecosystems and communities, while fine-filter strategies address needs of individual species of concern (e.g. Oregon Coast coho, northern spotted owls). The spatial scales at which strategies and activities are implemented varies with both. Generally, coarse-filter strategies are aimed at structures, features, and processes that promote broad-scale landscape and ecosystem function and biodiversity. Related targets and standards are implemented at the landscape scale, though decisions are often made at the stand level. Fine-filter strategies supplement coarse-filters to address potential shortcomings in habitat requirements for species of concern (e.g. breeding, wintering, dispersal). Related targets, standards, and restrictions are usually implemented at the stand level with consideration for landscape context (e.g. amount, quality, and configuration of available habitat).

Key Landscape-scale Economic Considerations:

- Integrating revenue and production goals with conservation and restoration goals. This is the primary challenge of state forests management. The state needs to realize a high level of production from the forest product producing potential of these lands to provide a high level of revenue to beneficiaries, while also funding all forest management activities related to other services. This forces decisions and strategies around cost and risk management that include incorporation of conventional strategies for managing timber resources integrated in broader landscape (e.g. emphasis on production in appropriate areas, forest regulation for long-term sustained yield, harvest at CMAI).
- Managing conservation areas on a larger scale. Areas with conservation focus provide current habitat and future refugia for species of concern with specific habitat requirements that are limited in other parts of the landscape (e.g. old forests with complex, interior habitat; areas that

provide cold water). Active and passive management approaches to habitat restoration, maintenance, or enhancement will be implemented as needed, at ecologically appropriate scales, and with consideration of short-term impacts. An ecological approach to integrated resource management also recognizes the dynamic nature of the landscape. Focused conservation areas are subject to external pressures and will not remain static on the landscape. Disturbance events change stand conditions, species move across the landscape, and new sites are discovered each year. The relative values of some areas change over time, as does the context of surrounding landscape. Thus, larger conservation areas need to be sufficiently large to accommodate large-scale events and large-scale goals. Smaller areas may be more transient, depending on circumstances and need.

- Identifying and utilizing viable habitats. Managers must consider the interplay of riparian buffers and aquatic function with landscape-scale habitat connectivity for wildlife provided by retention of certain stand types and conditions, as well as habitat elements in harvest units. Managers must also consider how costs associated with wildlife and aquatic strategies combined grow over the landscape and affect revenue and financial viability. Consistent with an ecological approach to integrated resource management, managers seek to identify and manage important areas and features for ecosystem function, in a manner appropriate to stream type, forest type, and region, using this to vary strategies across the landscape to provide options and promote resilience.
- Managing new or existing roads. State forests road systems are in many ways as dynamic as the forest itself. Each year, development and maintenance of new and existing roads systems must account for current issues and future needs. Roads require thoughtful management to minimize and mitigate impacts to streams and soils. New roads must be planned with both short-term needs and larger-scale, longer-term landscape benefits in mind. Roads are key to human access, which allows for enjoyment of many benefits. But successful integrated management requires large-scale, long-term planning with incorporation of best management practices and careful considerations of the costs and priorities.
- Managing recreational benefits and usage. As Oregon's population grows and diversifies, so do the types, levels, and locations of recreational activities on state forests. This is associated with the growing impacts on other resources and need for management. For example, the transportation system on state forests includes a wide variety of OHV, bicycle, horse, hiking, and mixed use trails. Similar to roads systems, without proper management, the off-road transportation network can impact the function of aquatic systems, sensitive wildlife areas, soil integrity, and forest productivity, as well as the experiences of other users. Yet providing for diverse and inclusive recreational, educational, and other cultural experiences on state forests is a primary goal. Thus, managers must consider where management of recreation is needed and how it relates to provision of other resources, services, and benefits.

Thresholds for Ecosystem and Landscape Function

A core principle of an ecological framework to integrated forest management is consideration of thresholds for function. Many thresholds exist related to ecosystem function, productivity, financial viability (i.e. agency function) and other social and economic goals. A balanced approach ensures that none fall below sustainable levels.

Thresholds for ecological function often relate to the habitat needs of species of concern. Salmon require stream systems below certain thresholds for water temperature, dissolved oxygen, and related metrics, as well as above certain levels of gravel and wood to meet all of their in-stream habitat needs for spawning, development, and migration. Standing dead trees and live trees with decadence and deformities, of various size and age classes, provide important habitat elements (e.g. nesting, denning, and roosting structures) for numerous wildlife species, thus are key to providing for the full suite of biodiversity on state forests at levels that provide for persistence and productivity.

Many species require suitable habitat (e.g. stand types and conditions) at or above certain thresholds on the landscape (Lindenmayer and Franklin 2008, Puettmann et al. 2009). Theories suggest critical thresholds for ecological function of habitat at about 30% of the landscape (Andren 1994). Thresholds for individual species may be even higher. Red tree voles, for example, may require at least 50% of the landscape in suitable habitat, with additional minimum patch size needs (e.g. > 20 ha) and a two-kilometer threshold between patches (Robbins 1997, Forsman et al. 2016, Lesmeister et al. 2016). Recent studies in early-seral forests have found thresholds in patterns of occupancy and abundance for several species of forest birds that were related to amount of broadleaf vegetation at multiple spatial scales (Betts et al. 2010, Ellis and Betts 2011, Ellis et al. 2012).

The carbon budget of a managed forest is another example of a threshold that must be considered in an ecological approach to integrated resource management. Whether a forest is a net sink or source is contingent on management strategies and harvest practices over time. Under the guiding principles and carbon-related goals of the FMP, state forests are intended to be managed as a net carbon sink. This places some potential constraints on harvest where management in a long-term sustained yield framework might otherwise allow for the forest to be a net source.

Financial thresholds are also major drivers of forest management strategies and can occur at the level of individual sale, annual operations plan, or across multiple years. Ultimately, after distribution of revenue to the counties and local taxing districts, revenue to the agency must remain net positive in order for state forests management to remain a financially viable endeavor. To some extent, this dynamic drives harvest levels regardless of the other benefits desired from state forests, since those benefits cannot be provided sustainably without maintaining the Division's solvency.

Many ecological and financial thresholds are tied to the measurable outcomes and quantifiable targets of the FMP, though often somewhat indirectly, using surrogate measures. Other thresholds are linked to the adaptive management plan, implementation plans, or Division policies. An adaptive management framework is essential for testing the effectiveness of strategies related to thresholds at all scales, particularly where there is uncertainty related to setting appropriate threshold levels (Puettmann et al. 2009). Adaptive management is also useful for assessing the level or scale of implementation needed to obtain a desired effect (Franklin et al. 2018). For example, how does variation in approaches to site preparation and young stand management affect costs and outcomes? What scales do buffering and management activities, in general, affect dissolved oxygen and stream temperatures? How heavy or light does a silvicultural prescription need to be to obtain a desired result?

There is no one-size-fits-all solution to integrated resource management in an ecological framework. A combination of approaches for maintaining and restoring the integrity and resilience of forest conditions is needed to ensure a sustainable flow of benefits (e.g. wood production, conservation of species and biodiversity) over time (Marcot et al. 2018). Large-scale goals for ecosystem function (integrity and resilience) and production of wood products require landscape approaches. Site-specific management objectives for ecosystem services (e.g. production, health, or habitat) are based in ecology and tailored to stand conditions and landscape context. Management objectives will vary over the landscape (even between adjacent stands) and by region. The goal of incorporating multiple spatial-scale considerations into decision-making (which also occurs at multiple scales) is to provide options to account for the variation that currently exists across the landscape and to adjust and adapt to change over time.

Temporal Considerations

Habitats for fish and wildlife are dynamic. Individual habitat patches, structures, and elements change over time in any given location, as a function of growth, decay, and disturbance (e.g. fire, disease, harvest, floods, drought). Therefore, their locations on the landscape also change through time. Sustaining and enhancing fish and wildlife habitats on state forests requires planning through time and tracking of progress towards desired stand and landscape-level goals. Management to create or enhance specific habitat attributes may be needed in response to current conditions or change over time. Management interventions should be timed appropriately within the context of natural stand development processes (Franklin et al. 2018).

Timber inventory must also be managed through time to provide for an appropriate age class structure and other long-term goals related to sustainable harvest. Economic cycles, disturbance events, public concerns, and environmental conditions can influence inventory in unanticipated ways that require constant tracking and refinement of monitoring techniques. Rather than assume stability and predictability, as a general strategy state forests management seeks to build resilient (i.e. healthy, diverse, and productive) forests that provide options for future management (Franklin et al. 2018). An adaptive management framework allows for frequent adjustments to account for changes in desired structures and stages and new understanding of ways to achieve them (Spies et al. 2018a).

Temporal change includes societal change. Public values and beliefs related to forests change over time, as reflected in changes in resource use and desired benefits from state forests. Growing recreational use and many other long-term recreation, education, and interpretive needs are related to population change and associated changes in values and beliefs for forests and forest management. State forests management must adapt to societal changes to maintain social license to manage over time.

Forest and watershed conditions and forest health are the foundations that provide for the long-term flow of ecosystem services from state forests. Long-term goals for stand types and stand conditions, quality of riparian function and aquatic habitat must incorporate both the opportunities and limitations created by variation in current conditions, watershed processes and forest health across the landscape. Balancing restoration activities to address long-term goals for timber production and ecosystem function and minimize or mitigate short-term impacts to inventory, habitat, or revenue is key to sustainable management of state forests.

Incorporating Climate Change in Integrated Resource Management

Perhaps the biggest source of uncertainty and risk for the future of state forests comes from climate change. Current models predict warmer drier summers in western Oregon, with more extreme heat events, and more extreme precipitation events in winter (Spies et al. 2018b). Changes in temperature and precipitation patterns may affect forest productivity and health and biodiversity in unforeseen ways, as well as have large but variable effects on species and ecosystems. Increased frequency and severity of fire or other disturbances can prove catastrophic to long-term goals without sufficient planning. Adaptation and mitigation of climate change effects on forest resources require robust and flexible strategies for forest management over time.

Climate change and related uncertainties are managed under adaptive management framework. This entails less reliance on model predictions and more on analysis, innovation, and adjustment. Timelines for targets set under the plan are shortened to allow for more flexible and frequent evaluation. Many ecological and financial thresholds are tied to the measurable outcomes and quantifiable targets of the FMP, though often somewhat indirectly using surrogate measures. Other thresholds are linked to the adaptive management plan, implementation plans, or Division policies. An adaptive management framework is essential for testing the effectiveness of strategies related to thresholds at all scales, particularly where there is uncertainty related to setting appropriate threshold levels (Puettmann et al. 2009).

Carbon storage is an area of uncertainty that requires an adaptive management framework for integrated resource management. The extent to which particular forest management strategies or overarching approaches to harvest and growth promote net storage or release is a constant process of learning and refinement. Future growth and accessibility of carbon markets is difficult to anticipate or manage for. Current strategies are to promote integrity, function, and resilience to sustain forest ecosystems and ensure future options.

Land managers will have an intimate understanding of the goals and strategies outlined in this Integrated Forest Management Plan. They are tasked with considering all of the goals when developing implementation plans at the landscape level and at the stand level during annual operations planning. The following sections detail the plan's guiding principles, as well as the goals and strategies for each resource in an integrated framework. The goals and strategies for each resource describe how each fit within the framework of the larger ecological approach, as well as how other resources are incorporated during planning and implementation.

Guiding Principles

The Forest Management Planning rule (OAR 629-035-0030) identifies required elements for FMPs. Among these are "guiding principles that include legal mandates and Board of Forestry policies." Taken together, and at the direction of the Board of Forestry, the guiding principles shall direct the development of the management plan including goals, strategies and measurable outcomes.

Principle 1

The Forest Management Plan will be grounded in the management mandates for Board of Forestry lands as expressed in the Greatest Permanent Value (GPV), Forest Management Planning OARs.

OAR Chapter 629, Division 35, Management of State Forest Lands, provides the foundation for the development of the FMP for BOF. Division 35 includes definitions, findings and principles associated with acquired lands, language defining GPV, and direction for the development of FMPs.

- The resources and values articulated in the OARs:
    - Sustainable and predictable timber harvest and revenues
    - Properly functioning aquatic habitats
    - Protection, maintenance, and enhancement of native wildlife habitats
    - Protection of soil, air, and water
    - Provision of outdoor recreation activities
    - Consideration of landscape effect
    - Protection from fire, disease, insects, and pests
    - Also mentioned: protection against floods and erosion, protection of water supplies, grazing, forage, and browse for domestic livestock, forest administrative sites, and mining leases and contracts
- The OARs direct that the FMP will include the following strategies:
    - Contribute to biological diversity of forest stand types and structures at the landscape level and over time.
    - Apply silvicultural techniques that provide a variety of forest conditions and resources.
    - Conserve and maintain genetic diversity of forest tree species.
    - Manage forest conditions to result in a high probability of maintaining and restoring properly functioning aquatic habitats.
    - Protect, maintain, and enhance native wildlife habitats.
    - Recognize that forests are dynamic.
    - Provide for healthy forests by using an integrated pest management approach and utilizing appropriate genetic sources of seed.
    - Maintain or enhance forest soil productivity.
    - Maintain and enhance forest productivity by producing sustainable levels of timber.
    - Apply management strategies that enhance timber yield and value while contributing to the diversity of habitats for native fish and wildlife.

- The state forests are actively managed:
    - The rules require active management of state forests defined as "applying practices over time and across the landscape to achieve site-specific forest resource goals using an integrated, science-based approach that promotes the compatibility of most forest uses and resources over time and across the landscape."
- The plans are to use an integrated management approach and pursue compatibility of uses over time and space:
    - Compatible means "capable of existing or operating together in harmony." Integrated management means "bringing together knowledge of various disciplines (forestry, fisheries, wildlife, and water) to understand and promote land management actions that consider effects and benefits to all."
- The plans consider landscape context:
    - The rules direct that "landscape context" be considered. Landscape is defined as "a broad geographic area that may cover many acres and more than one ownership, and may include a watershed or sub-watershed areas." Plans must contain "a description and assessment of the resources within the planning area and consideration of surrounding ownership in order to provide a landscape context."
- The counties have a recognizable interest:
    - The rules include a Board finding that "the counties in which these forest lands are located have a protected and recognizable interest in receiving revenues from these forest lands; however, the Board and the State Forester are not required to manage these forest lands to maximize revenues, exclude all non-revenue producing uses on these forest lands, or to produce revenue from every acre of these forests lands."
- The plans incorporate an adaptive management approach:
    - The rules direct that plans be based on the best science available, use monitoring and research to generate new information, and an adaptive management approach. Adaptive management means "the process of implementing plans in a scientifically based, systematically structured approach that tests and monitors assumptions and predictions in management plans and uses the resulting information to improve the plans or management practices used to implement them."

Principle 2

State forests will be managed, conserved, and restored to provide overall biological diversity of state forest lands, including the variety of habitats for native fish and wildlife and accompanying ecological processes. The GPV and Forest Management Planning rules are the Board's expression of providing conservation.

The GPV and Forest Planning rules include many attributes that are directly tied to providing conservation on Board of Forestry lands. These references include, but are not limited to, providing and restoring properly functioning aquatic systems; protecting, maintaining, and enhancing native wildlife habitats; contributing to biological diversity of forest stand types and structures at the landscape level and over time; and conserving and maintaining genetic diversity of forest tree species.

Principle 3

The plan will provide revenue to ensure financial viability and sustain the values that support GPV.

The FMP will provide sufficient revenue to support the stewardship of these forest lands and achieve the blend of economic, social, and environmental benefits. Financial viability is achieved over the long term through continued protection and management of the forest asset and over the short term with operational tools that ensure cash flow is available to the Division for sound management of state forests.

In the current business model, 98% of revenue is derived from timber sales and all BOF expenditures and revenues are managed in the Forest Development Fund. Expanding and diversifying revenue streams to support public benefits can increase long-term financial stability. Services are prioritized based on funding availability, through tools including fiscal and biennial budgets, fiscal year operating plans, timber marketing, and AOPs. Financial viability is achieved over the long term with business strategies that align anticipated funding availability with services that are prioritized by GPV. Several tools are used, including a business plan, business improvements, and financial metrics to assess future investments, revenue projections, IPs, the FMP, and risk management.

Principle 4

The plan will provide for a range of social benefits for all Oregonians, including direct and indirect financial contributions to local and state governments, ecosystem services, opportunities for public access and recreational use, support for diverse local employment opportunities, and a process for participating in the forest management planning and implementation process.

State forest lands support multiple social benefits on a variety of scales and seeks to contribute to community well-being for all Oregonians. They provide ecosystem services including clean air, clean water, shade, and wildlife habitat that enhance the quality of life for all Oregonians and draw visitors. Active forest management provides revenue for counties, social services and education. It builds communities by supporting family-wage jobs and contributing to local, regional and state economies. The Division provides lasting and diverse outdoor recreational, interpretive, and educational experiences that inspire visitors to enjoy, respect, and connect with Oregon's state forests.

Principle 5

The plan will recognize that investments in forest and watershed restoration are necessary to achieve desired outcomes that align with the GPV policy direction for BOF.

Restoration efforts are considered when an area has been heavily altered to a non-desirable condition. This condition may have arisen for a variety of reasons, including incomplete knowledge in previous management, unintended resource interactions, or even natural disturbance events with footprints that conflict with desirable outcomes given management goals. In these cases, restoration activities will be considered in an effort to move the resource to a more desired state, as articulated through management goals.

Forest Restoration

When the state acquired the northwest Oregon state forest lands, some lands had a legacy of repeated, large-scale wildfires, and other lands had been extensively logged. Oregonians approved bonds to implement a massive restoration project, planting primarily Douglas-fir. Many stands were planted with Douglas-fir that is now known to be off-site (i.e. not genetically adapted to local conditions). A large portion of reforested lands (e.g. 46% of Tillamook district) are affected by Swiss needle cast (SNC), a native fungus that affects the growth and vitality of forest stands. The combination of single species (Douglas-fir) stands and off-site seed is thought to increase the susceptibility of the stands to SNC. A long-term forest health strategy in the SNC zone is to actively manage stands to reduce the amount and proportion of Douglas-fir and increase the amount of native species not susceptible to SNC. In addition, seed sources adapted to local conditions will be used. Along with SNC, other stands would benefit from restoration treatment (e.g. large areas of compromised and aging alder stands).

Disturbance events (e.g. ice storms, wind events, floods, fires) can lead to under-productive forest conditions and susceptibility to insects and disease. These stands often require immediate action to restore resilient and productive forest conditions.

The FMP will recognize these restoration needs and develop goals and strategies that seek creative funding mechanisms to implement them. The restoration effort will contribute to healthy forest landscapes that will be resilient in the face of climate change, fire, or other disturbance events and stressors. Monitoring and adaptive management are important components of the restoration efforts.

Watershed Health

For over 20 years, Oregon has made a concerted effort to conserve and improve rivers and watersheds throughout the state, with the direct involvement of local communities. ODF's management plans and activities have been an important part of those efforts. The plan will continue to support the Oregon Watershed Enhancement Board (OWEB) mission to "help protect and restore healthy watersheds and natural habitats that support thriving communities and strong economies" and emphasize a continuing commitment to restoration activities. It will also recognize the vital contribution that these forests can make to the success of large-scale regional efforts like the Oregon Plan for Salmon and Watersheds.

Principle 6

The FMP will be developed and implemented at a scale and pace that provide the appropriate geographic and temporal blend of economic, social, and environmental outcomes.

The geographic scale of plan strategy and implementation will have an effect on the spatial distribution of plan outcomes. Likewise, the temporal pace of strategy implementation and investments will have an effect on the distribution of environmental, social, and economic outcomes over time. These dynamics will be considered in creating and implementing a plan that provides the most appropriate blend of spatial and temporal outcomes.

The plan will not individually optimize environmental, social, or economic outcomes, at each geographic scale, or for every time period, but will strive for the most geographically and temporally appropriate blend of environmental, social, and economic outcomes.

Principle 7

The plan will provide varying levels of economic, environmental, and social outcomes over time as fiscal conditions change. While this approach will result in short-term trade-offs among specific goals, over the long term, GPV will be achieved.

Different GPV outcomes may be emphasized at different time periods, depending on fiscal conditions. For example, when fiscal conditions are favorable, higher investments may be made in restoration efforts to promote forest stand development for both commercial (stand investment) and habitat goals. Fluctuating timber market conditions may favor more or less timber harvest, but, over the long term, the plan will provide a predictable and sustainable flow of timber. Protection of native fish and wildlife habitats will be maintained consistent with the strategies established in the plan. Services associated with non-revenue-generating activities may fluctuate based on competing priorities and budgetary constraints.

While the level of service provided for any given GPV outcome will vary, actions necessary to assure proper forest stewardship will be a high priority. Specific decisions will be made in a deliberative and thoughtful process that achieves GPV over the long term and considers future consequences.

Principle 8

The plan will comply with other state and federal laws and rules.

In addition to the management mandates specific to BOF, the FMP will address compliance with other state and federal laws and rules including, but not limited to: the state and federal ESAs; the federal Clean Water Act; the Oregon FPA; Oregon Fish Passage Laws; and cultural resource protection administered by the State Historic Preservation Office and coordinated with Indian tribes and the State Police. Protection and contribution to the recovery of listed species can utilize a range of approaches such as take avoidance with a combination of conservation, protection, and restoration strategies. The plan could be coupled with programmatic ESA compliance agreements such as Habitat Conservation Plans, Candidate Conservation Agreements with Assurances, and Safe Harbor Agreements.

Principle 9

Diverse input from Oregonians and a variety of interested parties will be a high priority throughout planning processes.

Understanding, acceptance, and support from stakeholder groups contributes to long-term success in managing State Forests. The Division is committed to open, equitable, and transparent stakeholder engagement processes. Additionally, counties within which BOFL is managed have a statutorily established relationship with the Board through the Forest Trust Lands Advisory Committee (FTLAC). The Division provides accurate and timely information to ensure FTLAC has the information they need to advise the BOF and the State Forester.

ODF recognizes the importance and value of reaching out to Oregon's federally recognized Tribes on issues related to managing Oregon's state forests. We will pursue opportunities to meet with Tribal chairs, councils and directors to listen and learn from the Tribes, seek opportunities for input and collaboration, and build relationships.

Principle 10

The FMP will achieve goals through cooperative efforts with other agencies and units of local government, user groups, or organizations.

Management objectives can often be achieved more effectively and efficiently through collaboration with others. Consultation and communication with other agencies and entities, including counties, will be important to identify areas where ODF's efforts intersect with other state initiatives. These include, but are not limited to: The Oregon Plan for Salmon and Watersheds (OWEB); the Oregon Conservation Strategy (ODFW); the Oregon State Parks and Recreation's (OPRD) Statewide Comprehensive Outdoor Recreation Plan (SCORP); Federal and State sister agencies; and the State Historic Preservation Office's cultural and archaeological programs (OPRD).

Principle 11

The FMP will be implemented to adapt to climate change and mitigate its impacts on the management of state forest lands. The FMP will also contribute to climate change mitigation and sequester carbon.

Future changes in temperature, precipitation, and hydrologic processes may alter the distribution of climate conditions, as well as the frequency of disturbances, including insects, disease, wildfire, and drought. Within the context of the Division's overarching adaptive management framework, the plan will implement forest management strategies directed at ecological processes and functional characteristics to determine the potential to promote resilient forest conditions. State forest lands and wood products derived from active management contribute to carbon sequestration, a factor in mitigating global climate change. A focus on strategies that adapt to changing conditions will ensure the Division is able to meet State Forests' management objectives over the long term.

Chapter 3 – Goals, Strategies, and Measurable Outcomes

The strategies for management of the uplands include specific concepts for timber production interwoven with strategies for other resources, including wildlife and habitat, fish and aquatic habitat, roads, recreation, cultural resources, and others. Strategies include both site-specific and landscape-level components. The durability of this plan lies in the commitment to these strategies themselves and not to any fixed portion of the landscape, which complement these strategies.

Pace and scale of timber management activities are established through District Implementation Plans. Planned harvest activities are designed to meet economic goals, while integrating social and environmental objectives. The following strategies for timber production and harvest are intended to provide a sustainable flow of timber and revenue while maintaining a desired array of forest conditions over time. When natural events such as windstorms or fires affect forest stands, management activities are adjusted to balance harvest goals with conservation objectives.

Forest Health

Key indicators of forest health considered in the scope of this plan include damage from insects, disease, animals, and abiotic stressors such as fire, weather extremes, and air pollutants. These disturbance agents kill or damage trees, or reduce growth. Certain damage agents are important contributors to the development of key habitat structures at landscape and local scales. The effects of these various disturbance agents are usually described in terms of number of acres affected, number of trees killed, degree of damage, or reduction in tree growth rates. All can be measured through various survey techniques. While the overall health of the forest is good, there have been increases in disease occurrence (e.g. Swiss needle cast) and abiotic damage (e.g. drought stress) across the plan area.

Goals

1. Maintain or enhance healthy forest conditions using best management practices to promote sustainable, productive, and resilient ecosystems.
2. Make current forest health data readily accessible to field staff and integrate fully into decision-making criteria.

Strategies

1. Actively manage the forest through the application of science-based silviculture and ecological forestry within stands and across the landscape to create a variety of forest conditions that are resistant to disturbance events.
2. Employ young stand management practices appropriate for individual sites to ensure successful stand initiation and development.

3. Use integrated pest management (IPM) to suppress or prevent unacceptable pest damage, and maintain appropriate background levels of damage agents that contribute to forest health.
4. Develop and maintain an Early Detection and Rapid Response (EDRR) program for the potential introduction of new exotic pests. Cooperate with other agencies and associations to prevent the introduction of non-native pests.
5. Implement State Forest Program's Swiss Needle Cast (SNC) Strategic Plan.
6. Use aerial, ground, and insect trapping surveys to monitor forest health to inform management decisions across the landscape.
7. Maintain spatial data for long-term tracking and integrate forest health information into forest management decisions.
8. Provide training and outreach to field staff when new disease agents are detected to help with EDRR and IPM implementation.
9. Provide periodic forest health updates and expertise in best management practices.
10. Participate in research and cooperative programs applicable to western Oregon forests that actively enhance forest health and biodiversity.
11. Incorporate forest health components into the State Forests' forest inventory at the appropriate spatial and temporal scales to support planning and ascertain long-term forest health trends.

Measurable outcomes

1. Maximize long-term forest productivity and resilience.
    a. Minimize extent and severity of diseases.
    b. Minimize the susceptibility of stands to stress from prolonged (and potentially worsening) heat and drought.
    c. Minimize impacts of novel exotic pests.

Production and Harvest of Timber and Special Forest Products

Active forest management gives local opportunity for employment, as well as other direct and indirect financial contributions to local communities. It also provides a variety of high-quality habitat types to support continued occupancy and persistence of native fish and wildlife over time. Restoration and enhancement requirements remain where fire and subsequent salvage logging or reforestation have reduced habitat elements or hindered their development (e.g. the Tillamook Burn). Diverse and complex habitats, late-seral habitat features in particular, will take many decades to develop through both passive and active management approaches. Less complex habitat (i.e. early to mid-seral) are understandably much easier to achieve. While moving the landscape toward more diverse habitat conditions, there are expected to be individual species, referred to as "species of concern," and associated habitats that require special consideration.

Goals

1. Provide sustainable and predictable production of forest products that generate revenues for the benefit of the state, counties, and local taxing districts.
2. Contribute timber revenue toward financial viability of the State Forests Division.
3. Offer direct and indirect financial contributions to local and state governments.
4. Give local support for employment in a diversity of job types.
5. Maintain the special forest products resource as a viable, sustainable commodity program that is compatible with other forest resources.
6. Make available opportunities to obtain special forest products to members of local communities in order to support recreation, jobs in the forest, fuel for heating, and other social values.
7. Ensure road system facilitates achievement of timber harvest objectives.

Strategies

1. Actively manage the state forest landscape and individual forest stands.
    a. Schedule the regeneration harvest of stands to balance volume, financial return, and other resource objectives.
    b. Implement harvest prescriptions that maintain or enhance the balance of volume, financial return, and other resource goals.
    c. Prioritize stands for harvest and silvicultural treatment using multiple criteria, such as stand condition, growth rate, forest health, and harvest revenue.
    d. Rehabilitate understocked and underproductive stands where possible to improve volume, financial return, and resource outcomes for wildlife, carbon storage, and forest health.
    e. Implement reforestation and young stand management prescriptions to balance volume, financial return, and other resource objectives.
2. Apply standards for silvicultural techniques and conservation strategies.
3. Actively manage the state forest landscape to incorporate silvicultural treatments that integrate harvest objectives with habitat and other conservation objectives at a landscape level.

4. Develop plans for each district that provide more specific direction, including timber harvest objectives, at time intervals no longer than ten years.
5. Implement adaptive management measures that are informed through monitoring results.
6. Maintain documentation to guide special forest product sales.
7. Develop and provide districts with resources to manage special forest products.

Measurable Outcomes

1. Maximize the probability of State Forests' financial viability.
2. Minimize ODF expenditures.
3. Maintain or increase revenue to counties and local taxing districts.
4. Maximize volume of merchantable wood fiber available for harvest.
5. Maximize the availability of timber for future harvests.
6. Maximize local employment and indirect benefit to local economies.
7. Maximize net revenue per acre available for harvest.

Wildlife

Forest management for biodiversity is characteristically implemented at two scales: the forest stand and the broader landscape. Thus, integrated strategies for conservation are applied at both the stand and landscape scales to provide functional habitat for all native wildlife species and contribute to the maintenance and enhancement of biodiversity. The strategies apply across the landscape, and include areas with high production and/or conservation value**.**

Goals

1. Foster and enhance functional and resilient systems and landscapes to support native wildlife communities.
2. Provide the variety and quality of habitat types and features necessary for long-term persistence of native wildlife species.

Strategies

1. Manage habitat for diversity at all levels of biological organization, from genetic to ecosystem.
2. Incorporate ecosystem function into planning, management, and monitoring.
3. Foster and maintain redundancy at various ecological scales.
4. Manage for diverse habitat types across the landscape and over time.
   a. Manage for a diverse array of seral stages, stand structures, and patch sizes and distribution.
   b. Protect, maintain, and enhance habitats that capture the range and variation of forest types, topography, and habitat features at the forest level.
   c. Identify and protect rare, unique, and otherwise important habitats, particularly those that are fragile, sensitive to disturbance, or that serve as potential refugia from climate change effects.
5. Manage for complex habitats, of all ages, with the full suite of habitat features within and across watersheds.
   a. Protect, maintain, and enhance legacy structures, such as remnant old-growth and other residual green trees, standing dead trees (i.e. snags), and downed wood during stand management activities to promote structural complexity at stand and landscape scales.
   b. Promote vertical layering where habitat restoration or enhancement are primary concerns or compatible with other goals, and supported by the species composition of the stand.
   c. Promote compositional diversity of vegetative species and structure at stand and landscape scales.
   d. Promote spatial heterogeneity at stand and landscape scales.
   e. Adapt standards to region and stand-specific goals and as stand and landscape conditions change over time.
6. Manage for functional landscapes for native wildlife.
   a. Create a variety of patch types, patch sizes, and patch placement over time.
   b. Provide for adequate interior forest habitats, especially interior habitat area (IHA) for mature forest patches.
   c. Maintain connectivity between habitats, as well as broad landscape permeability, for diverse wildlife species including species of concern.

   d. Provide for adequate interior forest habitats.
   e. Maintain connectivity between habitats, as well as broad landscape permeability, for diverse wildlife species including species of concern.
7. Protect, maintain, and enhance habitat for Species of Concern (SOC).
   a. Comply with ESA requirements and adopt management strategies that contribute to the survival and recovery of currently listed threatened and endangered species, as well as maintain habitat for species of concern to reduce the need for future listings.
   b. Conduct Species Assessments to identify species of concern for state forest lands and assess if plan-level habitat strategies are adequate or if additional strategies are needed.
   c. Identify, designate, and/or establish areas with high value habitat for SOC.
   d. Develop site plans for SOC, where appropriate.
   e. Update and revise species of concern policies to improve site protection.
   f. Implement density surveys, where feasible, to improve information on the status, location, and habitat use of SOCs.
   g. Collaborate across ownership boundaries.
8. Use active management to meet habitat objectives over time and across the landscape.
   a. Identify areas with potential to provide complex habitat, and develop and implement harvest prescriptions to protect, maintain, and enhance habitat features.
   b. Implement restoration activities to address forest health concerns and incorporate habitat values in harvest prescriptions and subsequent young stand management where appropriate.
   c. Identify areas where habitat enhancement is needed and compatible with other goals. Develop and implement appropriate harvest prescriptions or other projects.
9. Consider regional and landscape ownership patterns, habitat distribution, and known occupied species of concern sites when implementing above strategies.
10. Implement an Adaptive Management Plan that includes research and monitoring, evaluates implementation, experiments with techniques, and considers best available science.

Measurable Outcomes

1. Maximize wildlife habitat for all native wildlife species
   a. Maximize habitat extent for native wildlife species
      i. Habitat for species of concern & listed species
      ii. Habitat for game species
   b. Maximize within-stand structural diversity
   c. Maximize within-stand biological diversity
   d. Maximize diversity of habitat types
   e. Minimize probability of wildlife extirpation in the plan area
2. Maximize Compliance with Federal and State Endangered Species Acts
3. Minimize short- and long-term impacts of climate change on wildlife and habitat.

Aquatics, Landslides and Roads

The functionality of riparian and aquatic areas depends on the interaction of three components: vegetation, landform and soils, and hydrology. Riparian wetland areas are functioning properly when: adequate vegetation, landform, or large wood is present to dissipate stream energy associated with high stream flows, reducing erosion and improving water quality; filtering sediment, nutrient cycling, capturing bedload and aiding floodplain development; improving flood-water retention and ground-water recharge; stabilizing stream banks; developing ponds and channels of sufficient depth and duration to provide fish habitat; supporting biodiversity (USDI Bureau of Land Management 1993, revised 1995). In determining what constitutes "properly functioning aquatic systems," the overall approach in this plan is based on the following key concepts:

- Native aquatic species have co-evolved with the forest ecosystems in western Oregon.
- High quality aquatic habitats result from the interaction of many processes, some of which have been greatly influenced by human activity.
- Aquatic habitats are dynamic and variable in quality for specific species, over time and across the landscape.
- No single habitat condition constitutes a "properly functioning" condition. Rather, providing diverse aquatic and riparian conditions over time and space would more closely emulate the natural disturbance regimes under which native species evolved.

Goals

1. Maintain, protect, and restore habitats to promote properly functioning ecosystems that support the full range of aquatic species.
2. Establish a network of mature riparian buffers around streams and other waterbodies to support watershed functions that protect water quality and promote high quality aquatic and riparian habitat.
3. Minimize the effects of roads and landslides on watershed processes and aquatic habitat.
4. Provide for the long-term persistence of these ecosystems to minimize and mitigate unforeseen future conditions such as climate change.
5. Meet the requirements of federal and state regulations for aquatic resources such as the Federal Endangered Species Act and Federal Clean Water Act and Oregon's Statewide Planning Goals.

Strategies

Riparian and Aquatic Strategies

1. Establish riparian buffer standards appropriate to maintain, protect, and enhance ecological function of aquatic features.
    a. Classify streams by stream size, presence of fish, potential for debris flow, and flow duration
    b. Establish and maintain standards including a no-harvest buffer for all perennial streams, all fish streams, and seasonal streams of high debris flow potential.
    c. Establish and maintain standards including an equipment exclusion zone, variable tree retention, and retention of sub-merchantable vegetation or shrubs for small seasonal streams.

   d. Apply specific strategies to aquatic habitats to conserve, protect, and enhance ecological function with consideration to the impacts of climate change.
   e. Identify and protect areas that serve as potential refugia from climate change effects.
2. Protect, maintain, and enhance habitat for Species of Concern (SOC).
   a. Align management strategies with applicable species of concern strategies as published by state (ODFW) and federal (USFWS) agencies.
   b. Establish "Aquatic Anchors" in consultation with ODFW and, where habitat goals are compatible, align with the location of Terrestrial Anchors.
3. Apply alternative vegetation treatment within the riparian areas when circumstances indicate an alternate management approach better achieves aquatic resource goals.
   a. Implement vegetation treatment projects using a multi-disciplinary approach and, where possible, through interagency coordination.
   b. Monitor alternative vegetation treatment projects.
4. Maintain the natural functions and attributes of wetlands over time and ensure that no net loss of wetlands occurs as a result of management activities.
5. Enhance aquatic habitats to promote healthy aquatic ecosystems.
   a. Design and implement aquatic projects that promote the recovery of species listed under the federal endangered species list.
   b. Assess and identify opportunities for improving aquatic conditions for keystone species, or a species of concern, as defined by federal or state agencies.
   c. Report all riparian and aquatic restoration projects to Oregon Watershed Enhancement Board (OWEB) that qualify as OWEB projects.

Landslides, Debris flows, and Steep Slope Strategies

1. Evaluate and minimize risks associated from slides that could occur without a component of large wood from upland unstable slopes with potential to deliver sediment to aquatic resources. Avoid, modify, or mitigate canopy removal on these slopes.
2. Establish no-harvest riparian buffers on debris-flow prone streams below upland unstable slopes.
3. Establish additional leave-tree strategies for inner-gorge and aquatic-adjacent unstable slopes.
4. Design road alignment and waste area locations to avoid active or formerly active slope movements where the proposed activity will destabilize the landform or increase sediment reaching aquatic resources.

Road Strategies

1. Utilize best management practices and standards set by the *Forest Roads Manual, State Forests Engineering Policy and the Forest Practices Act*.
   a. Utilize durable surfacing, filtering, settling, traffic management, and drainage designs to minimize erosion and protect water quality during wet weather hauling.
   b. Disconnect, to the amount practicable, road drainage from the stream network and other waters of the state to dissipate on the forest floor. Use mitigation techniques when disconnect is not possible.
   c. Construct and maintain stable road prisms and landings that eliminate or minimize soil erosion and rock from sliding.

   d. Locate landings, quarries, stockpile sites, and waste areas outside of riparian areas.
   e. Construct and maintain culverts, bridge spans, and fills near streams so high flows are not constricted, ponded, or diverted and downstream bank/bed erosion is not exacerbated by upstream activities.
   f. Provide for fish passage at fish-bearing stream crossings.

2. Meet or exceed water quality standards for non-point sources as established by OR DEQ and FPA.
3. Avoid roads in critical locations, including parallel to riparian areas, areas with potential for slope instability, or impacts to water quality (*Oregon Department of Forestry Forest Practices Technical Note #7 "Avoiding Roads in Critical Locations"*).
   a. Avoid road construction in critical locations and, where necessary, do so only if impacts to the aquatic will not occur or can be mitigated.
   b. Look for opportunities to vacate, relocate, or stabilize existing or legacy roads away from critical locations.

Measurable Outcomes

1. Minimize short- and long-term impacts of climate change on aquatic resources and water quality.
2. Maximize stream habitat conditions to support a full range of native aquatic species and meet regulatory standards.
3. Maximize high water quality to support native aquatic species and meet regulatory standards.
4. Maximize access to high-quality habitat to support a full range of native aquatic species.
5. Minimize loss of wetlands and wetland functions.
6. Maximize resilience of aquatic species to impacts of climate change.
7. Maximize functions and values of wetland habitats.
8. Minimize road-related sediment entry into waters of the state.
9. Minimize road connectivity to streams at crossing and adjacent to streams.
10. Maximize probability of delivery of large wood during landslide events.
11. Minimize sediment delivery from road-related landslides
12. Minimize negative impacts to soils.
13. Minimize risk of sediment delivery to Waters of the State.

Recreation, Education, and Interpretation

Recreation, Education, and Interpretation (REI) are fundamental components of the legal mandates established in GPV. State forests comprise a significant percentage of public forest lands in northwest Oregon. In several counties they are the largest ownership open to the public for recreational use. Most of these lands are less than a two-hour drive from a major urban area. State forests positively impact local economies and provide diverse REI opportunities for both residents and visitors.

Goals

1. Provide a range of recreation opportunities, forest education programs, and interpretive opportunities to serve the needs of a diverse public.
2. Manage recreational use of forests in a safe and environmentally sustainable manner that seeks to minimize adverse impacts to resources and infrastructure.
3. Provide meaningful, memorable, and enjoyable REI experiences that help shape a lifelong appreciation and understanding of forests and forest stewardship.
4. Maintain and enhance recreational opportunities for interacting with wildlife.

Strategies

1. Use data on visitation, resource impacts, and infrastructure use levels, as well as the recommendations provided in Oregon Parks and Recreation Department's Statewide Comprehensive Outdoor Recreation Plan (SCORP), to identify opportunities for enhancing, expanding, and developing REI opportunities.
2. Develop, manage, and maintain REI infrastructure and programs consistent with the capacity of the resource, agency, and partners.
    a. Design and manage sustainable REI programs and infrastructure to minimize environmental impacts, reduce user conflicts, improve visitor accommodations and integrate with the management of state forests.
    b. Educate to promote responsible use to reduce impacts to the resource and infrastructure.
    c. Review and implement standards and guidelines to govern management activities, as well as facility design, development, operation and maintenance.
3. Expand and enhance partnership and community engagement opportunities to increase support, foster public stewardship of REI resources, build relationships between users and the department, increase understanding of forest management challenges, and increase program capacity.
4. Explore opportunities to diversify funding sources and develop cost share programs.
5. Complete and implement an integrated REI management plan that integrates REI into all areas of state forest management business.
6. Provide wildlife viewing, education and interpretation opportunities.
7. Minimize recreational impacts to sensitive fish and wildlife species and their habitat.

Measurable Outcomes

1. Minimize recreational impacts to resources.
    a. Minimize recreational impacts to resources near developed recreation sites.

   b. Minimize recreational impacts to resources away from developed recreation site.
2. Increase user safety.
   a. Increase staffing levels for law enforcement, ODF, and camp hosts.
   b. Enhance safety of existing recreation sites and amenities.
3. Maximize visit quality.
   a. Improve infrastructure.
      i. Increase quality of infrastructure for visitors.
      ii. Increase availability of infrastructure.
   b. Improve accessibility.
      i. Increase access to recreational opportunities.
      ii. Increase access to nature, especially for underserved populations.
      iii. Increase access to education and interpretation opportunities, especially in the context of a working forest, climate change, and renewable resources.
4. Maximize diversity of REI options within a forest setting.

Scenic Resources

Northwest Oregon state forests are near some of Oregon's major cities, are crossed by several major highways and rivers, and host a recreation infrastructure including many campgrounds and extensive trail networks. This makes state forests a major part of the natural beauty and aesthetic experience for thousands of Oregonians during their routine travels across the Coast Ranges and Cascades. Scenic value also contributes to the quality of recreational experiences and outdoor activities, such as sightseeing, camping, fishing and wildlife watching. Goals for retaining scenic buffers are balanced with goals for maintaining safe conditions for motorists and recreationists. Northwest Oregon state forests are also home to state designated scenic waterways, which are designated to create a balance between protecting the natural resources, scenic value, and recreational use of these rivers.

Goals

1. Meet the scenic protection requirements of the Oregon Forest Practices Act for visually sensitive corridors associated with designated scenic highways (ORS 527.755).
2. Meet public safety requirements in visually sensitive corridors.
3. Maintain compatibility with Oregon's Statewide Planning Goal 5 (Open Spaces, Scenic and Historic Areas, and Natural Resources).
4. Meet the requirements of the Oregon Scenic Waterways Program.

Strategies

1. Identify and classify areas for level of visual sensitivity, taking into consideration the surrounding viewshed.
2. Collaborate with the Oregon Department of Transportation to meet public safety requirements in visually sensitive corridors.
3. Collaborate with the Oregon Parks and Recreation Department on management activities within Scenic Waterways.

Measureable Outcome

1. Minimize visual impacts in areas designated by the Department of Forestry as visually sensitive.

Access and Public Safety

The road system on state forests lands is an integral part of achieving GPV. The road system facilitates timber harvest, wildfire suppression and other forest management activities as well as providing access for a wide range of recreational activities. Substantial investments have been made in constructing, surfacing, and maintaining the road system. While the road system provides the needed access to achieve the management objectives of the plan, it also has the potential to impact natural resources and public safety. The road system in state forests is located, constructed, used, and maintained in accordance with the State Forests Road Manual, the Oregon FPA, and other applicable laws. This ensures the safety of the public by identifying haul routes, clearly marking harvest units, and closing access when necessary.

Goals

1. Design road systems to provide for safety of the anticipated road users.
2. Facilitate the anticipated access for management and fire protection activities necessitated by the Forest Management and Implementation Plans.
3. Minimize or mitigate risks to public safety from road construction, maintenance, and use activities on steep and unstable slopes.

Strategies

1. Maintain a spatial database containing attributes of roads, trails, bridges, and culverts for transportation planning and tracking.
2. Coordinate transportation planning with planning for timber harvest, reforestation, and recreation.
3. Review road construction or reconstruction in areas identified as critical locations by the geotechnical specialist, the staff hydrologist, and state forests engineer.
4. Utilize transportation planning to minimize or mitigate the potential of landslides and delivery of sediment to streams.
5. Construct, improve, and maintain landings and roads using engineering design, construction techniques, and maintenance programs.
6. Manage traffic flow on the transportation system.
7. Monitor conditions of the transportation system at the appropriate level and adjust priorities as needed to react to infrastructure needs, safety, and changing environmental conditions.
8. Coordinate with local fire protection staff and adjacent landowners to identify risks and improve transportation systems to facilitate fire location and suppression.
9. Construct and maintain stable road prisms and landings that eliminate or minimize soil and rock from sliding or toppling.
10. Minimize opportunities for the erosion of soils and aggregate from the road prism through evaluation, maintenance, and improvements of road drainage structures.
11. Disconnect, to the amount practicable, road drainage from natural waterways so that it dissipates on the forest floor.
12. Evaluate road alignments to ensure proposed activities do not destabilize surrounding terrain.
13. Obtain evaluation of risk to resources from geotechnical or engineering specialists prior to:

a. final layout of road alignments, large fills, retaining walls, waste area locations, slope stability mitigations, or when activities cross areas of active or formerly active slope movements.
b. roadbuilding or harvest on high landslide-hazard locations located above structures and public roads.

Measurable Outcomes

1. Minimize unsafe conditions for road users.
2. Maximize long-term cost effectiveness for road maintenance and construction.
3. Maximize cost effectiveness of timber harvest access.
4. Maximize cost effectiveness of road system.

Carbon

State forests provide an important ecosystem service in the form of carbon sequestration, the uptake and storage of carbon in forests and wood products. When a forest absorbs more carbon than it releases through harvest, decomposition, and respiration it is considered to be a carbon sink. Conversely, if a forest releases more carbon than it absorbs, it is considered to be a carbon source. Mature forests provide long-term in situ storage of sequestered carbon in large trees, snags, down wood, vegetation, and soils. Carbon sequestration is becoming more important as the impacts of climate change are becoming fully understood and experienced.

Goal

1. Maintain or improve contributions to Oregon's carbon stores.

Strategies

1. Implement harvest practices that minimize soil disturbance.
2. Coordinate with state and federal agencies to identify, evaluate, and implement projects that enhance the long-term sequestration of forest carbon.
3. Implement log utilization standards that enhance carbon storage in durable wood products.
4. Maintain and enhance long-term soil productivity through:
    a. silvicultural practices and prescriptions that enhance long-term carbon storage.
    b. rehabilitation and restoration of underproductive and understocked stands.
    c. use of reforestation prescriptions and species adapted to local site conditions.
5. Mitigate fire risk through forest operations, fuel reduction projects, and public education.
6. Adapt policies, standards, and practices to improve forest resilience as new information on the effects of climate change, forest health, and carbon storage become available.

Measurable Outcomes

1. Minimize total forest carbon emissions.
2. Maximize storage of carbon in forest land.
3. Maximize utilization of timber sale outputs in durable materials.

Cultural Resources

Cultural resources are defined as archaeological and historical in nature. They may include objects, structures, buildings, districts, or sites used by people in the past and are valued for many reasons. Archaeological sites provide important information about past cultures. Many sites also have religious, historic, or associational values for American Indian communities. Historic sites have important interpretive, recreational, and heritage values, which are lost when artifacts and information are removed or destroyed. These resources are fragile and irreplaceable, especially objects still in their original locations. These undisturbed objects are vital in telling of the culture that created them, how long ago they were made, and what the landscape was like at the time. Cultural resources provide a meaningful record of past cultures, events, and ecological conditions in Oregon.

Goals

1. Preserve and protect archaeological sites or archaeological objects in accordance with state law (ORS 97.740 to 97.760; 358.905 to 358.955; and 390.235).
2. Conserve historic artifacts and real property of historic significance in accordance with state law, in consultation with the Secretary of State and the State Historic Preservation Office (ORS 358.640 and 358.653).
3. Preserve additional cultural resource sites that are determined by the Department of Forestry in consultation with tribal archaeologists and the State Historic Preservation Office.

Strategies

1. Coordinate with the State Historic Preservation Office to ensure all state and federal laws are followed.
2. Complete an inventory and assessment of cultural resource sites and conduct a prehistoric and historic cultural resource review.
3. Develop a procedure for integrating site protection into forest activity plans by providing practical guidelines for identifying, documenting, evaluating, and protecting sites.

Measureable Outcomes

1. Minimize the impacts of forest management on cultural resources.

Air Quality

Timber harvest results in a large quantity of limbs, tops and non-merchantable material. Leftover debris can be a barrier to tree planting, a fire hazard, and can increase potential for pest infestations. To eliminate the fire hazard and prepare the ground for tree planting, fire can be used as a tool to remove this material. This burning can affect air quality and is regulated under the federal Clean Air Act, the primary law regulating air quality. Under the law, the federal EPA sets National Ambient Air Quality Standards.

Goals

1. Contribute to meeting National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration standards (PSDs) established under the federal Clean Air Act (42 USC 7401 et seq.).
2. Maintain compatibility with Oregon's Statewide Planning Goal 6 direction to maintain and improve the air resource of the state.
3. Minimize wildfire impact on air quality.

Strategies

1. Comply with the Oregon Smoke Management Plan (OAR 629-048-0001 through 629-048-0500) and Visibility Protection Plan (OAR 340-200-0040, Section 5.2).
2. Use Best Burn Practices (OAR 629-048-210).
3. Use alternatives to prescribed burning (OAR 629-048-0200).
4. Plan burns to avoid smoke entering Smoke Sensitive Receptor Areas described and listed in OAR 629-048-0140.
5. Burn material, which would otherwise be a significant hazard during the summer months, under controlled and planned conditions.

Measurable Outcome

1. Minimize smoke impacts to air quality.

Plants

State forests have hundreds of understory plant species that fill many roles in the forest ecosystem. They provide organic matter to forest soils, influence micro-climate, and are used as cover and forage by many animals. In addition to their ecological functions, some plant species (e.g. beargrass, sword fern) are harvested commercially or for cultural uses.

Goal

1. Provide habitats, both within stands and across the landscape, that contribute to maintaining or enhancing native, sensitive and endangered plant populations at self-sustaining levels.

Strategies

1. Evaluate the presence of threatened and endangered plant species during timber sale planning.
2. Manage for a variety seral stages, stand structures, and stand sizes across the landscape.
3. Protect riparian vegetation during forest management activities.
4. Contribute to statewide efforts to reduce the quantity and range of non-native, invasive plant species.
5. Meet or exceed the requirements of the state and federal Endangered Species Acts.

Measurable Outcome

1. Minimize the impacts of forest management on native, sensitive and endangered plant populations.

Agricultural and Grazing Resources

State forests have limited grazing potential. Although state laws permit agriculture and grazing on state forests as long as they are compatible with other forest resources, the topography of the state forests is generally not suitable for most agricultural uses. Historically, all the districts in western Oregon allowed grazing on burned or logged areas under the open range laws. As forests were reestablished, grazing diminished. Open range grazing ended in the early 1980s.

Goal

1. Permit agriculture and grazing to the extent that they are compatible with other resource goals.

Strategies

1. Consider agricultural uses on a case by case basis, issuing permits when these activities are compatible with other forest resources and activities.
2. Consider grazing leases on a case by case basis, issuing when they are compatible with managing for greatest permanent value of the lands and do not conflict with other resources.

Measureable Outcome

1. Minimize impacts of grazing on forest resources.

Soil and Minerals

The mineral, oil, and gas potential of state forests is largely unknown. According to the Department of Geology and Mineral Industries, few systematic surveys have been conducted for most commodities. Additionally, no regional geochemical studies have been made to define or eliminate areas of possible metal mineralization. However, there may be potential for production of natural gas, industrial minerals, economic metals, and geothermal resources.

Goals

1. Ensure aggregate rock sources are available for long-term usage in forest management.
2. Minimize impacts to surface resources.
3. Maintain compatibility with Oregon's Statewide Planning Goal 5.
4. Make available personal use of small volumes of clay, stone, sand and gravel as a public benefit.
5. Minimize or mitigate loss of soil from harvest operations.
6. Ensure soil productivity is fully realized.

Strategies

1. Survey, evaluate, and identify aggregate rock sources important for the long-term management needs of northwest Oregon state forests.
2. Facilitate requests by DSL needed for the processing of claims and permits.
3. Maintain organic materials in the soil and consider leaving slash, cull logs, downed wood, and snags following harvest operations.
4. Implement site preparation techniques for tree planting that maintain organic materials in soils when feasible.
5. Implement site-appropriate silvicultural treatments that fully utilize soil productivity.

Measurable Outcomes

1. Minimize road-related sediment entry into waters of the state.
   a. Minimize sediment delivery from road-related landslides.
   b. Maximize probability of landslide-delivered large wood.
   c. Minimize negative impacts to soils and waters of the state from management activities.

Land Base

Acquiring and exchanging land can increase the amount of state forest land or consolidate state forest lands in contiguous blocks instead of in scattered parcels. The consolidation of state forest lands will increase management efficiencies and long-term economic values, as well as enhance stewardship practices and other forest resource values. The GPV Rule requires state forest lands to be maintained as forest lands, so thoughtful planning is needed to ensure forest infrastructure is minimized while still achieving other forest management goals.

Goals

1. Conserve the state forest land base in order to maintain resource values.
2. Ensure the land base is compatible with Oregon Statewide Planning Goals and the Oregon Coastal Management Program.
3. State forest lands ownership pattern improves management efficiency.

Strategies

1. Minimize the amount of forest land used for roads, road corridor clearings, landings, and mineral extractions. Ensure that construction and development specifications efficiently meet management activity objectives.
2. Follow the procedures in ORS 197.180 and OAR 660-0030, 660-0031, and the department's State Agency Coordination Program, OAR 629-0020, to ensure that land use programs and activities are consistent with Statewide Land Use Planning Goals and are compatible with acknowledged county comprehensive plans and land use regulations.
3. Continue with an active land exchange and acquisition program that consolidates ownership and improves the division's ability to provide Greatest Permanent Value, as budgets and workloads allow.
4. Develop and implement land survey plans for each district in order to establish and/or reestablish state forest boundaries necessary to meet management activity needs.

Chapter 4 – Guidelines

Asset Management, Implementation, Monitoring, Research and Adaptive Management Guidelines

Asset Management Guidelines

Maintaining or enhancing value for assets described in this plan is fundamental to long-term sustainability of resource values described in administrative rule (e.g. timber, revenue, recreation, native fish and wildlife). These guidelines align with Oregon statutes and rules, Board of Forestry policy, and ODF policy.

Implementation of the Western Oregon State Forest Management Plan will be consistent with these guidelines in order to ensure that the asset value of the forest is maintained or enhanced. These guidelines are influenced by the Implementation Priorities under which the Division is operating. Guidelines include:

- Conserve forest lands by maintaining the state forest land base.
- Maintain a land exchange and acquisition program that pursues acquisitions and exchanges as a means to consolidate state forest lands for management efficiencies, economic values, or enhanced stewardship practices.
- Grow and harvest trees in a sound environmental manner that provides sustainable timber harvest and revenues to the state, counties, and local taxing districts, jobs, as well as habitat for native fish and wildlife.
- Implement marketing strategies that increase the forest product value.
- Prioritize and undertake investments in stand management activities that increase timber quality/quantity and/or enhance ecosystem services.
- Maintain and enhance forest health with timely reforestation and young stand management practices that promote timber volume and value.
- Maintain strategies that address critical forest health issues (e.g. insects, diseases, fires).
- Utilize forest management strategies that mitigate climate change risks.
- Maintain, develop and protect investments in forest infrastructure (e.g. roads, bridges, recreational trails and facilities).
- Maintain investments in information systems (e.g. forest inventory, GIS systems, timber harvest tracking) that support planning and implementation processes and contribute to adaptive management processes.
- Prioritize and undertake investments in research and monitoring projects consistent with the Adaptive Management Plan.
- Maintain integration of monitoring, planning, and implementation processes.
- Maintain a budgeting and financial management system that assures revenues derived from state forests are sufficient to cover implementation costs.
- Implement and maintain timber accountability strategies and systems that ensure the state and other beneficiaries receive anticipated revenue from forest products.
- Maintain existing assets that support recreation, education, and interpretation activities. Prioritize additional investments based on whether resources can support additional assets over the long term.

Implementation Guidelines

The Western Oregon State Forest Management Plan, approved by the BOF, establishes policies and strategies for achieving greatest permanent value across western Oregon (Figure 27). The FMP contains resource assessments, management goals, strategies, and measurable outcomes. Measures are established for periodic reporting to the BOF on plan performance (performance measures) and to evaluate the effectiveness of policy standards. Operational policies describe specific management standards that are designed to guide the implementation of the plan strategies and meet the goals of the FMP. Implementation Plans, approved by the State Forester, provide linkages between the FMP, operational policies, and on-the-ground activities that are described in operation plans approved by District Foresters.

Implementation Plans cover a longer timeframe and larger spatial scale (district or multiple district) than operations plans. Implementation Plans characterize physical and biological landscape conditions, annual harvest objectives, reforestation targets, human uses, and considerations for threatened and endangered species. Implementation plans describe expectations for forest conditions over the long term, associated management activities, and expected outcomes. Implementation and operation plans characterize protection and management for all forest resources, identify district monitoring projects, and describe public engagement. Operation plans describe specific activities that will be carried out at smaller spatial (e.g. stand or watershed) and temporal scales to achieve expected outcomes.

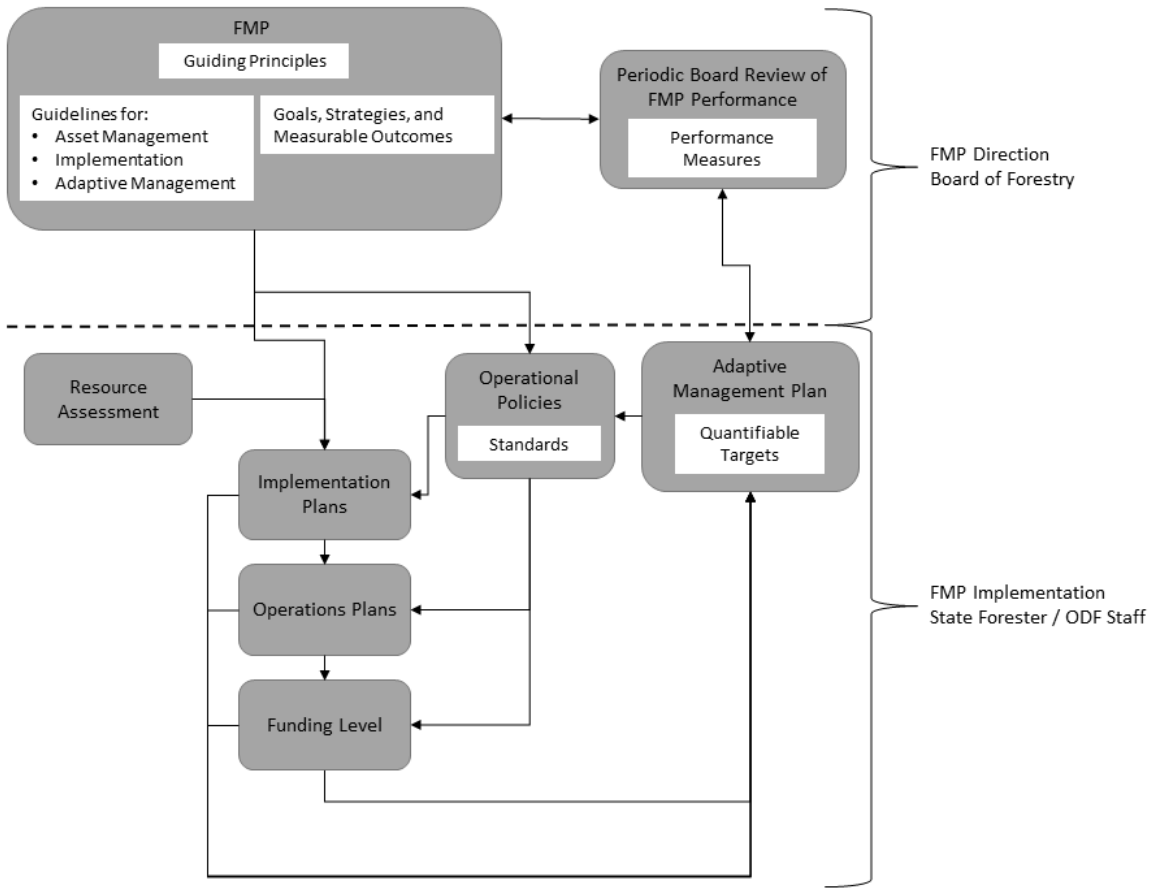

Figure 27. Plan components and the adaptive management process.

Implementation Responsibilities

The State Forests Division Chief and Area Directors provide guidance for implementing the FMP through operational policy and implementation plans. They review implementation plans, which are approved and signed by the State Forester. District foresters implement the Western Oregon State Forests Management Plan on their districts through the oversight and approval of operations plans.

Implementation Priorities

Funding levels for plan implementation vary with cyclical economic trends. FMP implementation is primarily funded through timber harvest revenues. Over the long term, it is likely that revenues will support the management activities necessary to meet the Greatest Permanent Value mandate and FMP goals. However, there may be periods where revenues limit funding. Annual budget instructions for developing fiscal budgets reflect the Forest Development Fund (FDF) balance and the projected FDF balance. The highest level of implementation and investment occurs when the FDF balance exceeds the prudent balance established in Division policy (see *Fund Balance Policy*) and the balance is forecasted to be relatively steady or increasing. While the lowest level occurs when the FDF balance is less than the prudent balance established by the Division and the balance is forecasted to decrease (Table 12). For this reason, the following priorities are established for conducting activities:

Table 12. Forest management investment levels based on the revenue forecast and Forest Development Fund balance. Level 1 is the lowest level of investment, while level 4 is the highest.

Forest Development Fund	Decreasing 3-year Revenue Forecast	Increasing 3-year Revenue Forecast
Less than prudent balance	Level 1: Maintenance to achieve core business and meet legal obligations, no new investments and scale back existing services	Level 2: Begin reinvesting in deferred maintenance, young stand management, highest priority research and monitoring
Prudent balance	Level 2: Continue reinvesting in deferred maintenance and consider small set of new strategic investments	Level 3: Modest funding for new strategic investments
Greater than prudent balance	Level 3: Maintain or expand existing investments and explore additional strategic investments	Level 4: Expand existing investments and fund new strategic investments

Descriptions are provided for management activities and the amount of investment for each level in the following list. The intent of the descriptions is to provide examples and a general sense for the priorities for the activities of the Division given the state of the Forest Development Fund. However, not every activity listed below will be undertaken in every case. For example, while land purchases and exchanges are listed under Level 4, these activities won't be undertaken if there are not parcels the Division is seeking to dispose or acquire.

- Level 1: Core business
  - *Management Focus*: Meet contractual and legal obligations. Examples may include: focus on high-revenue low-cost sales, reduce investments in policy initiatives, maintain REI services and infrastructure at existing level or scale back, ensure funding and resources needed for litigation, and highest priority young stand management activities.
  - *Investments*: Examples may include: maintain forest inventory program, minimum performance measure monitoring and reporting, T&E surveys, and road infrastructure.
- Level 2: Maintenance and Deferred Maintenance
  - *Management Focus*: Same as Level 1
  - *Investments*: Begin cautious reinvestment in deferred maintenance. Examples may include: young-stand management, forest inventory, research and monitoring, REI, and policy revisions and development.
- Level 3: Reinvestment
  - *Management Focus*: Manage to create a range of stand ages, increase pre-commercial and commercial thinning, with a modest amount of forest restoration activities.
  - *Investments*: Examples may include: complete deferred maintenance, begin funding strategic investments, and pursuing high priority land exchanges or acquisitions.
- Level 4: Full Implementation:
  - *Management Focus*: Full implementation. Examples may include: maintain or create a range of stand ages and complex habitat, conduct forest restoration.

- *Investments*: New strategic Investments. Examples may include: forest, habitat, and stream restoration; robust research and monitoring; expand REI; and land purchases and exchanges.

Operational Policy Standards

Operational policy standards are developed within Division operational policies at the direction of the State Forests Division Chief. These standards are tied to the FMP goals, strategies and measurable outcomes, and to the quantifiable targets outlined in the Adaptive Management Plan. These standards provide the framework for forest managers to develop implementation and operations plans. These standards will be evaluated and updated through the process outlined in the Adaptive Management Plan.

Operational policies that contain standards related to the implementation of the FMP include, but are not limited to:

- Marbled Murrelet
- Northern Spotted Owl
- Species of Concern
- Riparian and Aquatic
- Cultural Resources
- Visual
- Green Tree, Snag, Down Wood
- Old Growth
- Restoration
- Engineering
- State Forests Financial Policy
- Unstable Slopes and Harvest

Implementation Plans

Implementation plans are developed consistent with the direction of the Area Directors and State Forests Division Chief and describe the management approaches and activities designed to achieve the goals and carry out management strategies described in Chapter 3 of the Western Oregon State Forests Management Plan (FMP) and associated policy standards. The IPs will be detailed enough to guide all district activities for a period of at least ten years, although changing conditions may require more frequent revisions.

An IP will include the following:

1. A description of the current conditions of forest resources, including:
   a. forest inventory and stand growth
   b. wildlife present on the forest (e.g. big game, species of concern)
   c. aquatic resources
   d. extent and condition of forest roads
   e. current public use of forest and trends
   f. extent and condition of recreation, education and interpretation facilities
   g. other significant forest resource (e.g. cultural, energy, scenic) present

2. A description of how FMP goals and strategies will be applied
3. Maps designating the landscape design consistent with strategies described in Chapter 3 of the FMP and the process used to select them
4. Proposed management activities necessary to achieve FMP goals, including a description and analysis of silvicultural practices employed (e.g. growth and yield analysis combined with an economic analysis for precommercial thinning (PCT) to increase volume and revenue for the target stands over no PCT)
5. Estimates of management activity levels, outputs, and achievements
    a. Timber harvest (estimated volume and acres by harvest type [regeneration, thinning])
    b. Reforestation and young stand management activities (estimated site preparation, planting, vegetation and animal damage management, PCT [estimated acres)
    c. Road maintenance and long term development plans (estimated miles)
    d. Recreation maintenance and long term development plans
    e. Forest restoration activities (estimated acres)
6. Summary of the Forest Land Management Classification System (FLMCS) applied at the time the IP is approved in accordance with OAR 629-035-0050 to 629-035-0060 to reflect management strategies of the FMP

Initial IPs and the associated FLMCS will be available for public review and comment for a 60-day period prior to consideration for approval by the State Forester.

As new information becomes available, in response to changing conditions or development of new or better implementation strategies, districts may incorporate it into their implementation planning framework and develop a revised set of IPs. The State Forester determines when a major revision is necessary, while the Area Director determines when a minor revision is necessary.

The following circumstances are considered major revisions:

- Revisions that propose changes to the annual harvest level ranges of more than 25%.
- Any changes to the landscape design

The State Forester weighs scientific, operational, and public information to determine when a major revision is necessary.

Major IP revisions are available for a 45-day public review and comment prior to consideration for approval by the State Forester.

Minor IP revisions (i.e. all changes not defined as major revisions above) may occur more frequently in order to keep the IP up to date with current information and practices. The Area Director approves minor IP revisions.

Concurrent with IP development, districts will update the FLMCS consistent with FMP goals. Additional FLMCS updates may occur through the subsequent OPs.

Operations Plans

Operations plans (OPs) describe the projects one or more districts will pursue to implement the FMP for one or more fiscal years and must align with the IP. Management activities include, but are not limited to:

- Harvest operations
- Road construction, improvement, vacating, or obliteration
- Reforestation and young stand management
- Aquatic habitat restoration
- Development or maintenance of recreational trails or facilities

OPs will align with fiscal budgets and available funds. The OP should prioritize activities and investments in the forests (e.g. inventory, young stand management, recreation development) based on available funds. OPs are developed for one or more districts with the close participation of resource specialists from both the ODF and ODFW.

OPs will be available for a 45-day public review and comment prior to consideration for approval by the District Forester. The District Forester considers written comments from resource specialists and the public before approving an AOP.

Adaptive Management, Research, Monitoring, and Structured Decision Making Guidelines

The FMP for Western Oregon State Forests emphasizes the need for adaptive approaches to management in which changes are made in response to measurable outcomes resulting from management actions. This approach requires a commitment to integrating monitoring activities into IPs and incorporating the findings into decision-making processes. The state forests research and monitoring program will be funded to ensure that the levels of research, monitoring, and technology transfer are adequate to meet the information needs to support the FMP at a variety of funding and implementation levels.

Adaptive management is the process through which management practices incrementally improve by implementing plans in ways that provide opportunities to learn from experience. Through a program of targeted monitoring, surveys, reporting, and cooperative research, ODF will evaluate the implementation of FMP strategies in light of measurable outcomes. This process will provide a credible method to assess whether management strategies and associated standards meet FMP goals.

Two important objectives of the monitoring program are 1) to determine whether FMP strategies are implemented as stated and 2) to determine whether FMP programs and strategies are effective at achieving stated measurable outcomes. FMP goals and associated measurable outcomes serve as the basis for identification of specific information needs that should be addressed through new projects.

The primary purpose of adaptive management is to track outcomes and adjust management strategies using systematic and rigorous methods to better achieve FMP goals. Management practices are treated as working hypotheses to be tested against measurable outcomes so that their efficacy and efficiency can be improved over time.

Successful implementation of adaptive management requires a rigorous and structured process for decision-making. While monitoring and research will provide a better understanding of tradeoffs among competing goals, the decision to change management standards, or the implementation of those standards are value-laden and require input from many sources, including stakeholders.

Structured Decision Making (SDM)

This approach is designed to use a collaborative and facilitated application of multiple objective decision making and group deliberation methods to help guide the Division on environmental management and public policy problems (Gregory et al 2012). This is an organized, inclusive, and transparent approach to understanding complex problems and management alternatives. SDM begins with engaging stakeholders to clarify the decision context and define objectives and measures for specific resource goals (Figure 23). Alternatives are then developed that are intended to balance objectives. The Division then estimates the consequences of those alternatives and provides feedback to stakeholders, who, in conjunction with Division staff, evaluate trade-offs and help select the desired alternative. ODF implements, monitors and reviews the alternative. ODF then engages stakeholders again to adjust management strategies if needed, based off new information from monitoring.

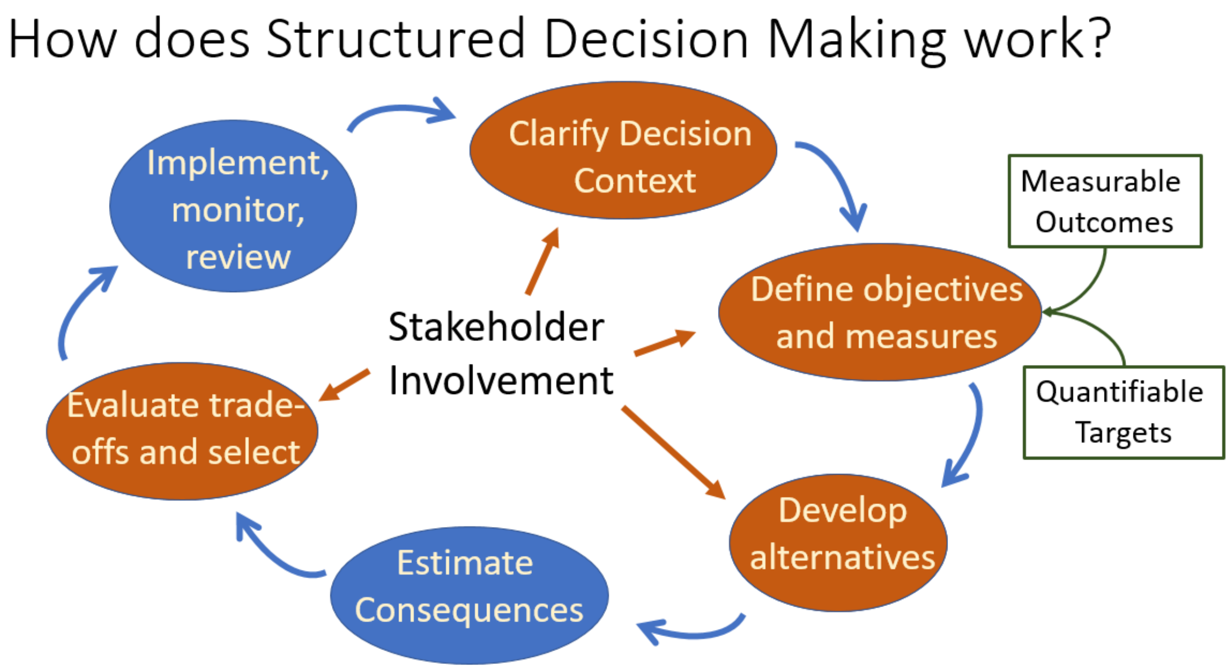

Figure 23. Structured decision-making process.

Description and Assessment

Forest management issues are ecologically, socially, and economically complex. This complexity, along with limited scientific understanding of dynamic forest ecosystems and natural disturbance events, contributes to uncertainty about the outcomes of forest resource management decisions. Changing social values and goals further increase uncertainty and contribute to controversy. Adaptive resource management is a rigorous and objective framework that addresses these issues. While SDM works to clarify and create understanding around values and decision context, adaptive management works to address uncertainty stemming from a lack of specific knowledge about natural processes and the effects of management actions.

This section describes the goals and strategies of adaptive management. It also describes the importance of research and monitoring for obtaining information necessary for decision-making and the process for dealing with changes in policies and practices when needed.

The following key concepts provide the foundation for adaptive forest resource management:

- Adaptive management is part of a deliberate decision-making process a system of making decisions that recognizes the dynamic nature of ecosystems, scientific understanding and societal demands.
- Adaptive management does not replace decision-making, but is a system that supports informed and objective decisions.

- Adaptive management requires a well-designed process including a strong monitoring program.
- Adaptive management requires a well-defined framework for dealing with change, such as SDM.
- Adaptive management requires adherence to the process and framework in order to adequately test and assess management practices.
- Adaptive management will support timely adjustments to management practices, relative to the outcomes being considered.

Goals

- Evaluate the extent that state forests are managed to achieve GPV by providing a full range of social, economic, and environmental benefits to the people of Oregon.
- Determine whether FMP strategies and operational policies are implemented as stated.
- Determine whether FMP strategies and underlying business plans establish and maintain financial viability to support ODF's continued delivery of GPV and distribute revenue to counties, schools and local taxing districts.
- Determine whether FMP and SOC strategies result in anticipated habitat or other conditions for SOC.
- Provide a learning opportunity to refine management practices and standards to better meet FMP goals.
- Increase understanding with stakeholders and public around management options and their associated trade-offs.
- Gather and address or incorporate meaningful input from stakeholders and public to foster decisions that address a broad variety of values and perspectives.

Adaptive Management Strategies

The following actions will be taken to ensure a strong adaptive approach for forest management in the context of the Western Oregon State Forests Management Plan.

Strategy 1

Implement an adaptive management process and framework that provides for change at the appropriate planning level and in a timely manner.

The range of decisions that will be made, how they will be made, and who will make them are described in the following matrix and discussed in more detail in the text that follows.

FMP success will depend on timely changes in strategies, approaches, REI programs and silvicultural prescriptions in accordance with new knowledge. As new information is available, it will be evaluated in the context of the guiding principles, goals, and strategies of the FMP. Implementation of changes will be spatially and temporally appropriate to the specific goals and measurable outcomes under consideration to ensure a thorough understanding of the effects of current management practices before instituting changes.

Decisions on change will be made by individuals or groups at the relevant planning level. For example, if research or monitoring information shows the need for a fundamental change in FMP strategies, the decision would be made by the BOF after a formal public involvement process. Whereas, and codified through Oregon Administrative Rule. Operational policy (i.e. management standards) changes would be made by the State Forests Division Chief, after engaging stakeholders gather input on the current policy, monitoring information and proposed changes to policy.

Where the proposed change does not significantly alter the fundamental strategies or operational policies, changes may be instituted by the Planning and Coordination Deputy Chief through the IP process, with stakeholder input. In these cases, changes will be documented and coordinated with relevant monitoring projects.

This emphasis on stakeholder engagement in IP and operational policy issues is intended to create a more transparent and robust process, increase mutual understanding of trade-offs, and foster agreement around implementation objectives and operational policies.

Forest Management Plan

At this level, planning is typically at broad spatial and long temporal scales and identifies general goals and strategies. Changes made will apply to all the districts, albeit to varying degrees, depending on the specific strategy.

Information, decisions, and management in the FMP encompass landscape scales, policy concepts, and social, cultural, and environmental influences that may extend beyond state forests. FMPs make forecasts for at least ten years and generally for 30-100 years or more. FMPs are reviewed periodically (at least every ten years). It may require ten years or more to develop relevant monitoring information for long-term forecasts.

If implementation of the FMP is not achieving desired results, as indicated by measurable outcomes and performance measures, the department will make revisions to operational policies. If the lack of performance can't be corrected through revised operational policies- the BOF will consider changes to the FMP. The BOF and State Forester will weigh the scientific, operational, and public information in a transparent and formal public process to determine changes to the FMP.

Operational Policies

Changes to operational policy will occur as needed, in response to monitoring data that indicate one or more measurable outcomes are not being met. Monitoring data, along with other best available science, will be used to provide an understanding of the root causes of the deficiency. A rigorous decision making process that includes stakeholder input will be used determine what aspects of operational policies need to change to achieve a better outcome in the context of other goals.

Implementation Plans

Changes at this level may occur over different spatial scales (e.g. a single or multi-district area) and over timeframes of one to ten years. IPs determine how FMP strategies will be implemented in each district.

IPs include management activities for the next ten years and estimate the expected progress toward FMP goals.

A subset of management activities identified in IPs will be selected for monitoring projects in a manner that addresses both the range of activities and measurable outcomes associated with FMP goals. The focus of monitoring efforts identified at this planning level will be on the effectiveness of FMP strategies and will form the primary basis for adaptive management of the FMP operational policies. These plans are reassessed periodically (at least every ten years) or if some significant event occurs or information is received that would significantly change the planned activities or approaches.

ODF will engage stakeholders in the IP process, using a structured decision making process. The State Forester will weigh the monitoring and scientific information, implementation objectives, stakeholder input, and public comment when considering the approval and subsequent changes to IPs.

Operations Plans

Operations plans (OPs) identify all major forest management activities that are proposed for (time period TBD). This includes silvicultural prescriptions, recreation projects, road construction and maintenance, stream restoration projects, and any other major projects. Monitoring information at this level will focus on compliance with operational policies and short-term effects of these activities toward FMP goals. This information will be used to effect change from year to year, at varying scales.

The (approver TBD) will weigh the scientific, operational, and public information through the operations planning process, then make changes and approve the operations plans. The operations planning process includes review by Department of Forestry staff and a variety of technical specialists.

Management Activities

Agency personnel learn and make changes on a daily basis in the forest. In order to achieve the best possible results, it is critical to adapt practices to new information and changing conditions. Frequently, professionals on the ground can identify improved techniques that can be used immediately to achieve better results. In addition to their immediate local application, these opportunistic adaptations will be formalized and incorporated into ongoing projects in order to maximize their potential benefits to OP, IP and FMP processes.

Field supervisors will be responsible for weighing the scientific and operational advantages and disadvantages of changes and determining whether change is appropriate.

Strategy 2

Develop and implement a monitoring program designed to evaluate the FMP management strategies over time. Review and update a monitoring plan at least every ten years.

Monitoring is an important step in the adaptive management process and is therefore a key element in the Western Oregon State Forests Management Plan. Oregon administrative rules for state forest management (OAR 629-035-0000 to 0110) require FMPs to include general guidelines for “implementation, monitoring, research, and adaptive management” that describe “the approach for determining whether the strategies are meeting the goals of the FMP; and, the process for determining the validity of the assumptions used in developing the strategies."

ODF will develop an adaptive management plan (AMP) that describes the approaches and activities that ODF will undertake over the course of the initial FMP implementation period to assess compliance with and effectiveness of the resource management strategies described in the Western Oregon State Forests Management Plan. The AMP guides the research and monitoring program during the initial FMP implementation period.

Strategy 3

Conduct a comprehensive review of the goals and strategies of this FMP every ten years following adoption.

At the completion of the initial FMP implementation period and every ten years thereafter, ODF will compile a ten-year implementation and monitoring report that summarizes the management activities that have occurred over the period, the results of monitoring and research efforts during that time, and any proposed changes to the FMP strategies made to better meet FMP goals. In preparing this report, ODF will use SDM to collaborate with other agencies as necessary to obtain the best available information and will support any major modifications proposed with information from independent scientific review.

Glossary

Active channel width	The average width of the stream channel at the normal high water level. The normal high water level is the stage reached during average annual high flow. This high water level mark often corresponds with the edge of streamside terraces; a change in vegetation, soil or litter characteristics; or the uppermost scour limit (bankfull stage) of a channel.
Activity center	A nest site or primary roost area for NSO.
Adaptive management	An approach to resource assessment and management that explicitly acknowledges uncertainty about the outcomes of management policies, and deals with this uncertainty by treating management activities as opportunities for learning how to manage better. Adaptive management is a system of making, implementing, and evaluating decisions, which recognizes that ecosystems and society are always changing. It is a systematic, rigorous approach for learning from our actions, improving management, and accommodating change.
Aggregate	Sand and pebbles added to cement to make concrete, or used in road construction.
Alluvial	Describes soil, debris, and other materials that have been deposited by currents of water.
Ambient	Surrounding.
Anadromous fish	Those species of fish that mature in the ocean and migrate into freshwater rivers and streams to spawn; an example is salmon.
Anchor habitat	An existing key habitat area for a specific species; these blocks of habitat are left in place on the landscape as anchors.
Andesites	A type of volcanic rock; its composition is intermediate between basalt and rhyolite. The most common rock in the Cascades.
Annosum	A root disease in trees, caused by *Heterobasidion annosum*.
Aquatic	In or on the water; aquatic habitats are in streams or other bodies of water, as contrasted to riparian habitats, which are near water.
Aquifer	A sand, gravel, or rock formation that is capable of storing or transporting water below the surface of the ground.
Aquatic Adjacent Unstable Slope	These slopes are, or have recently been, in a state of active shallow failure. They often have a dish or scalloped-shaped curvilinear expression outlining the upper extent of the failure surface. These are slopes where the toe of the unstable portion interacts directly with erosive forces of a stream.

Archaeological and historical resources	Those districts, sites, buildings, structures, and artifacts which possess material evidence of human life and culture of the prehistoric and historic past.
Archaeological object	An object that is at least 75 years old; is part of the physical record of an indigenous or other culture found in the state or waters of the state; and is material remains of past human life or activity that are of archaeological significance, including, but not limited to, monuments, symbols, tools, facilities, technological by-products and dietary by-products. (ORS 358.905)
Armillaria ostoyae	A fungus that infects many tree species, causing armillaria root disease.
Average high water level	The stage reached during the average annual high flow period. This level often corresponds with the edge of streamside terraces, marked changes in vegetation, or changes in soil or litter characteristics.
Basal area	The area of the cross-section of a tree stem near the base, generally at breast height (4.5 feet above the ground) and including the bark. The basal area per acre is the total basal area of all trees on that acre.
Best Management Practices	Oregon FPA rules adopted by the Board of Forestry to minimize the impact of forest operations on water quality. These rules ensure that, to the maximum extent practicable, forest operations meet the water quality standards established by the Environmental Quality Commission. The rules focus on reducing nonpoint source discharges of pollutants resulting from forest operations.
Biodiversity	Society of American Foresters defines biodiversity as “the variety and abundance of species, their genetic composition, and the communities, ecosystems, and landscapes in which they occur.” Gast et al. 1991 characterizes biodiversity operationally as: “... the variety, function, distribution, and structure of ecosystems and their components, including all successional stages, arranged in space over time that support self-sustaining populations of all natural and desirable naturalized flora and fauna.”
BMPs	See Best Management Practices.
Board foot	The amount of wood equivalent to a piece of wood one foot wide by one foot high, by one inch thick.
BOFL	Board of Forestry Lands.
Bog	A wetland that is characterized by the formation of peat soils and that supports specialized plant communities. A bog is a hydrologically closed system without flowing water. It is usually saturated, relatively acidic, and is dominated by ground

	mosses, especially sphagnum. Bogs are distinguished from other wetlands by the dominance of mosses and the presence of extensive peat deposits.
Breccias	Aggregates composed of angular fragments of the same rock, or of different rocks united by a matrix.
Burial	Any natural or prepared physical location whether originally below, on or above the surface of the earth, into which, as a part of a death rite or death ceremony of a culture, human remains were deposited. (ORS 358.905)
Certification	Approval by LCDC of a state agency program found to be consistent with the Statewide Planning Goals.
Channel migration zone (CMZ)	An area adjacent to an unconfined stream channel where channel migration is likely to occur during high flow events. The presence of side channels or oxbows, stream-associated wetlands, and low terraces are indicators of these zones. The extent of these areas will be determined through site inspections using professional judgment.
Class I areas	National park lands and some wilderness areas are designated as federal mandatory Class I areas under the Clean Air Act.
Class I-III	The Clean Air Act divides clean air into three classes; Class I allows for minimal degradation of air quality, while Class III allows a relatively greater degree of degradation.
Clean Air Act	Federal law passed in 1970, and amended several times since. The authority to implement the act is delegated to the states. The act is implemented, in part, through a permit system.
CMZ	See Channel Migration Zone.
Colluvial	Describes soil, debris, and other materials that have been moved downslope by gravity and biological activity.
Common School Forest Lands	Common School trust lands that have been listed by the State Land Board for the primary use of timber production. See Common School Trust Lands.
Common School trust lands	State lands owned by the State Land Board; the primary goal in managing these lands is the generation of the greatest amount of income for the CSF over the long-term, consistent with sound techniques of land management. Common School trust lands that have been listed by the State Land Board for the primary use of timber production are called Common School Forest Lands. Other Common School trust lands are designated as rangelands or for other uses.
Composition	The different species of plants and animals that live in an ecosystem.

Corridor Areas of habitat that connect separate but similar habitat patches, within the landscape mosaic. For example, an area of mature timber may connect larger patches of mature timber.

CSFL See Common School Forest Lands.

Debris slide Rapid landslide occurring on a slope. The material moved may include soil, wood, and vegetation. The slide may or may not reach a stream channel. See also Landslide.

Department of Land Conservation and Development (DLCD) State agency that administers Oregon's statewide planning program and provides professional support to the LCDC.

DEQ Oregon Department of Environmental Quality.

Dispersion The spreading or scattering of smoke.

Disturbance A force that causes significant change in an ecosystem's structure and/or composition; can be caused by natural events or human activities.

Drainage basin The large watersheds of major rivers. The Oregon Water Resources Department and the Oregon Department of Environmental Quality have delineated 18 major drainage basins in Oregon.

Earthflow Movement of material, both sediment and vegetation, down a slope. Earthflows are typically large, but move only a few centimeters each year. See also "landslide."

EPA Environmental Protection Agency. This federal agency administers the Clean Air Act, among other responsibilities.

ESU See Evolutionarily Significant Unit.

Evolutionarily Significant Unit (ESU) A group of stocks or populations that: 1) are substantially reproductively isolated from other population units of the same species, and 2) represent an important component in the evolutionary legacy of the species. (NMFS 1991). This term is used by the National Marine Fisheries Service as guidance for determining what constitutes a "distinct population segment" for the purposes of listing Pacific salmon species under the ESA. For example, the "Oregon Coast Chinook ESU" is a delineation that encompasses all populations of Chinook salmon from the Necanicum River on the northern Oregon coast, to Cape Blanco on the south coast.

Fragmentation The relationship of the landscape matrix to other types of patches; as fragmentation increases, the matrix becomes smaller and geometrically more complex. Maximum landscape fragmentation occurs when no dominant patch exists. Also defined as the spatial arrangement of successional stages across the landscape as the result of

	disturbance; often used to refer specifically to the process of reducing the size and connectivity of late successional or old growth forests.
Function	Activity or process that goes on in an ecosystem; some typical functions are plant growth, animal reproduction, decay of dead plants.
Geographic information system (GIS)	A computer system that stores and manipulates spatial data, and can produce a variety of maps and analyses.
Geotechnical	The study of soil stability in relation to engineering.
Geothermal	Of or relating to the internal heat of the earth.
GIS	See "geographic information system."
Goals	In ODF FMP, goals are general, non-quantifiable statements of direction.
Grave	See "Burial."
Groundwater	The subsurface water supply in the saturated zone below the water table.
Guiding principles	The rules, goals, and responsibilities that guide planning processes for state forests.
Habitat conservation plan (HCP)	A comprehensive planning document that is a mandatory component of an incidental take permit application pursuant to section 10(a)(2)(A) of the ESA.
HCP	See "habitat conservation plan."
Headwall	The steep slope or rocky cliffs at the head of a valley.
Heterobasidion annosum	The fungus that causes annosum root disease.
Historic artifacts	Objects (e.g., furnishings, art objects, personal property) which have historic significance. "Historic artifacts" does not include paper, electronic media or other media that are classified as public records. (ORS 358.635)
Historic property	Real property that is listed in the National Register of Historic Places, established and maintained under the National Historic Preservation Act of 1966, or approved for listing on an Oregon register of historic places.
Human remains	The physical remains of a human body, including, but not limited to, bones, teeth, hair, ashes or mummified or otherwise preserved soft tissues of an individual. (ORS 358.905)
Hydrocarbon	Any compound containing only hydrogen and carbon (e.g., natural gas).
Hydrological maturity	The degree to which hydrologic processes (e.g., interception, evapotranspiration, snow accumulation, snowmelt, infiltration, runoff) and outputs (e.g., water yield and

	peak discharge) in a particular forest stand approach those expected in an older forest stand under the same climatic and site conditions. In this document, for rain-on-snow runoff, a well-stocked conifer stand is defined as hydrologically mature when it is at least 25 years old.
Hydrology	Study of the properties, distribution, and effects of water on the landscape, under the surface, in the rocks, and in the atmosphere.
IHA	See “interior habitat area.”
Indian tribe	Any tribe of American Indians recognized by the Secretary of the Interior or listed in the Klamath Termination Act, 25 U.S.C. 3564 et seq., or listed in the Western Oregon Indian Termination Act, 25 U.S.C. 3691 et seq., if the traditional cultural area of the tribe includes Oregon lands (ORS 97.740).
Induced landscape diversity	Aspects of the landscape that change as a result of disturbances such as fire, windstorms, human activities, and animals; for example, the successional stages of vegetation that occur after a wildfire.
Inherent landscape diversity	Aspects of the landscape that are relatively permanent (changing only slowly over long periods of time) in any particular landscape, but that vary among landscapes. Examples are climate, soils, topography, and aspect (e.g., south-facing aspect).
Inner gorge	An area next to a stream where the adjacent slope is significantly steeper than the gradient of the surrounding hillsides. It is the result of downcutting of the stream into the surrounding landscape and the resulting slope is reacting to the erosive work of streamflow at its base.
Interior habitat area	That portion of the older forest patch that remains effective when the negative effects of high contrast edge are removed.
Land Conservation and Development Commission (LCDC)	A seven-person commission that sets the standards for Oregon’s statewide planning program. Members are volunteers appointed by the Governor and confirmed by the State Senate.
Land Use Board of Appeals (LUBA)	Established in 1979 essentially as a state court that rules on matters involving land use. Appeals from LUBA go to the State Court of Appeals, then the Supreme Court.
Landscape	An area of land containing a mosaic of habitat patches, often within which a particular “target” habitat patch is embedded. Also defined as a unit of land with separate plant communities or ecosystems forming ecological units with distinguishable structure, function, geomorphology, and disturbance regimes.

Landslide	The dislodging and fall of a mass of earth and rock. There are many types of landslides (e.g., debris slides, earthflows, rock block slides, slumps, slump blocks, slump earthflows). The different types of landslides vary tremendously in how they occur, how far they move, what type of materials move, etc.
Late successional habitat	A forest stand whose typical characteristics are a multi-layered, multi-species canopy dominated by large overstory trees; numerous large snags; and abundant large woody debris (e.g., fallen trees) on the ground. Other characteristics such as canopy closure may vary by the forest zone (lodgepole, ponderosa, mixed conifer, etc.).
Legacy Road	A general term referring to a road built prior to modern road-building standards. The grade may or may not be presently in use. Portions of these roads often have a higher risk of sediment delivery to streams.
Lithic scatter	A location where prehistoric stone tools were made, usually from obsidian. The tools and weapons were used locally or traded.
Loading	The quantity of a substance entering a body of water.
Management basin	An area used for forest planning. Management basins range from 5,000 to 8,000 acres. Their boundaries are based primarily on drainage and topographic patterns within the major drainage basins and watersheds, with some adjustments to follow roads or obvious topographic features.
Matrix	The dominant landscape element in which patches are embedded.
MBF	Thousand board feet.
MMBF	Million board feet.
Monitoring	The measurement of environmental characteristics and conditions over an extended period of time, in order to determine status or trends in some aspect of environmental quality. **Implementation monitoring —** Asks the question, "Did we do what we said we would do?" **Effectiveness monitoring —** Asks the question, "Are the management practices producing the desired results?" **Validation monitoring —** Asks the question, "Are the planning assumptions valid, or are there better ways to meet planning goals and objectives?"
NAAQS (National Ambient Air Quality Standards)	Under the federal Clean Air Act, the EPA was responsible for setting air quality standards. They developed NAAQS, which establish the maximum concentration for various pollutants that may be present in the ambient (surrounding) air. Standards are measured on short-term (3, 8, or 24 hours) or annual basis.

National Environmental Policy Act	Also known as NEPA; became law in 1969. NEPA is the national charter for the protection of the environment. NEPA requires all federal agencies to consider and analyze all significant environmental impacts of any action proposed by those agencies; to inform and involve the public in the agency's decision-making process; and to consider the environmental impacts in the agency's decision-making process.
Neotropical migrant birds	Birds that migrate annually to the biogeographic realm that includes South America, the Indies, Central America, and tropical Mexico.
NEPA	See "National Environmental Policy Act."
Nonpoint source	Entry of a pollutant into a body of water from widespread or diffuse sources, with no identifiable point of entry. The source is not a distinct, identifiable source such as a discharge pipe. Erosion is one example of a nonpoint source.
Non-salmonid fish	Any fish species outside the family *Salmonidae*; may be resident or anadromous; examples are Pacific lamprey and sculpins.
Northwest Oregon state forests	Includes all state forests in the planning area.
OHV	Off-highway vehicle.
Old growth	A forest stand whose typical characteristics are a patchy, multi-layered, multi-species canopy dominated by large overstory trees, some with broken tops and decaying wood; numerous large snags; and abundant large woody debris (e.g., fallen trees) on the ground. In western Oregon, old-growth characteristics begin to appear in unmanaged forests at 175-250 years. (See **Late successional habitat**.)
Owl circle	Area defined for the purpose of identifying the home range of an NSO pair or resident single; circle size varies by physiographic province. In the Oregon Coast Range, the radius of an NSO circle is 1.5 miles, encompassing the area of 4,766 acres. Guidelines established by the USFWS (later rescinded) required protecting 70 acres of NSO habitat immediately around an NSO activity center, 500 acres within 0.7 miles, and 1,906 acres within 1.5 miles.
Particulate	Small particles that are in smoke produced by burning wood and other forest debris. Two kinds of particulate are controlled under federal and/or state requirements: TSP and PM-10.
Patch	The landscape patch is an environmental unit between which quality differs, such as a habitat patch.
Phellinus weirii	A fungus that infects some species of trees, causing laminated root rot.
PM-10	Particles smaller than 10 microns in diameter, present in wood smoke.

Point source The release of a pollutant from a pipe or other distinct, identifiable point, directly into a body of water or into a water course leading to a body of water.

Pollutant Any substance of such character and in such quantities that when it reaches a body of water (or the air or the soil), it degrades the resource by impairing its usefulness (including its ability to support living organisms).

Population The organisms that make up a particular group of a species, or that live in a particular habitat or area.

For fish: "A group of fish spawning in a particular area at a particular time which do not interbreed to any substantial degree with any other group spawning in a different area, or in the same area at a different time." [OAR, Division 7, 635-07-501(38)]. For example, "Nehalem River fall Chinook salmon" are a population.

Prescribed burning Controlled fire burning under specified conditions in order to accomplish planned objectives; also called slash burning, as a frequent objective is to reduce the amount of slash left after logging.

Recognized Indian tribe A tribe of Indians with federally acknowledged treaty or statutory rights.

Recreation Opportunity Spectrum (ROS) A framework for understanding and defining various settings of recreation environments, activities, and experiences. The settings are defined in terms of the opportunities to have different sorts of experiences, and range from primitive to urban. They are defined by setting indicators (e.g., access, naturalness, facilities, social encounters).

Resident fish Fish species that complete their entire life cycle in freshwater; non-anadromous fish; an example is a resident population of cutthroat trout.

Riparian area Three-dimensional zone of direct influence and/or interaction between terrestrial and aquatic ecosystems. The boundaries of the riparian area extend outward from the stream bed or lakeshore.

Riparian management area (RMA) A protected area with site-specific boundaries established by ODF; the width varies according to the stream classification or special protection needs. The purpose of the RMA is to protect the stream, aquatic resources, and the riparian area. Aquatic resources include water quality, water temperature, fish, stream structure, and other resources.

RMA See "riparian management area."

Rock block slide Type of landslide in which the weakness and initial breaking is in the underlying rock, not the soil. See also "landslide."

ROS See "Recreation Opportunity Spectrum."

Sacred object An archaeological object that is demonstrably revered by any ethnic group, religious group or Indian tribe as holy; is used in connection with the religious or spiritual service or worship of a deity or spirit power; or was or is needed by traditional native Indian religious leaders for the practice of traditional native Indian religion. (ORS 358.905)

Salmonid Fish species belonging to the family *Salmonidae*; includes trout, salmon, and whitefish species.

Seral stages Developmental stages that succeed each other as an ecosystem changes over time; specifically, the stages of ecological succession as a forest develops.

SHPO See "State Historic Preservation Office."

SIP State Implementation Plan. This plan implements the Clean Air Act and contains general provisions for protecting air quality in all areas of the state.

Site A geographic locality in Oregon, including but not limited to submerged and submersible lands and the bed of the sea within the state's jurisdiction, that contains archaeological objects and the contextual associations of the archaeological objects with: each other; or biotic or geological remains or deposits. (ORS 358.905) See specific types of sites on next page, as defined in Oregon law.

Pre-historic archaeological site — Created and/or used by humans indigenous to the area before Euro-American inhabitance.

Historic archaeological site — Created and/or used by humans since the time of Euro-American inhabitance; usually below and/or above-ground diminishing remains.

Historic site — Created and/or used by humans since the time of Euro-American inhabitance; usually above-ground structural intact remains.

Site of archaeological significance — Any archaeological site on, or eligible for inclusion on, the National Register of Historic Places as determined in writing by the State Historic Preservation Officer, or any archaeological site that has been determined significant in writing by an Indian tribe. (ORS 358.905)

Site class Site class is a measure of an area's relative capacity for producing timber or other vegetation. It is measured through the site index. The site index is expressed as the height of the tallest trees in a stand at an index age (King 1966). In this document, an age of 50 years is used. The 5 site classes are defined below.

Site class I — 135 feet and up

Site class II — 115-134 feet

Site class III — 95-114 feet

Site class IV — 75-94 feet

Site class V — Below 75 feet

Slope stability	The degree to which a slope resists the downward pull of gravity. The more resistant, the more stable.
Slump	Type of landslide; involves a failure in the soil, tends to be spoon-shaped, and the base often oozes out. See also "landslide."
Slump blocks, slump earthflows	Types of landslides. See "landslide", "slump", and "earthflow."
Source/sink relationships	"Source patches" are more productive areas in the landscape, which supply emigrants to less productive patches, termed "sinks."
Species	"…any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." [Section 3(15) of the ESA]
State Agency Coordination Program	Required under law for each state agency, to establish procedures to assure compliance with statewide land use goals and acknowledged city and county comprehensive plans and land use regulations.
State Historic Preservation Office	Oregon's SHPO was created in 1966 by federal statute. It administers the Statewide Plan for Historic Preservation and submits Oregon's nominations for the National Register of Historic Places.
Statewide Planning Goals	Statewide Planning Goals are adopted by the Land Conservation and Development Commission to set standards for local land use planning.
Stock	"For the purposes of fisheries management, a stock is an aggregation of fish populations which typically share common characteristics such as life histories, migration patterns, or habitats." [OAR, Division 7, 635-07-501(51)]. For example, "North-mid coast fall Chinook salmon" can be defined as a stock. This stock includes a number of fall Chinook "populations" from basins in this area (e.g., Siuslaw, Yaquina, and Tillamook Bay).
Stocking	A measure of the adequacy of tree cover on an area. Unless otherwise specified, stocking includes trees of all ages.
Strategy	In ODF FMPs, strategies are specific actions that will be taken to achieve the management goals. (See also "goal.")
Stream	A channel that carries flowing surface water during some portion of the year, including associated beaver ponds, oxbows, side channels, and stream-associated wetlands if these features are connected to the stream by surface flow during any portion of the year. Ephemeral overland flow is not a stream since this type of flow does not have a defined channel.

Stream-associated wetland — A wetland that is immediately adjacent to a stream. This includes wetlands that are adjacent to beaver ponds, side channels, or oxbows that are hydrologically connected to the stream channel by surface flow at any time of the year.

Stream classification — Under Oregon's FPA, streams are classified in two categories based on their beneficial use.

Type F — Fish-bearing stream.

Type N — Not a fish-bearing stream.

- **Perennial streams —** Year-round surface flow. In the FPA, defined as a stream that normally has summer surface flow after July 15.
- **Intermittent streams —** Surface flow only part of the year. In the FPA, defined as a stream that normally does not have summer surface flow after July 15. Ephemeral streams may run only during or shortly after periods of heavy rainfall or rapid snowmelt.

Stream reach — A section of stream that is geomorphically distinct, and that can be delineated from other adjacent sections based on channel gradient, form, or other physical parameters.

Structure — The physical parts of an ecosystem that we can see and touch; typical structures in a forest are tree sizes, standing dead trees (snags), fallen dead trees.

Succession — A series of changes by which one group of organisms succeeds another group; a series of developmental stages in a plant community.

Threatened and endangered species — Federal and state agencies make formal classifications of wildlife species, according to standards set by federal and state ESAs. The classifications are defined below. Federal designations are made by the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS). Oregon designations are made by ODFW.

Federal Classifications

Candidate species — Those species for which the USFWS or NMFS has sufficient information on hand to support proposals to list as threatened or endangered.

Endangered species — A species determined to be in danger of extinction throughout all or a significant portion of its range.

Federally listed species — Species, including subspecies and distinct vertebrate populations, of fish, wildlife, or plants listed at 50 CFR 17.11 and 17.12 as either endangered or threatened.

Proposed threatened or endangered species — Species proposed by the USFWS or NMFS for listing as threatened or endangered; not a final designation.

Threatened species — Species likely to become endangered species throughout all or a significant portion of their range within the foreseeable future.

State Classifications

Endangered species — Any native wildlife species determined by the State Fish and Wildlife Commission to be in danger of extinction throughout any significant portion of its range within Oregon; or any native wildlife species listed as endangered by the federal ESA.

Sensitive species — A watchlist, developed by ODFW, of wildlife species that are likely to become threatened or endangered throughout all or a significant portion of their range in Oregon. Subdivided into four categories: critical, vulnerable, peripheral, and undetermined status.

Threatened species — Any native wildlife species that the State Fish and Wildlife Commission determines is likely to become endangered within the foreseeable future throughout any significant portion of its range within Oregon.

Tillamook decline — A condition that has been observed in many Douglas-fir plantations in coastal northwest Oregon. Only Douglas-fir is affected; tree symptoms include chlorosis (yellowing), needle loss, and reduced growth (both height and diameter).

TMDLs — Total maximum daily loads; one measure of water quality.

TSP — Total suspended particulate in smoke; one measure of air quality.

Unrecognized Indian tribe — A tribe of Indians that has never been recognized by the federal government, or whose federal relations were terminated by the Klamath Termination Act or the Western Oregon Indian Termination Act.

Unsaturated zone — The layer of soil or rock between the aquifer and the surface of the ground. In this layer, some water is suspended in the spaces between soil or rocks, but the zone is not completely saturated.

Upland Unstable Slope — A potential landslide initiation site, which is disconnected from the aquatic zone. Often these locations have failed previously or show signs that future failure could occur.

Watershed — In general, a watershed is defined as an area within which all water that falls as rain or snow drains to the same stream or river. There are different levels of watersheds, from the watershed of a small stream to the watershed of the Willamette River. In this document, the large watersheds of major rivers are called "drainage basins.". The term "watershed" is used to describe the drainages of mid-sized rivers (e.g., Nehalem, Siuslaw, North Santiam).

Water table — The top of the groundwater. The water table is generally subsurface; marshes and lakes form where the water table meets the land surface.

Wetland — As defined in Oregon's Forest Practice Rules OAR 629-24-101 (77), wetlands are "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.” The process to determine the presence of wetlands will be consistent with the method described in the 1989 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (USDI Fish and Wildlife Service et al. 1989). Common examples are marshes, swamps, and bogs.

Appendix A: State Forest Planning and Harvest Scheduling Methods Over the Last Sixty Years

The State Forests Division has been conducting forest planning and harvest scheduling since the mid-1950s using a variety of methods. This paper provides a summary of the various methods that were used.

1950 through 1970

Little documentation remains from these early plans. Generally, they were only two or three pages per plan. However, some key points regarding the planning procedures can be deduced from this evidence.

General Information

- The Division recognized the different goals for BOF and CSL and it had a sustained yield policy. However, no other records remain of more specific policies.
- Allowable Cut calculations were based on County/Fund and hemlock/Douglas-fir stands (e.g. Douglas-fir stands on BOF lands in Clatsop County were considered a "Sustained Yield Unit").
- Remaining records only address harvesting. Other management activities are not addressed in the available records. Although significant planning must have occurred for the reforestation of the Tillamook Burn.
- Harvest volumes were projected out 100 years.
- Inventory was completed in each planning unit just before planning commenced, although the inventory methods were not documented.
- Growth and Yield information seemed to be based on Bulletin 201[3]. Although, in some instances, it appears to have been based on an analysis of the local inventory.
- An "Allowable Cut" methodology based on 10-year age classes and rotation length was used.
    - Douglas-fir rotations of 90 to 100 years.
    - Hemlock rotations of 70 years.
    - A standard set of forms were used for conducting the calculations.
    - For the first decade, the total acres and volume over the rotation age were summed and divided by ten to determine annual allowable cut.
    - The calculations were based on gross acres with no allowance for riparian areas or any other inoperable area.
    - Harvest volumes were represented in board feet based on 32-foot logs.
- The documentation is not clear, but responsibility for the approval of these plans seemed to bounce between the Timber Management Director and the Assistant State Forester.

[3] Technical Bulletin 201 – The Yield of Douglas Fir in the Pacific Northwest; R. E. McArdle, W. H. Meyer, and D. Bruce; United States Department of Agriculture; 1961.

- In 1968 there was legislative direction on State Forests to increase timber harvests under a six-point program. This included more thinning, expansion of positive reforestation measures, conversion of brush lands and scrub alder stands to conifer, completion of a primary road network in ten years, and fertilization.

1971 through 1980

Significant advances were made in forest planning during the 1970s in terms of technical process and breadth of analysis.

General Information

- Extensive policies and procedures were developed in 1971 for planning and the calculation of the Allowable Cut. These procedures included significant economic analysis of rotation lengths and young stand management activities
- The economic analysis of young stand management activities:
  - included planting, interplanting, various types of site preparation and release, conversion of brush fields and alder stands to conifer plantations, pre-commercial thinnings, and fertilization;
  - considered operability (logging system), discount rate, and internal rate of return;
  - resulted in specific guidelines for when and where to conduct these activities; and
  - was considered a business case for conducting these activities.
- The Allowable Cut calculation used Sustained Yield Units of Fund and District, but not species.
  - A Willamette Region Sustained Yield Unit was considered during the planning process, but it was rejected because it did not produce appreciably higher harvest volumes.
- The OSCUR[4] inventory was developed for this planning process and was completed on each district prior to conducting the planning.
- Growth and yield information was derived from Washington State Tariff Tables[5]. Yield tables were produced by species (Douglas-fir/hemlock) based on five management regimes and four site classes. Volume was expressed in cubic feet.
- A computer simulation model was used to generate sustainable annual harvest volumes. Multiple runs were conducted with different harvest parameters based on professional judgment. The computer model was called *Simulating Intensively Managed Allowable Cut* (SIMAC) and was published by the United State Forest Service (USFS) in 1971.

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[4] OSCUR stands for "Ownership, Soils, (vegetative) Cover, (land) Use, and (operation [i.e. logging system]) Rating." This stand inventory was developed by the State Forests Division in the early 1970s. It was succeeded by the OSCUR II inventory that was implemented in the early 1980s and remained in use until the early 2000s when it was replaced by the Stand Level Inventory (SLI).

[5] Turnbull et al; 1970; *Comprehensive Tariff Tables for the State of Washington, Department of Natural Resources.*

- The acres in the various "Conservancy Use Classes", precursor to the Forest Land Management Classification System (FLMCS)[6], were deducted from the gross acres prior to the model runs.
- The long-term sustained yield generated by the harvest modeling was based on cubic feet of timber volume harvested. The model provided equivalent values in board feet and acres harvested by cover type.

- In addition to anticipated volume, the resulting plans estimated revenue distribution, annual employment in logging and milling, and indirect annual benefits such as income generated and jobs outside the industry.
- Although the plans were based on long term sustained yield, they were considered 30-year plans. While the plan's goal was an even-flow of volume, there was guidance to make an attempt at producing an even-flow of revenue.
- The annual harvest objective given to the Districts was in acres harvested by cover type based on an agency directive titled "Management By Objective."[7] This was a budgeting directive that required annual harvest objectives to be stated in acres because it was to easier to predict the work load in FTEs based on harvest acres rather than harvest volume.
- The plans were prepared by the Director of Inventory, Analysis and Planning, but there is no documentation regarding the formal approval of these plans.

1981 through 1990

The planning and harvest scheduling processes of the 1980s were similar to those of the 1970s, but there were several technical improvements and a couple of significant policy shifts.

General Information

- A report[8] was prepared in 1981 that set policies for the development of long-range plans and block plans[9] for the following decade.
  - The Sustained Yield Unit for planning became the "region." Northwest Oregon comprised Astoria, Tillamook, and Forest Grove; Willamette comprised Cascade, West Oregon, and

[6] The *Classification Criteria for Land Uses on State Forests and Management Rules for Classified Areas* appear to have been adopted in 1972 and included designations such as Production, Scenic Production, Scenic Conservancy, and Protective Conservancy. Areas with the Conservancy designation were officially considered "no touch" areas, but amounted to a very small portion of the landscape, estimated at approximately five percent.

[7] The "Management by Objective" methodology was part of a state-wide effort sponsored by the Executive Department.

[8] *State Forest General Technical Planning Decisions: Rotations, Hardwood Harvesting, Commercial Thinning, Intensive Management Priorities, and Fixed Cost Control* (1981); document approved by the State Forester, Deputy State Forester, Associate State Forester, and four Assistant State Foresters.

[9] Block Plans were harvest planning tools developed by each district. Each district was divided into planning "blocks" with a forester assigned to develop harvest units on Mylar sheets using ortho photos, air photos, and topographic maps. In addition to the harvest units, these sheets included existing roads and any road construction that was necessary to access the identified units. The Block Plans were made to include at least ten years' worth of harvest units.

  - Western Lane; Southern comprised Coos and Southwest Oregon; and Eastern comprised Klamath Lake and Eastern Oregon Districts.
  - The report did not contain a formal decision for designating regions as the Sustained Yield Units. However, briefing materials associated with the planning process indicated that regions produced higher sustained yields than districts.
  - The region had a non-declining flow of volume over time, but the harvest flow by district/county could fluctuate widely from decade to decade.
  - Analysis and memos accompanying the Northwest and Willamette plans indicate that there was significant internal controversy regarding this policy decision.
- The OSCUR II inventory was developed for this planning process and was completed on each district prior conducting the planning.
- Growth and yield information was generated by DFSIM. The yield tables were based on nine regimes and three site indexes for Douglas-fir and western hemlock stands.
- The harvest schedule model used for these plans was called the *State Forestry Department Simulated Forest Development* (SFDSFD) that was developed by an ODF staff member, Bill Volker. This was a simulation model, not a linear program or other optimization model. New assumptions in this modeling effort included:
  - recognition of inoperable areas such as roads, streams, and the various “conservancy” areas[10]; and
  - an availability review conducted by districts where they were allowed to postpone specific harvest units identified by the SFDSFD model for one or two decades.
- The economic analysis of harvesting and young stand management activities:
  - assumed a stumpage real price appreciation of two and a half percent above inflation for 28 years;
  - included planting, interplanting, various types of site preparation and release, conversion of brush fields and alder stands to conifer plantations, pre-commercial thinnings, and fertilization;
  - considered cost, workload, discount rate, and internal rate of return;
  - resulted in specific guidelines for when and where to conduct these activities; and
  - was considered a business case for conducting these activities.
- Additional economic analysis associated with these plans included district specific “marginal costs analysis.” Presumably this was conducted to determine whether harvest revenue on each district covered district costs as these plans were developed shortly after a major recession in the early 1980s that resulted in layoffs of State Forests staff.
- In addition to economic analysis at the forest plan level, each proposed timber sale underwent an economic feasibility analysis that resulted in it being classified as a Category 1 or 2 Sale. To be considered a Category 1 Sale, the ODF share of the revenue from the harvest must have covered all sale related cost through site preparation and planting. All other timber sales were Category 2 Sales and were approved based on the trend in the Forest Development Fund revenue projection.

[10] Acreage deductions for roads were about four percent, streams were about one to two percent, and a general operational reduction of one to four percent, as determined by each district.

- Except for the 1989 Willamette Plan, there is no documentation on the approval of these plans. The 1989 Willamette Plan was approved by the State Forester, reviewed by the Board of Forestry, and approved by the State Land Board.

1991 through 1999

State Forest management underwent significant changes in the 1990s as a result of the Endangered Species Act listing of northern spotted owls and marbled murrelets, as well as the Gubber-Grabber lawsuit. These events led to the adoption of several Oregon Administrative Rules in 1999: Greatest Permanent Value, Forest Planning, and Forest Land Management Classification.

Forest planning during this period occurred on a more ad hoc basis and only two plans were formally completed: the Eastern Oregon Region Long Range Forest Management Plan (1995) and the Elliott State Forest Management Plan and Habitat Conservation Plan (1995). The districts that were not covered by these plans tried to meet the annual harvest objectives of the previously approved plans or identified new interim harvest objectives.

General Information

- Very little documentation of the planning process now exists outside of the approved plans[11].
- Development of these plans included significant involvement by stakeholders, the general public, and other agencies.
- These plans were designed for a much broader audience, contained more discussion of forest resources (other than timber) than previous plans, and much less analysis.
- These plans were approved by the Board of Forestry and the State Land Board, while the Elliott HCP was approved by the US Fish and Wildlife Service.

Eastern Oregon Region Long Range Forest Management Plan

- The plan covers all BOF and CSL ownership in eastern Oregon, but focuses on those lands on the Klamath-Lake District (33,000 acres). The goal for the remaining 8,000 acres of CSL that were scattered across the rest of eastern Oregon were to be consolidated with larger blocks of land through land exchanges or de-listed, with management reverting to the Department of State Lands.
- The Forest Service Pacific Northwest Stand Exam system was implemented as the district inventory prior to beginning the planning process.
- The harvest scheduling was conducting using the Prognosis stand simulation model for 210 of the 243 stands on the district. The remaining 33 stands were not included in the harvest schedule because they were plantations less than six years old and no inventory information was available for them.
- Harvest outputs were specified for six decades.

[11] The documentation that does exist is regarding the development of the strategies for the Northwest and Southwest Oregon State Forests Management Plans approved in 2001.

- Areas (acres) were used to control the rate of harvest and an anticipated volume was reported (i.e. within a decade, the annual harvest acres would be approximately the same, but the volume could fluctuate).
- Decade to decade, harvest acres and volumes were not at an even-flow. Harvest declined for the first three decades, from about 9 MMBF per year to about 6 MMBF per year[12]. The anticipated harvest increased to about 10 MMBF by the sixth decade.

- The plan does not contain any analysis of the economic viability of the plan or analysis of reforestation and young stand management activities. There was some analysis prior to starting the planning process on the viability of even-aged versus uneven-aged management strategies.

Elliott State Forest Management Plan and Habitat Conservation Plan

- An approved forest management plan was never printed, only the 1993 draft is available. The approved HCP was printed. The draft plan contains an analysis of seven management alternatives. Alternative six was the basis for the approved plan.
- The Sustained Yield Unit for the plan was the Elliott State Forest. The scattered parcels on the Coos District were not included in the plan.
- The OSCUR II inventory was the basis for the yield tables. Similar stands were grouped into regimes, but the plan does not specify the number of regimes.
- Yield tables were created using DFSIM and the Stand Projection System (SPS)[13]. It is not clear, but DFSIM was most likely used for the "natural" stands, while SPS was presumably used for the plantations.
- The SFDSFD simulator was used to project forest development and harvest over time.
  - The analysis excluded non-productive areas such as roads, riparian zones, un-loggable and non-commercial areas for the harvest opportunity pool.
  - An availability review was conducted on the outputs of SFDSFD as well as for intensive management opportunities, such as thinning and intensive management.
  - The SFDSFD analysis considered clear-cuts only. The thinning objective in the plan was based on a separate analysis conducted by the district.
  - The draft forest management plan (page III-66) state that the sustained yield for the Elliott was calculated based on volume and contains a discussion of volume versus acres for setting the sustained yield[14].
- The plan contained an economic analysis of total cost versus total revenue for the first decade of the plan.

[12] The third decade for Eastern Oregon Long Range Plan starts in 2016.
[13] SPS is a commercial growth model developed by Dr. James D. Arney, a forestry consultant.
[14] Personal communication with Norma Kline of the Coos District indicates that the harvest objective in the final plan was based on acres.

2000 through 2004

The planning process became more complex with the FMPs containing goals for multiple resources and even greater public involvement.

Northwest and Southwest Oregon State Forest Management Plans (2001)[15]

- The State Forester developed and recommended these plans and the Board of Forestry adopted them as administrative rules.
- These plans contain a vision, goals, and strategies for the districts covered by the plans, but they did not contain harvest objectives or quantitative estimates of any management activities. The harvest objectives would be determined in the individual district implementation plans.
- The Sustained Yield Unit under these plans was the district and the plans were to be reviewed/revised at least every ten years
- Harvest model outputs were used by the Board of Forestry to inform their decision on FMP approval[16]. However, the outputs from these models were not used to inform the development of the district implementation plans or set annual harvest objectives.
- The Division contracted with Dr. John Sessions to develop the harvest models for this project. These goal-oriented models were based on heuristics to find a very good, but not necessarily the optimal, solution to the problem[17]. These models:
    - projected outputs over a 200-year horizon in 20 ten-year periods;
    - included the goals of Present Net Value, harvest volume, and stand structure;
    - produced outputs for annual volume harvest and stand structure development over time; and
    - were 'spatial models' that could enforce spatial constraints, such as clear-cut size and report harvest activities as a GIS output.

  There was no field involvement in the development of these models and only limited field review of the outputs.
- The growth and yield inputs for these models were derived from yield tables developed for the C.L.A.M.S. Project[18]. These yield tables were applied to the State Forest OSCUR Inventory polygons.

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[15] The Northwest Oregon State Forest Management Plan covered Astoria, Forest Grove, Tillamook, North Cascade, West Oregon, and Western Lane Districts, while the Southwest Oregon State Forest Management Plan only covered the Southwest Oregon District.

[16] Documentation of these plans is found in Appendix I, "Decadal Analysis of Alternatives", of the Northwest Oregon State Forest Management Plan.

[17] See "Overview of the Harvest & Habitat Model Choices and Model Structure" by John Sessions and Pamela Overhulser for an explanation of why heuristics were chosen for these models. Although this paper was written for the H&H Project, the same rationale applies to the initial models for the 2001 plan.

[18] Coastal Landscape Analysis and Modeling Study (C.L.A.M.S.) based at O.S.U. had the goal of analyzing the aggregate ecological, economic, and social consequences of forest policies of different landowners in the Coast Range. Part of the study developed yield tables for the Coast Range using F.I.A. plots and Landsat imagery.

District Implementation Plans

Each District covered by the Northwest and Southwest Oregon State Forest Management Plans developed an implementation plan that described how the forest management plan would be implemented on that district.

- The State Forester approves the implementation plans.
- These plans included estimates of management activities (harvesting, road construction, reforestation) that would occur over the next 10-year period.
- Harvest models were not developed for these plans.
- The harvest objectives in these plans were determined through a "district opportunity analysis" that is described in Appendix A of each of the 2003 District Implementation Plans.
  - The analysis consisted of a six-step process that relied almost entirely on the professional judgment of district staff.
  - Annual harvest objectives were defined as a range of acres for four categories: conifer clear-cut, conifer partial cut, hardwood clear-cut, and hardwood partial cut.
  - Annual harvest volume was estimated from the acre ranges and the average harvest volume per acre for each of the harvest categories.
  - The implementation plans clearly stated that harvest acres, not volume, were the objective.
- The other management activities in the implementation plans, such as road construction and reforestation, were also based on district staffs' professional judgment. These estimates were not well documented and did not include an economic analysis.

2004 through 2012

Since 2004, the Division has been continuously improving its harvest modeling based on the heuristic models developed by Dr. John Sessions. There was significant stakeholder dissatisfaction with the discrepancy between the analysis conducted for the Northwest and Southwest State Forest Management Plans and the district implementation plans that resulted in a work plan to improve the State Forests harvest modeling[19].

This model development started with the Harvest and Habitat Model Project[20] (H&H Project), continued through the Clatsop-Tillamook Strategies for the Achievement of the Board of Forestry Performance Measure Targets Project[21] (Clatsop-Tillamook Strategies Project), and eventually led to the revision of the Northwest and Southwest State Forest Management Plans and the revision of the implementation plans

[19] Work Plan to Address Harvest Schedule Modeling and Sustainable Harvest Levels in the District Implementation Plans; Section 12 of the Implementation Plans for Northwest and Southwest Oregon State Forest Management Plans notebook; March 2003.
[20] Harvest and Habitat Model Final Report (to the Board of Forestry); March 2006.
[21] The results of this project were documented in several reports to the Board of Forestry:
Board of Forestry Agenda Item 2; Nancy Hirsch; January 9, 2008.
Board of Forestry Agenda Item 1; Mike Cafferata and Ron Zilli; November 6, 2008.
Board of Forestry Agenda Item 4; Mike Cafferata and Rob Nall; April 24, 2009.

for Astoria, Forest Grove, Tillamook, North Cascade, and West Oregon. Development of heuristic models for the revision of the Elliott State Forest Management Plan and Habitat Conservation Plan (Elliott FMP) occurred concurrently with the development of the other plans.

All these modeling projects (H&H Project, Clatsop-Tillamook Project, and Elliott FMP) had similar characteristics and processes.

General Information

- There was significant field staff collaboration with the model project team in the development and testing of each of the models, as well as input from stakeholders.
- Four to fourteen models were developed for each district, with each model representing a different management scenario, or alternative, for that district.
- The models and analysis were designed for use at the strategic level (e.g. comparison of management scenarios) and the tactical level (e.g. identification of harvest and structure targets), but were not designed to be used at an operational level (e.g. identification of specific units for harvest by year). However, when possible, operational constraints were included in the models in an effort to improve the analysis at the strategic and tactical levels.
- The model and yield table assumptions were described in the “model linkages document” for each alternative that relates each of the models’ rules, constraints, or assumptions to a policy, plan, administrative rule, or statute.
- The modeling and yield tables were validated through a process known as the Model Solution Review (MSR) that consisted of importing the model solution for the first five periods into GIS (ArcView or ArcMap). The solution data imported into GIS was specific to each period and included stand structure and age across the landscape and the specific harvest locations. The harvest information included harvest type, net acres, harvest volume, gross/net value, and road construction costs. The goals of the MSR were to:
    - determine that the model was functioning as intended (i.e. it was following all the rules and that the rules were a reasonable representation of reality); and
    - determine whether the district could implement that harvest level for the 10-year implementation plan.

Growth and Yield

- The Division’s Stand Level Inventory (SLI) was used as the basis for the yield tables.
- From 2004 through 2007, the yield tables were based on stand strata, the average of all stands in the same vegetation type. After 2007, an imputation method was applied to the forest inventory and yield tables were generated for each stand that had been measured with SLI plots.
- Each stratum or stand in the inventory received a ‘grow only’ and multiple prescriptions, resulting in approximately 40 management pathways for each stand.

- Yield tables were developed using a hybrid process that combined YTG Tools[22] and the Forest Vegetation Simulator (FVS) from the US Forest Service.
    - YTG Tools holds the stand tables, conducts the harvest, and generates the volume and other output tables.
    - YTG Tools uses FVS to grow the stands from period to period.
- A set of yield tables was developed for each district that consisted of approximately 72 tables, with each table reporting a specific stand attribute for each prescription applied to each stand for 30 periods. These tables included attributes such as:
    - Basal area per acre before and after harvest;
    - Trees per acre before and after harvest;
    - Scribner volume removed by harvest (total and broken down by log diameters);
    - Pond value removed by harvest; and
    - Stand structure after harvest.
- Scribner volume was based on 40-foot logs.
- Pond values assumed no real price appreciation of logs.

Harvest Models

- The Sustained Yield Unit for each model was the district and the harvest objective was the annual volume harvest on an even-flow basis.
- The primary goals of the harvest models were annual volume, stand structure, and net present value.
- Outputs were projected over a 150-year modeling horizon in thirty 5-year periods.
- Each model was based on extensive spatial data represented by approximately 150,000 polygons and 40 attributes (defined in a data dictionary for each alternative).
- The decision unit in each model was a logical harvest unit that may be composed of multiple polygons:
    - The harvest units for all districts, except Coos, were developed under a contract with Logging Engineering International, Inc. Final review and approval of these harvest units was by the district.
    - Coos District developed their own harvest units.
- All models, except those for Coos District, included a transportation system that linked each harvest unit to a mill and incorporated hauling, road maintenance, and road construction costs.

[22] YTG (Yield Table Generator) Tools is a third-party application developed by the consulting firm Mason, Bruce, and Girard.

Appendix B: Species of Concern

Common Name	Scientific Name	Regulatory Status[1]	Reason Included	OCS Ecoregion[2]	District[3]				Species Habitat	Limiting Factors (LF)
Amphibians					**AST/ TL/ FG**	**NC**	**WO**	**WL**		
Black salamander	*Aneides flavipunctatus*	SSV	ODFW Sensitive	KM				SP	General cover (wood or talus), often near water.	Limited range and dispersal. Sensitive to disturbance.
Cascades frog	*Rana cascadae*	Fsoc, SSV	OCS Strategy Species	WC		X		SP	Mountain meadows, bogs, ponds above 2400' elevation. Lays eggs in shallow sunny edges of ponds.	Montane species vulnerable to genetic isolation. Experiencing substantial reductions in southern parts of range (*e.g.*, CA). Sensitive to waterborne pathogens.
Cascade torrent salamander	*Rhyacotriton cascadae*	SSV	OCS Strategy Species	WC		X		SP	Cold, fast-flowing, clear, permanent headwater streams, seeps and waterfall splash zones in forested areas. Gravel or small cobble substrate with continuous but shallow water flow for larvae and adults foraging and hiding. Continuous access to cold water. Requires moist adjacent forest and micro-habitat features, such as basalt rock.	Sensitive to increased temperature and sediment. Low reproductive rate.
Clouded salamander	*Aneides ferreus*	SSV	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Forest habitats or burned areas. Require large decaying logs, especially Douglas-fir.	Limited range (occurs primarily in Oregon). Loss of large logs.
Coastal tailed frog	*Ascaphus truei*	Fsoc, SSV	OCS Strategy Species	CR, WC, KM	X	X	X	X	Cold, fast-flowing, clear streams within forested areas. Adults need streambanks, logs, headwater springs, and gravelly seeps for foraging and small boulders in streams for egg laying. Tadpoles need	Limited range (PNW endemic), Low reproductive rate. Low dispersal ability. Sedimentation & increases in water temperature.

Common Name	Scientific Name	Regulatory Status[1]	Reason Included	OCS Ecoregion[2]	District[3]				Species Habitat	Limiting Factors (LF)
Amphibians					**AST/ TL/ FG**	**NC**	**WO**	**WL**		
									permanent streams with moss- and sediment-free cobble and boulder substrate. In Coast Range, may be limited to streams with hard-rock substrate rather than sandstone.	
Columbia torrent salamander	*Rhyacotriton kezeri*	SSV	OCS Strategy Species	CR, WV	X				Cold mountain streams, seeps, & springs. Requires loose gravel stream beds with specific geologic characteristics (gradient).	Limited dispersal. Sensitive to drying & changes in stream flow
Cope's giant salamander	*Dicamptodon copei*	SSV	OCS Strategy Species	CR, WC	X				Cold, fast permanent streams with deep cobble and small boulder substrate. Rocky streambanks or in-channel logs with crevices for egg-laying.	Limited range in OR. Vulnerable to channel dewatering and stream barriers. Sensitive to increases in stream temp & sediment.
Del Norte salamander	*Plethodon elongatus*	SSV	OCS Strategy Species	CR, KM				X	Primary habitat is talus slopes in upland areas.	Highly sedentary, disturbance to talus habitat.
Foothill yellow-legged frog	*Rana boylii*	Fsoc, SSC	OCS Strategy Species	CR, WC, KM, WV		X		X	Slow-moving streams with coarse substrate gravel bars, bedrock substrate with potholes, and low flow backwaters.	Shrinking range due to habitat loss from inundation and other hydrologic modifications. Loss of gravel bars and low-flow nursery areas, sedimentation.
Northern red-legged frog	*Rana aurora*	Fsoc, SSV	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Ponds and wetlands with shallow areas and emergent plants. Access to forested habitats.	Loss of egg-laying habitat. Predation & competition from bullfrogs and invasive fish.
Oregon slender salamander	*Batrachoseps wrighti*	Fsoc, SSV	OCS Strategy Species	WC		X		SP	Late seral forest and second-growth where there are abundant mid to advanced decay Douglas-fir logs and	Endemic to OR Cascades/ Restricted distribution. Require habitat complexity characteristic

Common Name	Scientific Name	Regulatory Status[1]	Reason Included	OCS Ecoregion[2]	District[3]				Species Habitat	Limiting Factors (LF)
Amphibians					**AST/ TL/ FG**	**NC**	**WO**	**WL**		
									bark debris mounds @ base of snags. Talus and lava fields that retain moisture.	of old-growth and unmanaged young forests. High site fidelity.
Siskiyou Mountain salamander	*Plethodon stormi*	Fsoc, SSV	OCS Strategy Species	KM				SP	Talus or rock outcrops in forests in the Applegate drainage.	Highly vulnerable to moisture loss & highly vulnerable to disturbance of talus microhabitat or forest overstory.
Southern torrent salamander	*Rhyacotriton variegatus*	Fsoc, SSV	OCS Strategy Species	CR, KM, WV			X	X	Cold mountain streams, seeps, & springs. Requires loose gravel stream beds with specific geologic characteristics (gradient).	Limited dispersal. Sensitive to drying & changes in stream flow.
Western toad	*Anaxyrus boreas*	SSV	OCS Strategy Species	CR, WC, KM	X	X	X	X	Wetlands, ponds and lakes for breeding. Extensive, sunny shallows with short, sparse or no vegetation for egg laying and for tadpole schools.	Loss of breeding habitat/change in water level, roadkill.
Reptiles										
California mountain kingsnake	*Lampropeltis zonata*	SSV	OCS Strategy Species	CR, WC, KM				X	Upland species. Oak & pine, chaparral. Cover in logs & rocks.	May be sensitive to loss of downed logs.
Common kingsnake	*Lampropeltis getula*	Fsoc, SSV	ODFW Sensitive	KM				X	Usually found in thick vegetation near streams.	Land use activities that fragment populations. Disturbance to riparian or leave litter hiding substrate.
Western pond turtle	*Actinemys marmorata*	Fsoc, SSC	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Marshy ponds, small lakes, slow streams, off-channel portions of rivers. Prefer muddy bottoms with aquatic vegetation. Need open ground for nesting & logs or vegetation in water for	Loss of aquatic & nesting habitats (conversion and invasive species). Road Mortality. Predation.

Common Name	Scientific Name	Regulatory Status[1]	Reason Included	OCS Ecoregion[2]	District[3] AST/ TL/ FG	NC	WO	WL	Species Habitat	Limiting Factors (LF)
Amphibians										
									basking. Safe movement corridors.	
Western painted turtle	*Chrysemys picta bellii*	Fsoc, SSC	OCS Strategy Species	CR, WC, KM	X	X	X	X	Marshy ponds, small lakes, slow streams, off-channel portions of rivers. Prefer muddy bottoms with aquatic vegetation. Need open ground for nesting & logs or vegetation in water for basking. Safe movement corridors.	Loss of aquatic & nesting habitats (conversion and invasive species). Predation.
Birds										
American peregrine falcon	*Falco peregrinus anatum*	SSV	OCS Strategy Species	CR, WC, KM	X	X	X	X	Rock escarpments, cliffs, outcrops for nest sites and brood-rearing.	Disturbance at nests.
Bald eagle	*Haliaeetus leucocephalus*	Fsoc, FPA	Protected by FPA	CR, WC, KM	X	X	X	X	Large water bodies near areas with large trees for nesting.	Loss large nesting trees.
Band-tailed pigeon	*Patagioenas fasciata*	Fsoc	Protected by FPA	CR, WC	X	X	X	X	Mineral sites in forested landscapes with a variety of stand ages and structures.	Reduction in quality and number of mineral sites. Large area requirements.
Black swift	*Cypseloides niger*	Fsoc	OCS Strategy Species	WC		X			Waterfalls with open access & limited light and crevices/ledges.	Small disjunct populations & unique nesting habitat.
Common nighthawk	*Chordeiles minor*	SSC	OCS Strategy Species	KM, WV	X	X	X	X	Gravel bars and sparsely-vegetated grasslands or forest clearings for nesting. Prey base requirements for general habitat.	Loss and degradation of nesting habitat due to changes in hydrology and wildfire. Increased predation pressure and reductions in aerial insect abundance.
Great gray owl	*Strix nebulosa*	SSV	ODFW Sensitive	WC, KM		X		X	Late seral forest for nesting, with nearby grassy openings for foraging. Large snags or	Large area requirements, reduction in amount of late seral forest & montane grasslands.

Common Name Amphibians	Scientific Name	Regulatory Status[1]	Reason Included	OCS Ecoregion[2]	District[3] AST/ TL/ FG	NC	WO	WL	Species Habitat	Limiting Factors (LF)
									trees suitable branch structure (e.g. mistletoe) for nesting.	
Great blue heron	*Ardea herodias*	FPA	Protected by FPA	CR, WC, KM	X	X	X	X	Large trees for nesting.	Sensitive to disturbance at nesting rookeries.
Lewis' woodpecker	*Melanerpes lewis*	Fsoc, SSC	OCS Strategy Species	WC, KM				X	Pine and oak woodlands, cottonwood riparian forest, burned areas. Large, well-decayed snags for nesting. Open canopy for foraging.	Population declines & local extirpation; habitat loss and degradation; loss of old cottonwood snags; competition with starlings for nest cavities.
Marbled murrelet	*Brachyramphus marmoratus*	FT, ST	ESA-listed	CR, KM	X		X	X	Late seral forest or younger forest with suitable nest platform structures present.	Reductions in late seral forest; low reproductive output & success. Habitat loss due to severe fire.
Northern goshawk	*Accipiter gentilis*	Fsoc, SSV	OCS Strategy Species	CR, WC, KM	X	X	X	X	Large areas with mosaic of forest stages, forest openings, and habitat components (snags & logs). Open forest floor for access to prey.	Large area requirements. Affected by reductions in amount of late successional and closed canopy forest.
Northern spotted owl	*Strix occidentalis caurina*	FT, ST	ESA-listed	CR, WC, KM, WV	X	X	X	X	Late seral forest or younger forest with residual late seral components.	Declining. Large home range. Reduction in late seral habitat. Habitat loss to severe fire.
Olive-sided flycatcher	*Contopus cooperi*	Fsoc, SSV	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Open older conifer forest, riparian habitat, forest openings & edges with tall prominent trees or snags.	Relatively large area requirements. Increased predation rates in harvest units or fragmented forest.
Osprey	*Pandion haliaetus*	FPA	Protected by FPA	CR, WC, KM, WV	X	X	X	X	Large snags and broken-topped trees in close proximity to large bodies of water.	Large snags and broken-topped trees in close proximity to water. Sensitive to disturbance at nest sites.
Pileated woodpecker	*Hylatomus pileatus*	SSV	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Late seral conifer forest with large trees and snags for nesting & roosting. Large logs for foraging.	Habitat fragmentation and reductions in snag availability due to fire suppression and forest health management.

Common Name	Scientific Name	Regulatory Status[1]	Reason Included	OCS Ecoregion[2]	District[3]				Species Habitat	Limiting Factors (LF)
Amphibians					AST/ TL/ FG	NC	WO	WL		
Purple martin	*Progne subis*	Fsoc, SSC	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Large snags with cavities, generally within 3 miles of a larger body of water.	Loss of nesting cavities. Competition with starlings for nest cavities, adequate aerial prey base.
Western bluebird	*Sialia mexicana*	SSV	ODFW Sensitive	CR, WC, KM, WV	X	X	X	X	Oak savannas & grasslands for foraging, cavities for nesting.	Habitat loss & degradation. Competition from non-native birds for cavities
Willow flycatcher	*Empidonax traillii*	Fsoc, SSV	ODFW Sensitive	CR, WC, KM, WV	X	X	X	X	Early seral forest with brushy understory. Brushy patches of vegetation near water	Declining populations, loss of nesting habitat
Mammals										
American Pika	*Ochotona princeps*	SSV	ODFW Strategy Species	WC		X			Talus, creviced rock, and other microhabitats that provide cool microclimates, with adequate forage close to rocky crevices.	Limited dispersal ability, low fecundity, very sensitive to high temperatures, and vulnerable to decreases in snowpack.
California myotis	*Myotis californicus*	SSV	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Primarily forest-associated; uses large snags for day roosts; occasionally found night roosting under bridges.	Reduction of large snags, patchy distribution, low populations.
Fisher	*Pekania pennanti*	SSC	OCS Strategy Species	CR, WC, KM				X	Forests and riparian corridors with moderate to dense canopy cover and diverse structural stages and plant communities. Cavities in live or dead standing trees for den sites.	Large home range, low rate of reproduction, specific denning habitat.
Fringed myotis	*Myotis thysanodes*	Fsoc, SSV	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Forest habitats; large snags and rock features for day, night, and maternity roosts (occasionally uses bridges for night roosting); caves and mines for hibernacula.	Disturbance at roosts, patchy distribution, reduction in snags.

Common Name	Scientific Name	Regulatory Status[1]	Reason Included	OCS Ecoregion[2]	District[3]				Species Habitat	Limiting Factors (LF)
Amphibians					AST/ TL/ FG	NC	WO	WL		
Gray Wolf	*Canis lupus*	FE, SSV	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Found primarily in forested landscapes where adequate prey (e.g., deer and elk) persist.	Availability of disturbance-free areas.
Hoary bat	*Lasiurus cinereus*	SSV	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Forest habitats, including late seral conifer forests for roosting.	Habitat loss.
Long-legged myotis	*Myotis volans*	Fsoc, SSV	OCS Strategy Species	CR, WC, KM	X	X	X	X	Late seral forest with snags & hollow trees, bridges, caves, mines for roosting, forest riparian & edges for foraging.	Reduction of late seral conifer, loss of hollow trees and tall, newly dead snags, loss of healthy riparian habitat, untimely bridge replacement.
Marten	*Martes caurina* and *M. americana*	SSV	OCS Strategy Species	CR, WC, KM		X	X	X	Associated mostly with late successional mixed conifer forest with multi-layer stands but found in other forests providing there is a high density of snags and logs for denning and foraging.	Low survival in fragmented forests. Road mortality. Predation.
Pallid bat	*Antrozous pallidus*	Fsoc, SSV	OCS Strategy Species	KM				X	dry open habitats, crevices in cliffs, caves, mines, bridges for roosting. Grassland & dry forest ecotones for foraging, open water, snags.	Disturbance at roosts; patchy distribution, loss of pine snags, native grassland, and open pine forests.
Red tree vole	*Arborimus longicaudus*	FC[a], SSV	OCS Strategy Species	CR, WC, KM	X	X	X	X	Dense conifer forest, prefers large stand size.	Small home range, limited dispersal ability, low reproduction rate.
Ringtail	*Bassariscus astutus*	SSV	OCS Strategy Species	CR, WC, KM				X	Large-diameter snags and logs for dens. Late seral forest, riparian, rocky areas.	Habitat loss & fragmentation.
Silver-haired bat	*Lasionycteris noctivagans*	Fsoc, SSV	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Late seral forest with snags & hollow trees for roosting.	Reduction of late seral conifer forests, loss of hollow trees and tall, newly dead snags.

Common Name	Scientific Name	Regulatory Status[1]	Reason Included	OCS Ecoregion[2]	District[3] AST/TL/FG	NC	WO	WL	Species Habitat	Limiting Factors (LF)
Amphibians										
Townsend's big-eared bat	*Corynorhinus townsendii*	Fsoc, SSC	OCS Strategy Species	CR, WC, KM, WV	X	X	X	X	Caves, mines, & isolated buildings for roost & hibernacula.	Highly sensitive to disturbance at roosts; highly specific roost requirements (dependent on uncommon or at risk structures for habitat). Pesticides and related prey reduction.
Fish										
Bull Trout, MF Willamette		FT, SSC	Strategy Species	WV		**SP**			cool temperatures for spawning and rearing. Channel complexity, and available migratory corridors.	Increases in fine sediment and temperature. Barriers to migration. Alterations to hydrology and watershed function
Chinook, Coastal, Spring		SSC	ODFW Sensitive	none	**X**		**X**			NA- Not a strategy species
Chinook, Coastal, Fall		none	ODFW Input	none	**X**		**X**			NA- Not a strategy species
Chinook, Lower Columbia, Fall		FT, SSC	Strategy Species	CR, WC	**X**	**SP**			clean gravel, complex habitat, cool temperatures for spawning and rearing. Access for anadromous migration.	Water quality. Alterations of hydrology and watershed function. Fish Passage. Riparian Condition. Marine Survival.
Chinook, Lower Columbia, Spring		FT, SSC	Strategy Species	CR, WC		**SP**			clean gravel, complex habitat, cool temperatures for spawning and rearing. Access for anadromous migration.	Water quality. Alterations of hydrology and watershed function. Fish Passage. Riparian Condition. Marine Survival.
Chinook, Rogue, Spring		SSV	ODFW Sensitive	CR				X		NA- Not a strategy species
Chinook, Southern OR/N CA, Rogue Fall		SSV	Strategy Species	CR, WC, KM				X	clean gravel, complex habitat, cool temperatures for spawning and rearing. Access for anadromous migration.	Water quality. Alterations of hydrology and watershed function. Fish Passage. Riparian Condition. Marine Survival.
Chinook, Upper		FT, SSC	Strategy Species	CR, WC		**X**		SP	clean gravel, complex habitat, cool temperatures for	Water quality. Alterations of hydrology and watershed

Common Name **Amphibians**	Scientific Name	Regulatory Status[1]	Reason Included	OCS Ecoregion[2]	District[3] AST/ TL/ FG	 NC	 WO	 WL	Species Habitat	Limiting Factors (LF)
Willamette, Spring									spawning and rearing. Access for anadromous migration.	function. Fish Passage. Riparian Condition. Marine Survival.
Chum, Coastal		SSC	Strategy Species	CR	**X**		**X**		gravel bars and side channels near tidewaters for spawning. Migrate to ocean soon after emergence.	Alterations of hydrology and watershed function. Fish Passage. Marine Survival. Estuarine habitat.
Chum, Lower Columbia		FT, SSC	Strategy Species	CR	**X**	**SP**			gravel bars and side channels near tidewaters for spawning. Migrate to ocean soon after emergence.	Alterations of hydrology and watershed function. Fish Passage. Marine Survival. Estuarine habitat.
Coastal Cutthroat, Oregon Coast		none	Strategy Species	CR, WC, KM	**X**		**X**	X	Large wood, in-stream structures and vegetation for protection while in freshwater. Juveniles prefer side channels, backwaters or pools for rearing. Clean gravel for spawning and rearing. Migratory corridors.	Habitat fragmentation or actions that increase population isolation. Water Quality. Alterations of hydrology and watershed function. Loss of estuarine habitat for rearing. Ocean productivity.
Coastal Cutthroat, Lower Columbia River (Southwest Washington Columbia River)		Fsoc, SSV	Strategy Species	CR, WC	**X**	**SP**			Large wood, in-stream structures and vegetation for protection while in freshwater. Juveniles prefer side channels, backwaters or pools for rearing. Clean gravel for spawning and rearing. Migratory corridors.	Habitat fragmentation or actions that increase population isolation. Water Quality. Alterations of hydrology and watershed function. Loss of estuarine habitat for rearing. Ocean productivity.
Coastal Cutthroat, Willamette (Upper Willamette)		none	Strategy Species	CR, WC	**X**	**X**	**X**	X	Large wood, in-stream structures and vegetation for protection while in freshwater. Juveniles prefer side channels, backwaters or pools for rearing. Clean	Habitat fragmentation or actions that increase population isolation. Water Quality. Alterations of hydrology and watershed function. Loss of estuarine habitat for rearing. Ocean productivity.

Common Name	Scientific Name	Regulatory Status[1]	Reason Included	OCS Ecoregion[2]	District[3]				Species Habitat	Limiting Factors (LF)
Amphibians					**AST/ TL/ FG**	**NC**	**WO**	**WL**		
									gravel for spawning and rearing. Migratory corridors.	
Coastal Cutthroat, SONC (Southern Oregon/California Coasts)		none	Strategy Species	CR, WC, KM				X	Large wood, in-stream structures and vegetation for protection while in freshwater. Juveniles prefer side channels, backwaters or pools for rearing. Clean gravel for spawning and rearing. Migratory corridors.	Habitat fragmentation or actions that increase population isolation. Water Quality. Alterations of hydrology and watershed function. Loss of estuarine habitat for rearing. Ocean productivity.
Coho, Coastal		FT, SSV	Strategy Species	CR, WC, KM	**X**		**X**	X	clean gravel, complex habitat, cool temperatures for spawning and rearing. Access for anadromous migration. Distribution: CLAMS IP, ODFW FH distribution	Stream complexity. Water quality. Fish passage. Riparian condition. Altered watershed processes. Marine Survival.
Coho, Lower Columbia		FT, SE	Strategy Species	CR, WC	**X**	**SP**			clean gravel, complex habitat, cool temperatures for spawning and rearing. Access for anadromous migration. Distribution: CLAMS IP, ODFW FH distribution	Water quality. Alterations of hydrology and watershed function. Fish Passage. Riparian Condition. Marine Survival.
Coho, S OR/N CA/ Rogue		FT, SSV	Strategy Species	CR, WC, KM				X	clean gravel, complex habitat, cool temperatures for spawning and rearing. Access for anadromous migration	Water quality. Alterations of hydrology and watershed function. Fish Passage. Riparian Condition. Marine Survival.
Lamprey, Western Brook		Fsoc, SSV	Strategy Species	CR, WC, KM	**X**	**X**	**X**	X	fine gravel beds for spawning, larvae burrow in fine sediment. Timing of development closely linked to water temperature	Reduced water quality. Passage barriers. Altered flow patterns. Dredging. Rapid water drawdowns. Marine survival.
Lamprey, Pacific		Fsoc, SSV	Strategy Species	CR, WC, KM	**X**	**X**	**X**	X	fine gravel beds for spawning, larvae burrow in	Reduced water quality. Passage barriers. Altered flow patterns.

Common Name	**Scientific Name**	**Regulatory Status**[1]	**Reason Included**	**OCS Ecoregion**[2]	**District**[3]				**Species Habitat**	**Limiting Factors (LF)**
Amphibians					**AST/ TL/ FG**	**NC**	**WO**	**WL**		
									fine sediment. Timing of development closely linked to water temperature	Dredging. Rapid water drawdowns. Marine survival.
Lamprey, River		Fsoc	Federal SOC	none	**X**	**X**	**X**	X (?)		NA- Not a strategy species
Steelhead, Coastal, Winter		SSV	Strategy Species	CR, WC, KM	**X**		**X**		clean gravel, complex habitat, cool temperatures for spawning and rearing, access for anadromous migration.	Water quality. Alterations of hydrology and watershed function. Fish Passage. Riparian Condition. Marine Survival.
Steelhead, Coastal, Summer		SSV	Strategy Species	CR, WC, KM			**X**		clean gravel, complex habitat, cool temperatures for spawning and rearing, access for anadromous migration.	Water quality. Alterations of hydrology and watershed function. Fish Passage. Riparian Condition. Marine Survival.
Steelhead, Lower Columbia, Winter		FT, SSC	Strategy Species	CR, WC, KM	**X**	**SP**			clean gravel, complex habitat, cool temperatures for spawning and rearing, access for anadromous migration.	Water quality. Alterations of hydrology and watershed function. Fish Passage. Riparian Condition. Marine Survival.
Steelhead, Lower Columbia, Summer		FT, SSC	Strategy Species	CR, WC, KM					clean gravel, complex habitat, cool temperatures for spawning and rearing, access for anadromous migration. Data layers of IP habitat- CLAMS ODFW FH distribution	Water quality. Alterations of hydrology and watershed function. Fish Passage. Riparian Condition. Marine Survival.
Steelhead, Willamette (Upper Willamette), Winter		FT, SSV	Strategy Species	CR, WC, KM	**X**	**X**	**X**		clean gravel, complex habitat, cool temperatures for spawning and rearing, access for anadromous migration.	Water quality. Alterations of hydrology and watershed function. Fish Passage. Riparian Condition. Marine Survival.
Steelhead, Klamath Mtns and Rogue, Summer		SSV	Strategy Species	CR, WC, KM				X	clean gravel, complex habitat, cool temperatures for spawning and rearing, access for anadromous migration.	Water quality. Alterations of hydrology and watershed function. Fish Passage. Riparian Condition. Marine Survival. Resource extraction

Common Name	Scientific Name	Regulatory Status[1]	Reason Included	OCS Ecoregion[2]	District[3]				Species Habitat	Limiting Factors (LF)
Amphibians					**AST/ TL/ FG**	**NC**	**WO**	**WL**		
									Highly diverse genetics and life history patterns	
Oregon Chub		none	Strategy Species	CR, WC		**X**	**X**	X	off-channel habitat, low flow, silty organic substrate, abundant vegetation and cover	Predation and competition by invasive species, barriers to passage, channelization, nonpoint source pollution, drainage of off-channel habitat, culvert cleaning
Umpqua Chub		Fsoc, SSC	Strategy Species	CR, WC, KM				X	off-channel habitat, low flow, silty organic substrate, abundant vegetation and cover	Restricted distribution, passage barriers, channelization, wetland drainage, nonpoint-source pollution, culvert cleaning, invasive species predation.

[1] Regulatory Status: FT = Federal Threatened; FE = Federal Endangered; FC = Federal Candidate for ESA Listing; FSOC = Federal Species of Concern; FPA = Site Protection under FPA; SE = State Endangered; ST= State Threatened; SC = State Sensitive - Critical; SSV = State Sensitive - Vulnerable. a = Distinct Population Segment north of the Siuslaw River is a federal candidate for ESA listing.

[2] Oregon Conservation Strategy (2016) Ecoregion: CR = Coast Range; WC = West Cascades; KM = Klamath Mountains; WV = Willamette Valley.

[3] District: AST = Astoria, TL = Tillamook, FG = Forest Grove, NC = North Cascade, WO = West Oregon, WL = Western Lane (including Coos and SW Units); X = Species known or presumed to be present, SP = Species range overlap limited to one or few individual scattered parcels.