MEDFORD WATER COMMISSION'S

Forest Management Plan

BIG BUTTE SPRINGS WATERSHED - MAY 2020

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I. EXECUTIVE SUMMARY

The Big Butte Springs Watershed, consisting of approximately 56,000 acres lying west of Mt. McLoughlin in the Southern Cascades, provides high quality drinking water to 140,000 people in Medford and neighboring communities. The Commission owns nearly 3,700 acres of mostly forested land inside of the watershed, purchased to help protect water quality and quantity of the Springs by controlling activities on those lands most likely to affect the Springs.

This document presents a forest management plan to guide the forest activities on the Commission and neighboring lands. This forest management plan is designed to achieve the following goals:

1. Create a forested landscape which supports the yield of a consistent source of high-quality, cool and clean water.
2. Reduce the risks of and increase the resiliency to wildfires.
3. Improve and maintain forest health and productivity.
4. Create financial sustainability whereby revenue-generating activities are used to offset non-revenue generating activities over the long term.

This plan outlines specific principles which will guide the Commission's forest operations to achieve the goals stated above and create the desired future forest conditions. Current forest conditions were determined by conducting a comprehensive inventory of timber and fire-prone forest **understory** vegetation (fuel loads) and dividing Commission lands into 26 **stands** for individually prescribed management. The inventory suggests that overall, the forest is healthy but overstocked and would benefit from a reduction in tree density as well as a reduction in fuel loads.

As of the end of 2019, Commission lands contained an estimated 40 million **board feet** of commercial grade timber growing at approximately 2% per year. Based on the **standing volume** and anticipated growth rate under management, it is estimated that between 775 **MBF** and 1,000 **MBF** could be harvested each year to maintain the optimal tree density over the long term. Using a continuous management approach most forest **stands** will benefit from treatment every 15 years, which when considering all forested acres results in the treatment of approximately 200 acres (6%) per year comprised of both commercial harvest and non-commercial **fuels** reduction projects. A proposed schedule for the first 30 years of treatment projects is presented, while acknowledging that the exact timing of specific projects should remain flexible to meet changing market or forest health conditions.

This plan outlines a set of forest management strategies as well as specific allowable harvesting techniques appropriate for use given the Commission's goals and principles around minimizing disturbances to the land and water resources. In general this plan relies heavily on the use of **uneven-aged management** strategies (as opposed to **even-aged management**, i.e., clearcutting), as they are well suited to increase water retention and protect water quality, minimize the need for chemicals, and increase forest health and fire resiliency; while at the same time generating revenue from the beneficial removal of commercial grade timber.

In addition to commercial harvest and **fuels treatment** guidance, this document presents opportunities for ecological restoration which align with Commission goals, such as restoring meadows to increase water retention in the Springs source. It is envisioned that all non-revenue generating projects, such as **fuels treatment** and ecological restoration projects, will be funded through revenue generated during commercial timber harvest activities. In this way the forest

management plan represents a financially sustainable path forward to achieving our goals and desired future forest conditions.

Finally, as the Commission owns only 7% of the lands within the Big Butte Springs Watershed, this document presents key opportunities for collaboration with neighboring landowners and other key partners and stakeholders to further achieve our goals around protecting the Springs supply while supporting the greater community in which we live.

II. INTRODUCTION

Medford Water Commission (Commission) owns and manages nearly 3,700 acres of mostly forested land in the Big Butte Springs Watershed. The greater Watershed, approximately 56,000 acres west of Mt. McLoughlin in the Southern Cascades, provides high quality drinking water to 140,000 people in Medford and neighboring communities. In addition to Medford, the Commission provides water to Central Point, Eagle Point, Jacksonville, Phoenix, Talent, White City, and two small water districts. The City of Ashland additionally has an emergency intertie connection and periodically receives water from the Commission. The average daily water demand from customers served is approximately 23 million gallons per day (MGD), with peak daily demands reaching 65 MGD during the summer months. This demand for potable water is projected to increase over time as the Rogue Valley continues to grow.

The Commission's forest management plan is designed to achieve the following goals:

1. ***Yield a consistent source of high-quality, cool and clean water.***
2. ***Reduce the risks of and increase the resiliency to wildfires.***
3. ***Improve and maintain forest health.***
4. ***Create financial sustainability.***

A. Vision and Goals of Commission Forest Management

The vision for this management plan is to outline best forest management practices which, when implemented, will sustain an abundant supply of high-quality water and a healthy watershed. Commission forest land management will be a model of careful, effective, and financially sustainable watershed management which aligns with the State of Oregon desired land practices.

The Commission's forest management plan is designed to achieve the following goals:

1. Create a forested landscape which supports the yield of a consistent source of high-quality, cool and clean water.
2. Reduce the risks of and increase the resiliency to wildfires.
3. Improve and maintain forest health and productivity.
4. Create financial sustainability whereby revenue-generating activities are used to offset non-revenue generating activities over the long term.

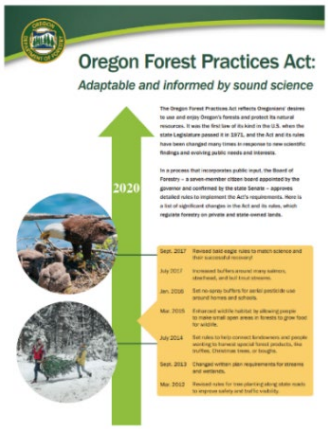
B. Forest Management in Oregon

Forested land in Oregon is owned and managed by many different entities – Federal, State and local agencies and governments, private companies, non-profit organizations and individuals. Different regulations apply to different categories of landowners, but essentially, forest land is

managed under two primary sets of regulations – the Northwest Forest Plan (and associated regulations) for Federal land, and the Oregon Forest Practices Act for State and private land.

i. Oregon Forest Practice Act

In I971, Oregon became the first state to implement a comprehensive set of laws governing forest practices - the Oregon Forest Practices Act (OFPA). It was prompted by emerging concerns about multiple forest resources, including water quality and wildlife habitat. OFPA provides a statutory framework for a comprehensive program that includes detailed rules, technical assistance and monitoring. The OFPA is periodically updated and Forestry Rules have been added to reflect new scientific data, operating technologies and forestry practices.



The OFPA and Rules set standards for any commercial activity involving the establishment, management or harvesting of trees on Oregon's forestlands. They regulate these forest operations on all non-federal lands, including Commission forests. Operation on lands managed by the U.S. Forest Service and Bureau of Land Management are not directly regulated by OFPA, but both agencies agree to meet or exceed OFPA and Rules requirements.

The Oregon Department of Forestry (ODF) administers the OFPA. ODF Stewardship Foresters work with landowners and operators to help them achieve their objectives while complying with OFPA requirements. ODF helps landowners review pre-operation plans, inspect operations, understand and comply with harvest regulations, determine reforestation compliance, investigate complaints and, when necessary, take enforcement actions.

ii. Northwest Forest Plan

In 1994, the Northwest Forest Plan (NWFP) was adopted to end the impasse over management of Federal forest land in the Pacific Northwest. It came primarily in response to concerns about removal of old-growth forests and threats to the Northern Spotted Owl, whose populations fell as a result of intensive logging on Federal land. The NWFP is designed to protect sensitive species and habitats while contributing to social and economic sustainability. It covers 24.5 million acres of Federally managed land in Oregon, Washington and northern California including National Forests, Bureau of Land Management (BLM) land and National Parks. Forest practices on these lands are regulated by the NWFP and regulations of the Federal agencies managing the land.

iii. Oregon Plan for Salmon and Watersheds

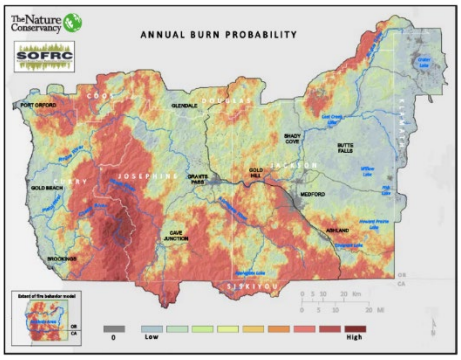
Salmon are important indicators of watershed health and have great cultural, economic, and recreational importance. In response to listings of several salmon species under the federal Endangered Species Act, and with broad support and participation from all sectors and regions of the state, the Oregon Legislature and Governor established the *Oregon Plan for Salmon and Watersheds* (OPSW) in 1997. The OPSW is implemented primarily by the Oregon Watershed Enhancement Board (OWEB).

OPSW organized specific actions, or measures, around the factors that contributed to the decline in fish populations and watershed health. Most of these actions focused on improvement of water quality, water quantity and habitat restoration. Landowners and other private citizens, community organizations, interest groups and all levels of government came together to organize, fund, and implement these measures. Watershed councils and soil and water conservation districts have led efforts in many watersheds, including the Rogue Basin.

Many of the measures supported by the OPSW are focused on forested land, such as riparian restoration and streamside tree planting, instream habitat and complexity, fish passage barrier removal and land conservation.

iv. Forest Collaboratives

There are many companies and organizations in the Rogue Basin focused on forest management. Several organizations are preservation-based and emphasize forest protection. But in recent years forest collaboratives have emerged to bridge the gaps in forest management between private, environmental and agency concerns. The Southern Oregon Forest Restoration Collaborative (SOFRC) is a broad coalition of land management agencies, private timber, conservation organizations, forestry experts, community leaders and landowners focused on forest restoration in the Rogue Basin. SOFRC is very concerned about the increasing threat of wildfires in the Rogue Basin.



In 2017, SOFRC, in collaboration with The Nature Conservancy, developed the *Rogue Basin Cohesive Forest Restoration Strategy* (RBCFRS), which promotes careful **thinning** and controlled burning on 1 million acres across the 4.6 million-acre Rogue Basin. This strategy is linked to the *National Cohesive Wildland Fire Management Strategy*, a plan developed by Federal land management agencies in coordination with a wide range of stakeholders. Like the National Strategy, the RBCFRS works across all land ownerships to restore resilient landscapes, promote fire adapted communities, and improve opportunities for safe and effective wildfire response. The Rogue Forest Restoration Partnership is an offshoot of SOFRC that will begin implementing the RBCFRS in six projects across the Rogue Basin. The project is funded by OWEB.

Other collaborative projects and initiatives include the Collaborative Forest Landscape Restoration Program (CFLRP) and Innovative Financing for National Forests (IFNF) grant programs, which have the potential to bring funding to the Rogue for forest restoration and wildfire risk reduction. These grant-funded projects are described in Section IX.

C. Implementation and Administration of the Plan

The Commission, with assistance from its forestry consultant Mason, Bruce & Girard, developed this forest management plan to guide the management of the forested portions of the Commission's property. The plan lays out a clear strategy for site-specific actions on both near- and long-term bases in order to achieve the Commission's goals outlined in this document. The plan outlines a clear strategy for the overall property as well as site-specific actions and will be used by the Commission along with its consultants and contractors for all forest-related activities. This plan will be administered by the Watershed Department of the Commission.

The plan outlines a clear strategy for the overall property as well as site-specific actions and will be used by the Commission along with its consultants and contractors for all forest-related activities.

The Commission's forest management plan draws from other sources and partnerships, including:

- Oregon Dept. of Fish and Wildlife's *Oregon Conservation Strategy*. 2006, updated 2016
- Oregon Forest Resources Institute's *Oregon's Forest Protection Laws – An Illustrated Manual*. 2018, Third Edition.
- Oregon Governor's Council on Wildfire Response, *Report and Recommendations*. 2019
- U.S. Forest Service, Upper Big Butte Watershed Analysis. 1995

Other key partners include Oregon Dept. of Forestry, BLM, private timber companies and Jackson County.

III. BACKGROUND

A. Water Resources

Big Butte Springs and the Rogue River, shown in the map in Figure 1, are the primary sources of drinking water to the City of Medford and surrounding communities. Big Butte Springs provides 26.4 MGD of exceptionally high-quality water that is consistently cold and clear, with ideal mineral content. Spring flows are collected underground and require no treatment other than disinfection to meet water quality standards. Providing reliable, safe, clean drinking water for the region is the Commission's top priority.

Big Butte Springs provides the majority of the Commission's drinking water throughout the year and is the sole source during the winter months. The Commission uses the Rogue River as a supplemental source of water when demands exceed the Big Butte Springs capacity during the spring, summer and fall; as well as during an emergency if the Springs supply were unavailable. Water from the Rogue River is treated at the Robert A. Duff Water Treatment Plant (Duff WTP). The Duff WTP currently has the capacity to produce 45 MGD and is scheduled for expansion to 65 MGD within the next ten years.

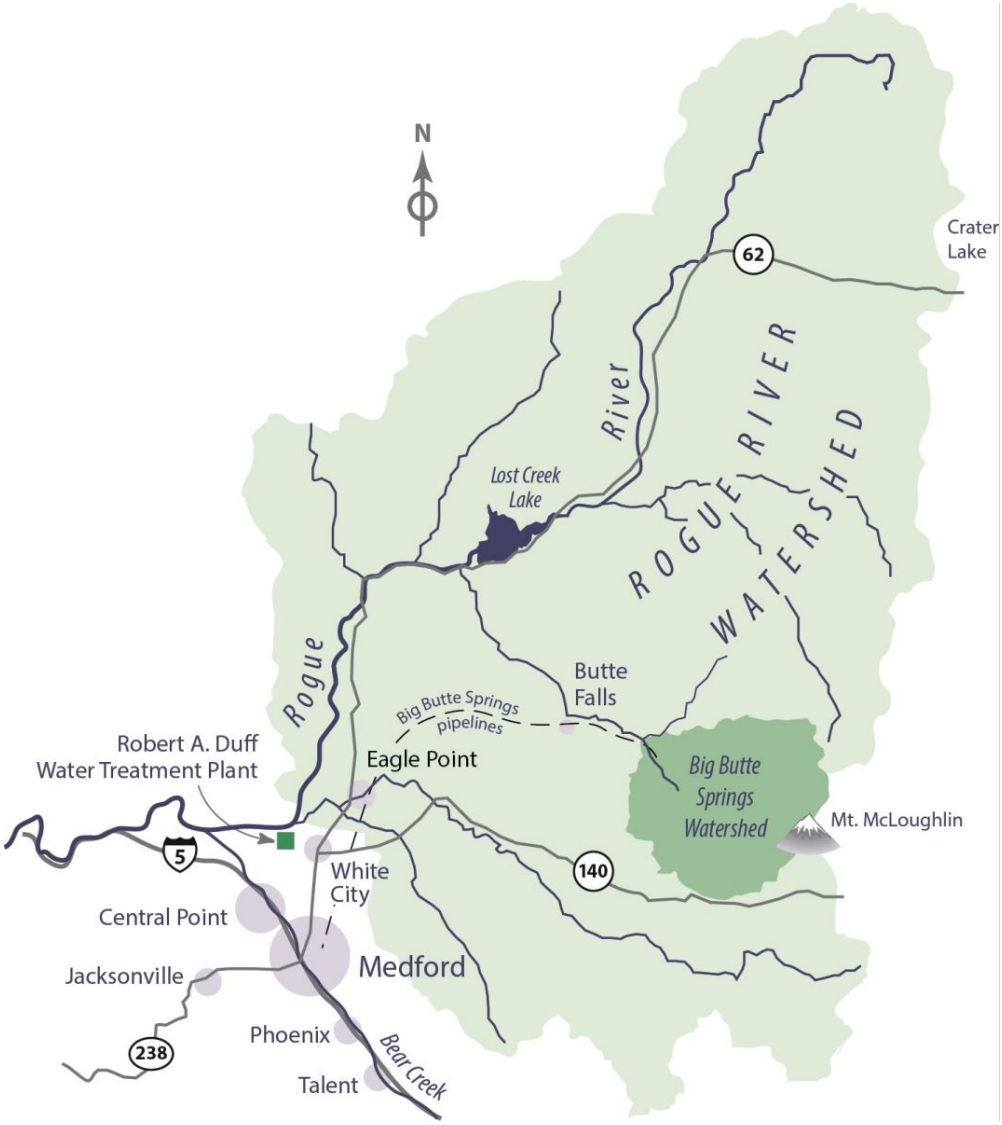


Figure 1. Watersheds Serving Medford Water Commission – Groundwater Source (Big Butte Springs) and Surface Water Source (upper Rogue River). Big Butte Springs has a 56,000-acres watershed and is the year-round source for the Commission. The upper Rogue watershed is approx. one million acres and provides drinking water when demand exceeds the Springs capacity.

The Big Butte Springs Watershed has three sub-watersheds: Willow Creek, Fourbit Creek and Skeeter Creek as shown in Figure 2. There are about 97 miles of streams in the Big Butte Springs Watershed. The watershed contains numerous springs – some have been developed into livestock watering sites or tapped for human consumption, while others remain natural. Big Butte Springs is comprised of several springs near the mouth of Willow Creek that have been captured and directed into pipelines that serve the Commission's customers. The combined flow of Big Butte Springs is about 50 cubic feet per second (cfs), but only 41 cfs is captured for drinking water.

Willow Lake is a 300-acre manmade reservoir owned by the Commission that stores a maximum of 8,500 acre-feet of water. This water is released during the summer months to support Eagle Point Irrigation District's needs and to offset the springs water diverted by the Commission. The

lake is also used for recreation, boating, fishing and swimming, in the summer, but much of its volume is released late in the summer for irrigation.

Wetlands in the watershed, including wet meadows, are generally confined to riparian areas but are extensive in some areas, particularly along lower Fourbit Creek and at the terminus of Skeeter Creek where it flows into Skeeter Swamp, and then underground into a natural sump.

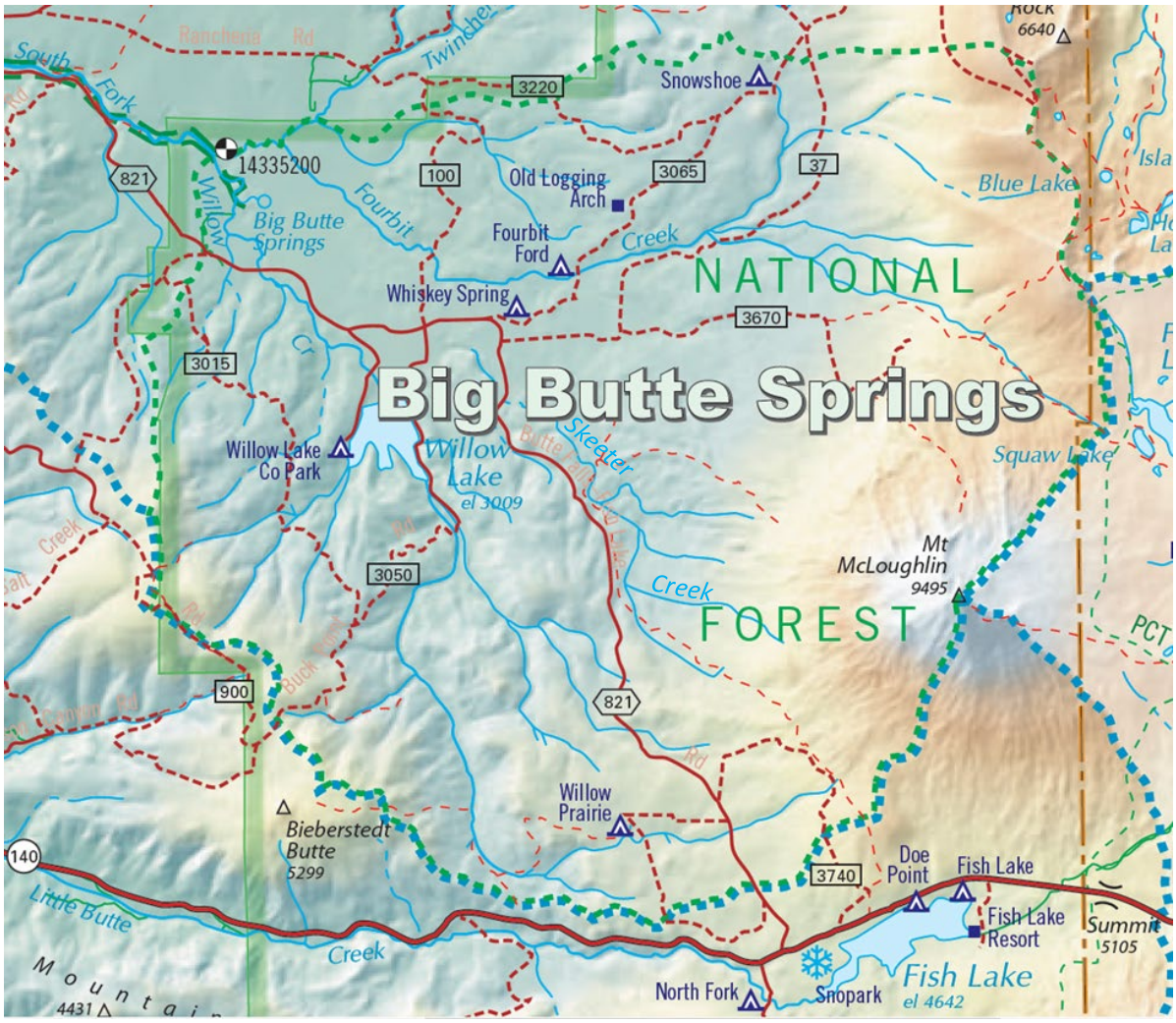


Figure 2. Water Resources and Other Landmarks in the Big Butte Springs Watershed. The BBS Watershed is delineated by the green dashed line. Most of the watershed is National Forest land, including a portion of the Sky Lakes Wilderness around Mt. McLoughlin.

Monitoring of Big Butte Springs over the past fifty years reveals a remarkably consistent and high-quality source. The Springs are subject to reduced outflows during periods of extended drought, and an increase in turbidity has been observed during periods of intense precipitation. Turbidity is evident at times in Willow Creek because of colloidal clay material from Willow Lake, and higher densities of roadways and logging in the Willow Creek sub-watershed. Other sub-watersheds with fewer roads and logging, Fourbit and Skeeter Creek for example, have much less erosion and lower turbidity.

B. Geographic Setting

i. General Description

Big Butte Springs is located approximately five miles east of Butte Falls. The recharge area or zone of contribution for the springs consists of 56,000 acres of private and public lands in Jackson County, except for 350 acres in Klamath County. This watershed or "springs recharge zone" was delineated in the 1990 Big Butte Springs Geohydrologic Report.

The Big Butte Springs Watershed lies in the southern West Cascades Range, as shown in Figure 3. The West Cascades ecoregion is characterized by mixed coniferous forests, but the dominant tree species in each area is determined by latitude, elevation, slope, aspect and other site characteristics, and the history of land management and fire in the area. The elevation of the Commission's property ranges from 2,650-3,150 feet. Soils in the West Cascades are volcanic in origin and are generally fertile, porous, and nutrient rich, which supports vigorous tree growth. Volcanic activity in the Big Butte Springs watershed varies from 4 million years ago to as recent as 20,000 years ago.

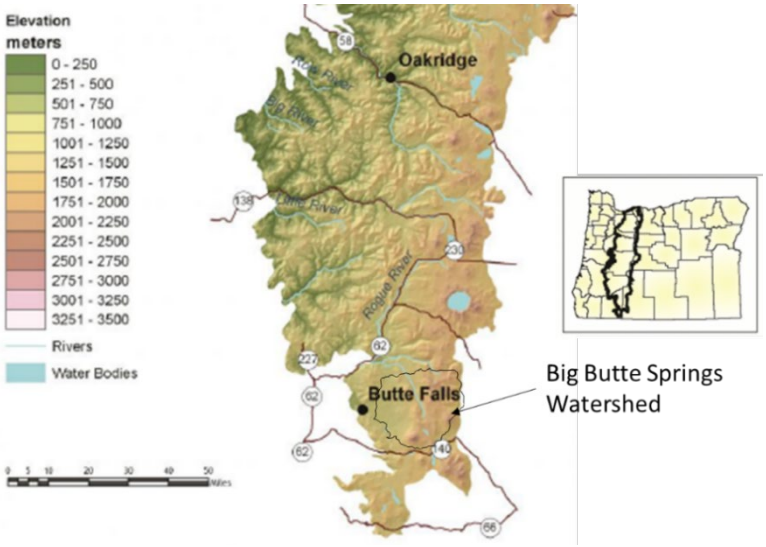


Figure 3. Big Butte Springs Watershed Location. The Big Butte Springs Watershed is at the southern extreme of the West Cascades Ecoregion. The West Cascades Ecoregion extends the entire length of Oregon, but the southern section is considerably warmer and drier than the northern section.

ii. Climate

The climate in the area can be described as Mediterranean, with generally mild, wet winters and warm, dry summers. Temperature averages range from 25°F in December and January to 86°F in July and August. Annual precipitation in the watershed ranges from 35 inches in the lower elevations to approximately 80 inches on the upper slopes of Mt. McLoughlin and the High Cascades. Precipitation generally occurs as rain in the lower elevations, with more snow in the higher areas. Seventy percent of the precipitation typically occurs between November and March. As the climate changes periods of higher temperature are expanding, more precipitation is falling as rain, and precipitation events are becoming more extreme.

C. Regional Ecology

i. Southern Cascades

The southern Cascades portion of the West Cascades Ecoregion is characterized by gently sloping mountains, broad valleys, a long summer drought and high vegetation diversity. The dominant tree species in the southern Cascades below 4,000 feet are Douglas-fir (*Pseudotsuga menziesii*) and Ponderosa pine (*Pinus ponderosa*). Other common conifers include white fir (*Abies*

concolor), incense cedar (*Calocedrus decurrens*)and sugar pine (*Pinus lambertiana*). Other natural vegetation types included grasslands, wetlands, shrublands and deciduous forest.

ii. Fire

Although the watershed is moister than most of the Rogue Basin, fire has a major influence on its ecosystems, and much of the area is fire dependent, i.e., the plant and animal communities have evolved in a frequent fire regime. The southern portion of the West Cascades is typically drier than the Cascades to the north, with relatively frequent, lightning-caused fires that can be excessively severe. Fuel loads are relatively high in the Big Butte Springs watershed due to higher precipitation and advantageous growing conditions, and the dry summers create conditions that can easily ignite. As the climate warms, forests are becoming more vulnerable to fire throughout western North America.

Fire protection for the Commission's Big Butte Springs (BBS) Watershed property is the responsibility of the Oregon Department of Forestry (ODF).

iii. Wildlife and Vegetation

The Big Butte Springs Watershed provides rich habitat for many animal and plant species. Of all of Oregon's ecoregions, the West Cascades is considered the healthiest for native wildlife and plants. Very few species have been extirpated from this ecoregion, and a lot of effort and investment has gone into protecting and recovering threatened and endangered species. Much of the remnant classic late-successional (old growth) forests on public land are managed with an emphasis on biodiversity under the Northwest Forest Plan, which is focused on recovery of the Northern Spotted Owl, but also addresses the needs of a wide array of species affected by loss and fragmentation of late-successional forests, including more than 1,000 species of animals, plants, and fungi. However, numerous limiting factors continue to affect wildlife and vegetation in the region including severe wildfires, invasive species, passage barriers for fish and other animals, and increased human activity including recreation, cattle grazing, transportation, agriculture and silviculture. Sensitive wildlife and plant species in the Big Butte Springs Watershed are shown in Appendix A.

D. Land Ownership and Infrastructure

The Commission owns a relatively small but sensitive and valuable portion of the Big Butte Springs Watershed. Figure 4 depicts the infrastructure around Big Butte Springs. Structures in the springs area include the BBS Operator's residence, the public events pavilion, the disinfection facility, Springs collection facilities, other operations and storage buildings, and numerous pump houses and storage sheds.

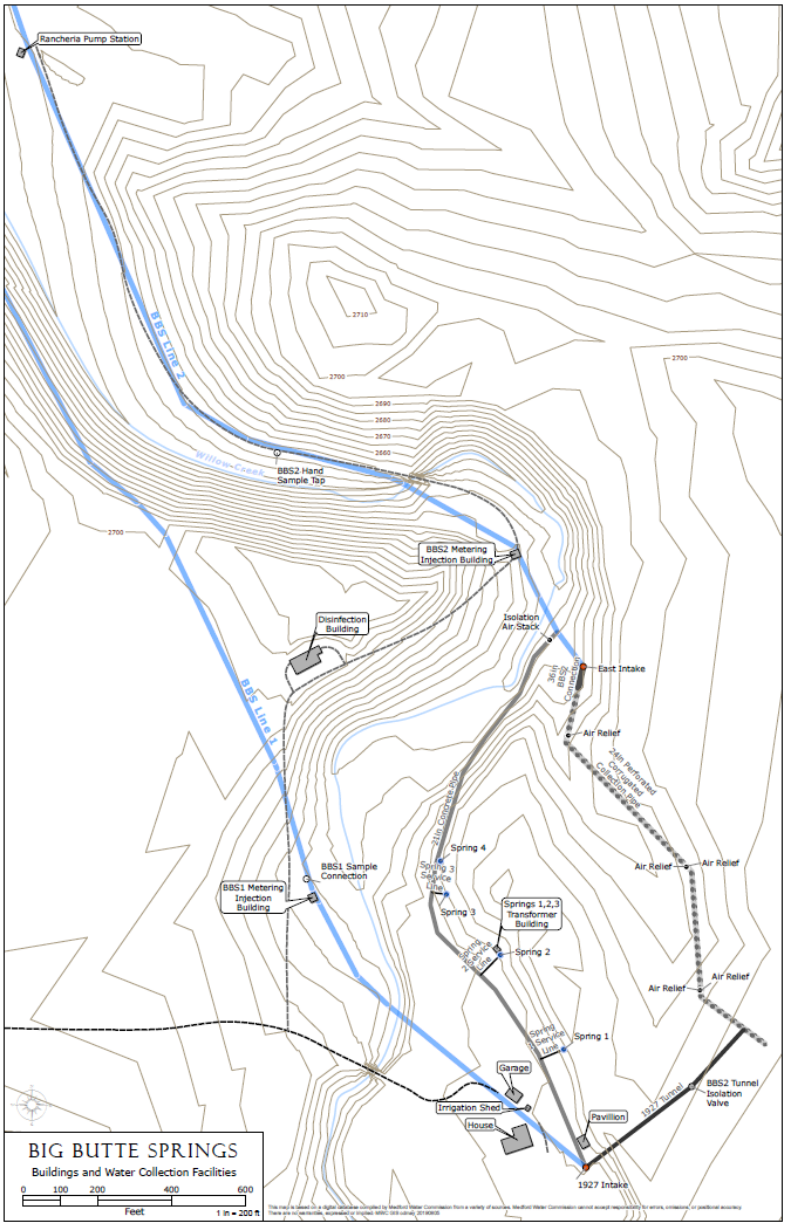


Figure 4. Big Butte Springs Complex and Associated Infrastructure. The original intake and pipeline were built in 1927, with additional structures and facilities added in succeeding years. The area shown is approx. 50 acres.

i. Roads and Fencing

There are about 50 miles of roads on Commission property and other roads in the immediate vicinity – either County or USFS-owned and maintained roads. The entire Big Butte Springs Watershed has a relatively dense network of roads, approximately 250 miles, averaging 3 miles of road per square mile (*USFS BBS Analysis*). Roads create problems for drinking water management – they provide corridors for introduction of non-native species, contribute to habitat fragmentation and intensify runoff volume and intensity through channelization and increased impervious surface. Roads also present challenges for the Commission because they can be sources of contamination through accidental spills or dumping and are often the spots where human-caused fires start.

The Commission has an extensive network of fencing, largely constructed to exclude livestock from its lands, but also to mark property boundaries to discourage trespassing. Currently the Commission maintains about 27 miles of fencing in the watershed. Many more miles of fence are maintained by livestock owners. The USFS leases land to livestock owners in the area who graze cattle throughout the watershed in the summer. Lessees are responsible for maintaining the fences between their lease areas and neighboring properties and roadways.

ii. Land Ownership

Land ownership in the Big Butte Springs watershed is predominantly public, as shown in Figure 5. The Commission owns about 3,700 acres (7%) of the 56,000-acre watershed. The Commission has no jurisdictional authority over management activities on others' lands but collaborates with neighbors and stakeholders to advocate for best management practices to protect source water. The public lands in the Big Butte Springs Watershed are managed by the Forest Service, the Bureau of Land Management, Jackson County and Medford Water Commission. These public lands are managed for multiple uses including drinking water, timber production, transportation, recreation, cattle grazing, and wildlife. The privately owned lands are used for timber production, agriculture, recreation, and residential.

The Commission owns about 3,700 acres (7%) of the 56,000-acre watershed.

Although excluded from Commission land except around Willow Lake, the public has access to most of the Big Butte Springs Watershed. Willow Lake Recreation Area is a popular destination for camping, boating and fishing, and hosts thousands of visitors per year, especially in the summer. Four other USFS campgrounds lie within the watershed – Whiskey Springs, Willow Prairie, Fourbit Ford and Snowshoe. Whiskey Springs is developed, with running water and a popular day-use area; the other campgrounds are primitive.

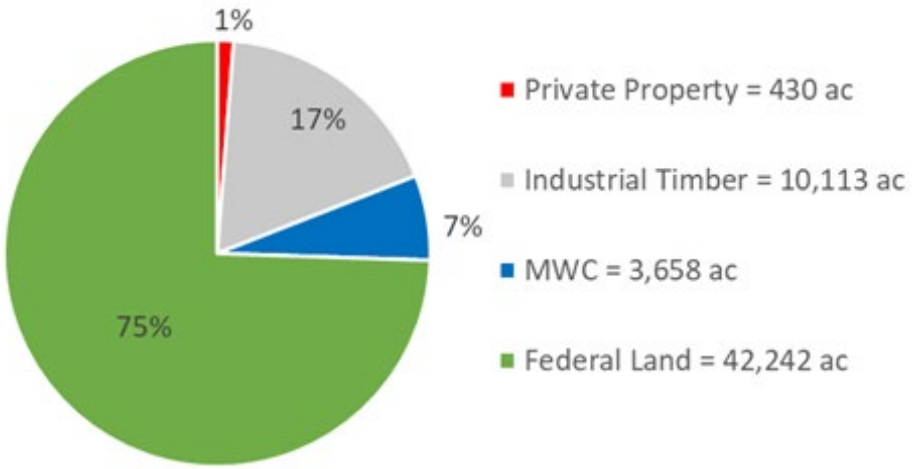


Figure 5. Land Ownership in Big Butte Springs Watershed. Most of the 56,443-acre watershed is Federally managed (U.S. Forest Service and BLM), with industrial timber the next largest landowner.

E. Management History

In 1927, the first water pipeline was constructed from Big Butte Springs to Medford and water began flowing to the city. Since that time the Commission has gradually obtained ownership of the core Big Butte Springs property. In 1999, the Commission contracted with the Rogue River Siskiyou National Forest (RRSNF) to develop a forest management plan for the Commission's Big Butte Springs property. Implementation of that plan began in 2000 and continued into 2009. Management activities included management planning, **stand** identification and mapping, limited timber harvest and **fuels treatment**. **Fuels treatment** projects included **thinning** the **understory** and hand treatment of lower lever forest **fuels** to reduce fire hazard. The activities of that initial period of management plan implementation were completed in 2009, and very minimal forest management activities were conducted between 2009-2018.

In 2018, Commission staff decided that sustained active management of the Watershed property was needed to reduce the risks exacerbated by overly dense forests - drought kill, disease, insects and fire. The Commission and its consultant began developing a long-term forest management plan as an essential component of source water protection. This plan is the result of that effort.

IV. CURRENT CONDITIONS

The Commission's forestland is generally in good condition. However, in the absence of active management or fire, some areas of Commission-owned lands have become overstocked with dense **understory** vegetation. Commission forestlands have experienced a minimal background level of damage from insects, disease, windthrow and other stressors. A main objective of active management is to maintain or enhance the present conditions so that the risks from fire and other stressors do not attain hazardous levels.

The Commission's forests are generally healthy but are becoming overstocked and will benefit from active management to maintain & improve forest health.

A. Inventory Overview

As a part of the overall management project, a comprehensive inventory of Commission-owned forests was conducted in early 2019. Forest inventories are valuable tools for planning and conducting short and long-term forest management. The inventory provides a statistically sound estimate of the standing **merchantable timber** on the property divided into 26 different forest **stands**. These **stands** are used as management units to describe the various vegetation types and to predict the average annual growth of timber on the property. The inventory calculates the total volume of timber, the vegetation types and conditions, and growth projections. The total volume of standing timber allows for a valuation of the timber assets owned by the Commission.

Each **stand** description includes the vegetation type, species composition, diameter class distribution, vegetation condition and tree counts per acre. This information is used to guide the prioritization and treatment needs of individual

stands. The growth projections inform sustainable harvest levels that can be maintained over the long-term and achieve the Commission's goals and objectives while generating revenue from the property.

Stands were identified as portions of **Blocks**, A-E, which refer to the general location of each group of **stands** as shown on the map in Figure 6 on the next page. **Block** A corresponds to **Stands** numbered in the 100's surrounding the springs infrastructure and Cook Road, **Block** B is the 200's adjacent to Whiskey Springs Campground, **Block** D (there is no **Block** C) is the 400's surrounding Willow Lake, and **Block** E is the 500's adjacent to private residences west of Willow Lake.

Other **stand** metrics include **Site Index**, **Basal Area** and **Stand Density Index**. **Site Index** refers to the capacity of the site or **stand** to produce vigorous timber, based on "Dunning's Site Index" equations. **Basal Area** represents the amount of space occupied by trees as a cross sectional area in ft^2/acre in a **cruised stand**. **Stand Density Index (SDI)** is a measure of how crowded a **stand** is by factoring the number of **trees per acre** and the average tree size. The higher the **SDI** the more growing space is occupied and the more crowded the **stand** is.

All commercial forest **stands** seen as having the potential for beneficial management activities over the next 30 years were **cruised**, as shown in Figure 6. Areas not **cruised** included plantations, areas considered not currently capable of growing commercial size trees, brush fields, meadows and other non-forested areas. Several areas have been planted with Ponderosa pines – areas of Doug-fir **root rot**, and other areas that were formerly open agricultural fields or meadows. Some of the plantations were planted with **defective** varieties from out of the area that have not thrived and are stunted.

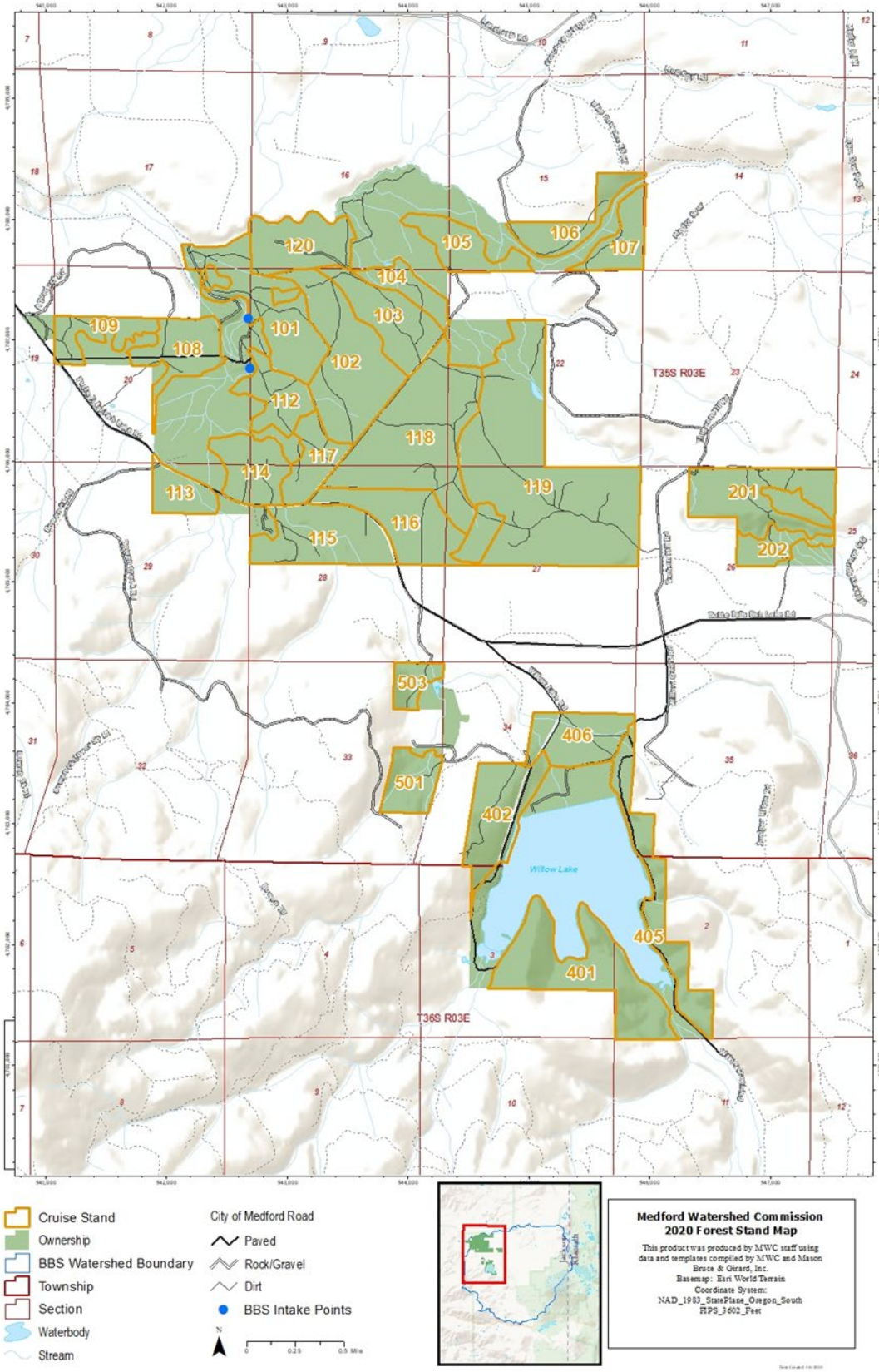


Figure 6. Commission-Owned Land and Forest Stands (3,658 acres, green shaded). Commission land is bordered by a combination of private land (ranches, private residences and industrial timber), and Federally-managed lands (USFS and BLM).

The inventory was conducted using sample plots distributed across the **stands** in a systematic grid pattern with a random starting point. Site tree data were collected in each **stand** (sample of trees, measuring height, **DBH** and age to determine **stand** ages and growth rates) along with current 5 and 10-year growth data (trees bored with an increment borer to determine the total age, and measured growth rates for the past 5 and 10-year periods).

B. Inventory Results

The area **cruised** was 2,310 net acres, which excluded riparian management zones and roads. A total of 26 **stands** were selected for inventory, shown in Table 1.

Table 1. Cruise Stands from Inventory. This table, from the Inventory, shows the relative amount of timber, size and vigor of each forest stand.

Block	Stand ID	Net Acres	Trees per Acre	Basal Area (ft^2/ac)	Stand Density Index	Site Index	Net Vol/Ac (Bd. Ft.)	Total MBF
A	101	98.7	208	135.4	240	67	18,801	1,855.3
A	102	156.0	593	180.7	372	65	21,379	3,335.1
A	103	81.9	350	184.3	340	72	19,096	1,563.3
A	104	23.4	446	169.2	333	55	16,809	393.6
A	105	56.7	194	202.0	326	62	25,474	1,445.0
A	106	54.3	209	102.6	192	74	7,064	383.8
A	107	46.1	266	100.9	199	68	5,151	237.2
A	108	61.2	276	180.0	319	55	19,306	1,180.6
A	109	46.1	88	132.5	199	66	14,358	661.8
A	112	52.0	240	186.7	319	72	23,331	1,213.0
A	113	32.3	262	127.0	238	62	13,016	420.7
A	114	61.3	344	150.8	289	61	14,912	913.7
A	115	99.5	135	146.4	234	74	16,936	1,685.5
A	116	104.2	611	154.8	330	71	20,973	2,186.2
A	117	49.4	274	132.9	250	74	15,404	760.3
A	118	217.6	458	139.8	287	71	14,268	3,104.8
A	119	385.8	161	117.9	204	69	14,024	5,411.0
A	120	75.4	170	72.6	140	50	3,670	276.5
B	201	110.4	353	174.4	326	63	17,917	1,977.2
B	202	22.0	205	146.6	255	71	16,968	373.5
D	401	174.7	236	192.7	326	74	19,525	3,410.4
D	402	92.3	377	134.2	268	70	19,907	1,837.0
D	405	93.4	300	184.4	330	70	20,463	1,910.4
D	406	56.0	371	216.8	392	69	25,465	1,425.3
E	501	35.5	378	126.4	255	47	11,313	401.2
E	503	24.1	407	167.8	325	70	17,395	418.5

A summary of tree species and size classes is presented in Table 2. These data show Douglas-fir and Ponderosa pine to be the most prevalent species on the Commission property. Overall, the inventory determined that there is a **present total standing volume of merchantable timber** (trees 10" **DBH** and greater) **of 38,780 thousand board feet (MBF)** (alternatively stated as 38.8 million **board feet**).

Table 2. Commission Forest Property-Wide Volume Estimate in 2019. This table shows the total volume of merchantable trees, the species break-down, and the sizes.

DBH Class (in.)	Douglas-fir MBF	White fir MBF	Ponderosa pine MBF	Sugar pine MBF	Incense cedar MBF	Other spp. MBF	All Species MBF
10-16	2,901.7	589.0	839.8	-	185.8	18.3	4,534.6
16-22	5,272.1	805.9	2,120.4	15.9	387.6	70.4	8,672.3
22-28	6,135.7	990.1	3,823.6	42.8	348.7	39.1	11,379.9
28-34	3,941.0	599.4	3,604.1	13.7	253.5	-	8,411.7
34-40	1,551.3	90.9	1,818.3	124.0	108.7	-	3,693.1
>40	976.2	53.2	445.2	404.7	210.0	-	2,089.3
Total	**20,777.9**	**3,128.5**	**12,651.4**	**601.1**	**1,494.3**	**127.7**	**38,780.9**

C. Growth Projections

Site and growth data determined that most or all of the timber growing area is above average site class (indicating growing capacity). **Stands** were rated using an industry-standard five class site classification system, with Site V as the slowest growing or lowest rated site and Site I as the highest. Most of the Commission's **stands** were classified as Site II or III, which indicates that Commission forests are growing well, but there is room for improvement through active management.

Site classification, stocking and computer simulation modeling were used to determine the average annual growth percentage stated as a percentage growth in **MBF**. Table 3 displays the estimated growth potential annually for the next 10 years, and then in 10-year increments out to 100 years. Note that the growth projections are based on a static "hands-off" regime of no management or vegetation manipulation. This is based on natural growth, **regeneration**, and **stand** attrition in the absence of active management. This would indicate that absent of any major disturbance (fire, harvest, large scale windthrow or disease, etc.) **stands** would continue to age and stocking would increase unchecked. Under that scenario, **stands** increase in stocking and density, trees age, and growth slows.

Table 3. 100-Year Growth Projections for Commission Forest Stands. This table shows the decreasing growth rates of Commission forests assuming no management actions or major disturbances. Active management will result in an increased growth rate.

Year	MBF	PAI (bdft/ac)	% Growth
2018	38,781	*n/a*	*n/a*
2019	39,542	329	2.0%
2020	40,086	235	1.4%
2021	40,690	261	1.5%
2022	41,308	268	1.5%
2023	41,830	226	1.3%
2024	42,587	328	1.8%
2025	43,253	288	1.6%
2026	43,862	264	1.4%
2027	44,483	269	1.4%
2028	45,089	262	1.4%
2038	51,852	293	1.5%
2048	59,238	320	1.4%
2058	66,547	316	1.2%
2068	73,497	301	1.0%
2078	80,026	283	0.9%
2088	85,425	234	0.7%
2098	90,625	225	0.6%
2108	94,822	182	0.5%
2118	98,770	171	0.4%

The modeling shows an average growth rate over the next 10 years of 1.5% annually across the entire watershed. Individual **stands** would be expected to have growth rates between -0.3% (indicating that mortality exceeds growth) and 6.5% (indicating a rapidly growing **stand**). Absent any kind of management, the overall watershed growth rate would slowly decrease to 0.4% in 100 years.

Based on a 3% growth rate, potential sustainable harvest would produce an average of just over 1 million board feet per year.

D. Future Trends

With active and careful management, including periodic harvest and **fuels treatment** to maintain stocking control, overall tree growth will likely increase over time. Under this scenario it is anticipated that the average growth rate could be increased to around 3% annually. The average annual estimated growth under 2019 conditions (2%) would be approximately 775 **MBF**, which indicates that with little change in forest conditions, approximately 775 **MBF** could be harvested annually with no long-term loss of standing tree density. Based on a 3% growth rate, potential sustainable harvest would produce an average of approximately 1,100 **MBF** or just over 1 million **board feet** per year.

Figure 7 depicts an approximation of the predicted range of growth responses following a commercial timber harvest for a hypothetical **stand** and the time frame it will take to regrow to the pre-harvest volume. At that time the **stand** would be evaluated for the next commercial timber harvest.

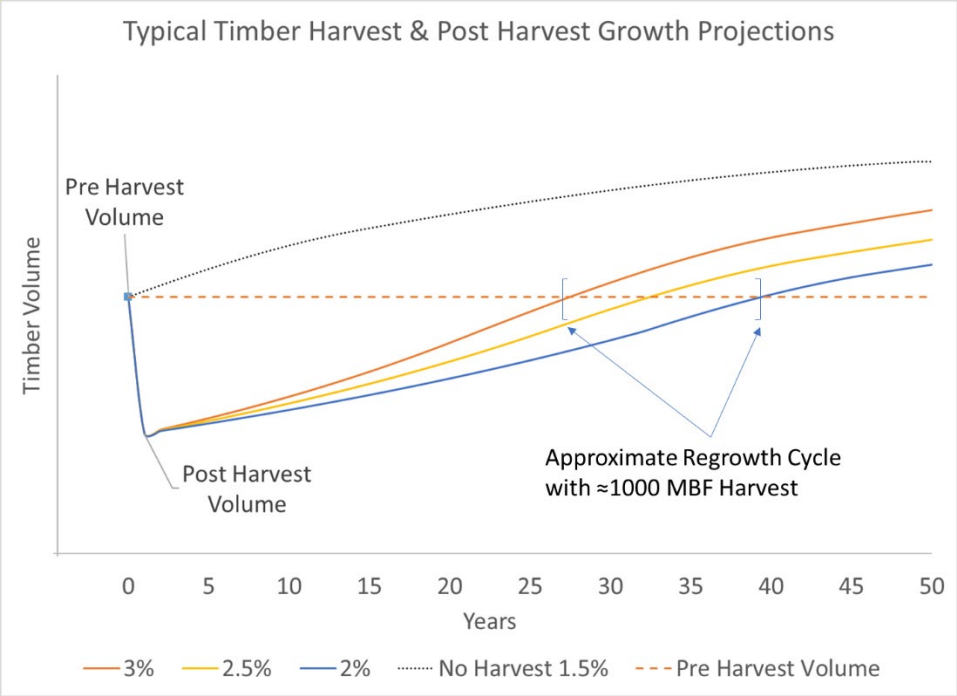


Figure 7. Timber Harvest and Post-Harvest Growth Projections. After a timber harvest of 1,000 MBF, a typical stand would take 27-39 years to regrow the volume harvested at estimated post-harvest growth rates. A higher growth rate results in a return to pre-harvest volume levels sooner than lower growth rates.

The Commission will adopt a continuous management approach to forestry, with timber harvests and/or **fuels treatments** planned to occur every year. Given the current forest conditions and growth rates, most **stands** will benefit from treatment every 15 years, alternating as Commercial and **Non-commercial thinnings**. To treat all 3,330 acres of forest once every 15 years, the Commission will treat approximately 200 acres (6%) a year as 100 acres of commercial and 100 acres of **non-commercial thinnings**.

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The changing climate will influence the health and growth rate of the forest, but its effects are difficult to predict. If regional temperatures continue to climb, evaporation and transpiration would increase (i.e., increased water loss). Temperature shifts could eventually change the tree species mix to more pine, especially in lower elevations, but Douglas-fir and other fir and moist forest species are expected to thrive in the Cascades for the foreseeable future. Higher temperatures could also trigger tree disease outbreaks, insect infestations, and more frequent and intense fires.

V. Management Goals and Principles

The Commission has developed a set of priorities for management of the Big Butte Springs property to align with its primary role as a municipal water provider. These priorities will support the Commission's goals, establish a framework for desired future conditions and guide our management strategies. Specifically, this forest management plan is designed to achieve the goals outlined below.

A. Discussion of Goals

1. Manage for a forested landscape with the capacity to yield a consistent source of high-quality, cool and clean water.

   Clean, abundant water comes from healthy forested watersheds. Threats to forest health and the Commission's source water, such as fire, drought and disease, are exacerbated by unhealthy and overstocked forests. Overstocked forests with a closed tree crown canopy can also decrease water yield through increased evapotranspiration and interception of snow and rainfall. Forest management conducted by the Commission will aim to preserve and restore an ecologically resilient forest with the ability to endure these stressors and protect our water supply source.

2. Manage forest conditions to reduce the risks of and increase the resiliency to wildfires.

   Wildfires have occurred in the past and will occur again on the Commission's property. Fire is arguably the greatest threat to our infrastructure and the degradation of our source water quality and quantity. Proper forest management can promote conditions that reduce the risks and severity of wildfire. The Commission will manage for forest conditions where fires are less likely to ignite, and encourage conditions where fires will spread slowly, can be more easily contained or suppressed and are less likely to become destructive high severity fires.

3. Improve and maintain forest health with ecological integrity and resiliency.

   A healthy forest is best suited to endure the stressors of drought, fire and disease. A healthy forested ecosystem is aesthetically pleasing, provides wildlife habitat, recreation opportunities and forest products. Forest health, beyond individual tree health, includes the health of streams, wetlands and meadows. The Commission's restoration and forest management practices aim to promote and maintain a forested ecosystem with enduring health.

4. Create financial sustainability whereby revenue-generating activities are used to offset non-revenue generating activities over the long term.

   Given the overstocked forest conditions and amount of **merchantable timber** on the Commission's land, the forest can be managed with sustained **commercial thinning** and timber harvests. **Commercial thinning** will be used as an opportunity to reach the Commission's desired future conditions and achieve its goals while generating revenue that will fund non-revenue generating forestry and restoration activities. Maximizing revenue will not be elevated above the Commission's landscape goals, policies and objectives.

B. Desired Future Forest Conditions

The 2019 Inventory report indicates that the Commission's forests are generally healthy but are becoming overstocked and will benefit by modifying forest conditions with strategic, sustained forest management. A uniform forest condition across all the Commission's forested lands is not desirable and would not meet its management goals and objectives. Instead, a diverse forested landscape will best align with the goals outlined above and provide the **ecosystem service** of source water protection. In a dry mixed conifer forest with a history of moderate wildfire frequency and a warming climate, a mosaic of more open forests with fewer trees is best suited to resist the threats of fire, drought and disease. The aerial photograph in Figure 8 captures the diverse forest conditions the Commission will promote with a holistic approach to forest management that promotes an ecologically resilient forest containing a diversity of tree species and ages. The Commission's vision of the desired future conditions includes the following:

- A forest with wide healthy riparian areas buffering our streams and wetlands with ample shade.
- A forest with large fire-resistant trees, more able to endure wildfires and drought, amongst pockets of young vigorously growing trees and areas of cool dense woods.
- A forest with openings and meadows where snow and precipitation can accumulate and recharge our groundwater.
- A forest that will continue to provide cool clean water, wildlife habitat, beauty and sustainable revenue.

Figure 8. Example of Desired Future Conditions. The desired future conditions of forested landscape with a mosaic of open forest, pockets of young trees, some dense cool areas and a healthy open meadow (former Stanley Ranch; Commission property).

C. Principles to meet Goals and Desired Future Conditions

To reach the desired future conditions, tree densities and fuel loads must be reduced through active forest management. The following principles are intended to guide the Commission's forest management operations to achieve our goals and objectives while limiting potential negative impacts to source water quality and quantity.

1. Aquatic Habitat

   Given the importance of healthy aquatic habitats to source water protection and the presence of sensitive species such as salmon and other aquatic life, the Commission's forest management will aim to protect, maintain and restore these resources, including streams, off-channel habitat and wetlands, with forestry BMPs and Ecological Restoration Strategies.

2. Chemicals

   Given the volcanic geology of the watershed, with high infiltration rates and fast groundwater travel time, groundwater contamination risks are naturally elevated.

   The use of chemicals, including pesticides and fertilizers, will be avoided whenever possible. Management strategies which do not require the use of chemicals will be pursued to protect public health while maintaining our forestry objectives. The Commission likewise advocates for alternatives to chemical use on adjacent lands within the greater Big Butte Springs Watershed.

3. Forest Species Composition

   Given the ecological context and the predicted future climatic conditions of the Southern Cascades, the Commission will manage for a diverse community of native plant species that are well adapted to drought and fire, provide wildlife habitat, resist disease and maintain enduring forest health. A rich **understory** of herbaceous plants and shrubs will be promoted where appropriate. Extra precaution will be taken to reduce the spread of **invasive species** and **noxious weeds**. All vegetative plantings will come from locally sourced and site appropriate native genetic stock.

4. Forest Structure

   A healthy and resilient forest is a forest with structural diversity. The Commission will manage for a fine scale mosaic of forest structures with variable tree densities, including multi-aged **stands**, forest openings, meadows, areas of **regeneration** and pockets of cool late seral stages with large mature trees. Tree densities will be horizontally heterogeneous, reduce fire risk and increase drought resiliency. Open areas will be promoted that allow snow accumulation on the ground and reduced interception and evaporation caused by the tree canopy.

5. Land Acquisition

   To further protect water resources, acquisition of additional land and conservation easements will be pursued when strategic opportunities arise. Land acquisition will be prioritized to those lands posing the greatest susceptibility to groundwater contamination.

6. Livestock

   Given the potential for livestock to negatively affect aquatic habitat and resources, they are excluded from all Commission lands unless specific opportunities arise for their use as a restoration tool. The Commission advocates for the exclusion of cattle from

sensitive riparian areas and wetlands outside the Commission-owned lands in the greater watershed in order to best protect water quality.

7. Meadows

   Meadows have potential to act as fire breaks, provide areas of snow accumulation and groundwater recharge zones. They provide important wildlife habitat, have aesthetic value and will be preserved and actively restored when opportunities arise.

8. Neighboring Lands

   Because the Commission owns only 3,600 acres of a 56,000-acre watershed, the Commission will seek collaboration opportunities with adjacent landowners including industrial timber owners, the USFS and BLM to promote forest management on adjacent lands as an integral component of overall source water protection.

9. Partnerships

   The Commission will seek partnerships where they advance the ability to carry out this management plan. Examples of key partnerships include working with consultants and contractors to design and execute harvest activities, as well as working with non-governmental agencies to support ecological restoration activities.

10. Public Access

    Unaccompanied public access on Commission property is limited to the area surrounding Willow Lake, though the public does have open access to much of the remaining watershed lands not owned by the Commission. The effects of forest management on public safety and recreation, such as tree hazards and the scenic quality of the forest, will be considered and mitigated. The increased fire risk associated with public access will be reflected in the application of **fuels treatment** and **slash** disposal techniques.

11. Restoration

    In conjunction with traditional forest management techniques, the Commission will employ **Ecological Restoration Strategies** such as meadow, riparian and instream habitat restoration, snag retention and **prescribed fire** to reach the desired future conditions and improve the health of the watershed.

12. Riparian Zones

    Given the importance of healthy riparian zones to aquatic resources and water quality, the Commission will maintain and advocate for riparian **buffers** on all stream classes, lakes and wetlands beyond the minimum ODF requirements to provide shade, retain cool water temperatures, act as erosion and sediment **buffers** and contribute **large woody debris** to stream channels.

13. Roads, Soil Disturbance and Compaction

    Roads increase soil compaction, water runoff and erosion into streams and creeks, which can negatively impact the quality of the Springs. Commission forest activities

will limit new road construction and consider road decommissioning opportunities to protect water quality and groundwater infiltration from erosion and soil compaction.

14. Tree Health

    Healthy trees are resistant to stressors such as fire, disease and insects. The Commission will manage for healthy vigorous trees of appropriate species and age classes.

15. Wildlife Habitat

    Given the importance of wildlife habitat as a component of a healthy forest and the occurrence of sensitive species on the Commission's forests, the Commission will manage and seek opportunities to preserve and improve wildlife habitat through forest management and ecological restoration strategies.

VI. Forest Management Strategies

Various forest management strategies have been employed by timber managers based on their unique sets of needs and objectives for their given lands. This section presents a general overview of the relevant strategies used in the industry with a discussion on how suitable they are relative to the Commission's goals.

A. Even-aged Management & Clear Cuts

Given the number one goal of the Commission's forest management is to protect water resources, **Even-aged Management** and Clear Cuts are generally not appropriate for the Commission.

Given the number one goal of the Commission's forest management is to protect water resources, Even-aged Management and Clear Cuts are generally not appropriate for the Commission.

Even-aged forestry uses clear cuts as the **commercial thinning** component. After nearly all of the trees are removed, the site is then prepared by removing **slash**, and competing vegetation is treated with herbicides. Reforestation is required by law and is accomplished by planting new seedlings followed by subsequent competing vegetation control with herbicides and pre-**commercial**

thinning. Due to the complete removal of trees, shade is lost leading to warmer ground and water temperatures, along with increased erosion and water runoff.

Some even-age treatments may occasionally be employed to meet or address specific site conditions such as areas of **root rot** where all trees must be removed to limit the spread, or areas heavily damaged by wind, fire, disease or insect attacks.

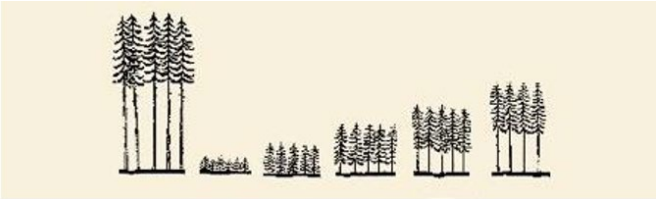
UNEVEN-AGED FOREST MANAGEMENT ENABLES THE COMMISSION TO REACH DESIRED FUTURE CONDITIONS THAT:

- Maintain a Largely Forested Landscape
- Encourage Species Diversity
- Create Structural Diversity
- Minimize the Need for Chemicals
- Increase Fire Resiliency
- Enhance Forest Health
- Generate Revenue

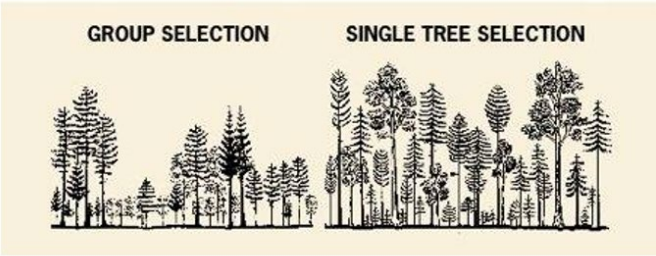
B. Uneven-Aged Management

Uneven-Aged Management is a forestry practice that maintains a largely forested landscape while managing **fuels** and harvesting commercial timber. In an uneven-aged managed forest, planned timber harvests (**commercial thinning**) remove some but not all merchantable trees from a variety of **age classes** and retain trees at lower and healthier densities. **Commercial thinning** projects are alternated with **non-commercial thinning** and **fuels treatment** projects to thin out the **understory**, reduce fire risk and promote tree **vigor**. With this system, the prescribed desired forest conditions can be encouraged and maintained while avoiding the use of clear cuts and the need to replant seedlings and use chemicals. Instead, a healthier and diverse forest is created where seedlings regrow naturally, fire risk is reduced, and revenue is generated.

Uneven-aged management represents a high-level strategy that supports a diverse forested landscape. **Uneven-aged management** can be applied in more than one way as discussed below.



Even-aged "age-class" Forestry



Uneven-aged Management System

Figure 9. Illustration Contrasting Even-aged and Uneven-aged Forest Management. Even-aged management typically takes all merchantable trees in a timber harvest (clear cut) and subsequently manages a single cohort of trees to be harvested when they reach the desired commercial volume. Uneven-aged Management maintains forest cover and thins forest stands by selecting groups or individual trees for harvest, leaving residual trees of different age/size classes to continue to grow. *Image courtesy Rolf Gersonde, Northwest Natural Resources Group.*

i. Forest Restoration Treatment Themes and Guidelines

To create the diverse forest conditions needed to meet the multiple goals and principles outlined above, reference conditions must be established that guide how uneven-aged forest management will be applied at each **stand** location. The Commission will utilize two Forest Restoration Treatment Themes adapted from the Rogue Basin Cohesive Forest Restoration Strategy, by The Nature Conservancy and Southern Oregon Forest Restoration Collaborative (SOFRC), as guidance for the uneven-aged forest management prescriptions. Using well researched reference conditions of past forest composition in the Rogue Basin, the following treatment themes were developed to provide forest structure and composition guidelines of appropriate tree density targets for different management objectives.

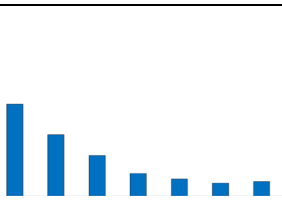
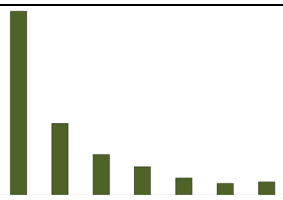
1. Ecosystem Resilience and Forest Productivity (Eco Resilience) – The Eco Resilience theme is structured to reduce fire risk, increase drought resistance, and promote a forest of healthy vigorous trees by creating a more open forest of drought and fire adapted species. **Stands** will, in general, have fewer **trees per acre** than current conditions, particularly in the small to mid-age classes. **Stands** will include pockets of early seral stage forest dominated by younger small trees and pockets of dense forest. The Eco Resilience theme will be used the most extensively across the Commission's lands as it is most suited to meet most of the Commission's forestry goals and principles.

2. Complex Forest – This theme is intended to preserve and encourage pockets of complex **Late Seral forest** with higher tree densities of large old trees and a rich multi-layered **understory**. Areas of complex forest are critical wildlife habitat, and can be used to provide shade, and stream buffering and protection as extensions of riparian management zones, on cool north slopes and along intermittent streams and draws.[1]

Quantitative general guidelines for post treatment forest structure and composition by forest management Treatment Theme are provided in Table 4 below. As detailed in the table, the Eco Resilience theme is a more open, fire resilient forest with fewer trees in smaller age classes, lower **basal area**, less **canopy cover** and lower tree densities (**TPA**, **RDI**, **SDI**). The large average tree size (**QMD**) of the Eco Resilience theme reflects the fire resilient conditions of large drought and fire resilient tree species. The higher **canopy base height** translates into less **ladder fuels** that could carry a surface fire into the forest canopy. The Complex Forest, in comparison, is a denser, cooler forest with more biomass and higher tree density indices (**TPA**, **RDI**, **SDI**). It has larger **tree clusters** including less drought resistant species with a multilayered canopy and denser **understory**. These Treatment Theme guidelines will be tailored as treatment prescriptions to meet the specific goals for a given site.

[1] The SOFRC Forest Restoration strategy outlines 3 different "Complex Forest" treatment themes that have been consolidated here into one theme for simplicity.

Table 4. Quantitative guidelines for post treatment forest structure and composition by forest management Treatment Theme. As can be seen in the shape of the distribution curves and the lower post treatment density targets, the Ecological Resilience Forest is a much more open forest than the denser Complex Forest.

Treatment Theme	**Eco Resilience**	**Complex**
Treatment Application	Extensively used across stands	Reserved for cooler moist areas with low fire risk
Species Composition	Pine, D-fir, Cedar, Oak, Madrone	D-Fir, Pine, Cedar, W-fir, Maples, Hazelnut
Representative Age Class Distribution Curve		
Basal Area ft^2/acre	82-125	125-180
Canopy Cover	35-40%	40-65%
SDI	150-175	225 +
RDI	0.30 - 0.35	0.45 +
TPA	80-125	150-210
Understory Density	Low-Medium	Medium-High
Tree Cluster Size	Small-Medium, < 10 trees	Medium-Large, > 10 trees
Canopy Base Height	10 ft +	5ft
QMD	15"	12.5"

Eco Resilient = Ecosystem Resilience Theme
D-fir = Douglas-fir
W-fir = White fir
SDI = Stand Density Index
RDI = Relative Density Index
TPA = Trees per Acre
QMD = Quadratic Mean Diameter

ii. Tree Densities and Structure Guidelines

In the absence of fire and forest management, forests across the West have become over-stocked and structurally homogeneous. A more open forest with openings and areas of lower tree density is desirable to reduce fire severity, increase snow accumulation and groundwater recharge and promote pockets of **regeneration**. The inventory assessment of 2019 indicates that the Commission's forests are currently in overall good health but are overstocked and will benefit from reduced tree densities and increased horizontal and vertical **stand** diversity.

Forest management will reduce tree densities across the age class distribution, with the greatest reductions in the mid to small age classes. Based on a given site's topography, **insolation** and specific management objectives, *Treatment Themes* and their associated **distribution curves** and tree density targets will be used to create a fine scale patchwork of forest composition with **variable tree densities**. Tree density targets adapted from the *Forest Restoration Strategy* presented as age class distribution in Figure 10 below and the **Stand Density Index (SDI)** and **Relative Density Index (RDI)** found in Table 4 above**,** are not intended as strict standards. Instead they will be used as guidelines for treatment prescriptions, to be updated and further adapted in the future.

The tree distribution graph found in Figure 10 below depicts an approximation of the current tree densities by size class of the Commission's forest compared to post treatment guidelines for the desired future forest conditions. As stated above, the Eco Resilience theme guidelines will

be applied the most extensively in the Commission's forest. By comparing current tree densities, depicted in gray, with the Eco Resilience guidelines in blue, the following differences and management implications can be seen.

1. A clear overstocking of tree densities in the smallest 0-5" **DBH** age class and the need for **non-commercial thinnings** and **fuels treatments**.
2. Lower and healthier tree densities in the 5-10" **DBH size/age class** reflective of effective previous **fuels treatments** in 2008.
3. Opportunities for commercial timber harvests where current tree densities are above treatment theme guidelines in the mid age/size classes from 10-25" **DBH**.
4. A slight deficit in the largest age class of 35" + representing the need to allow further development of late seral stage forest.

Current conditions are much closer to the guidelines of the Complex Forest theme. These smaller differences indicate that areas to be managed as Complex Forest will require lighter, **non-commercial thinning** and **fuels treatment**, much less **commercial thinning**, and less need to promote the development of late seral stage forest.

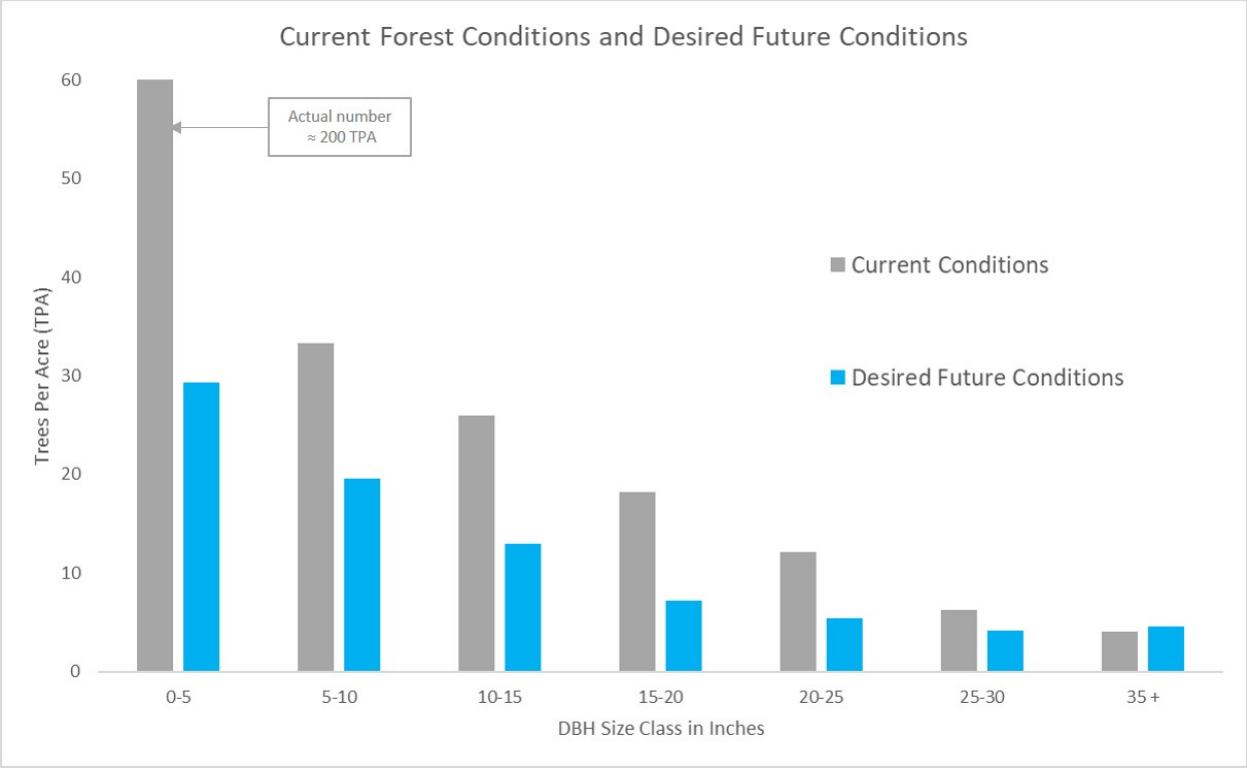


Figure 10. Current Conditions vs. Desired Future Conditions. Commission current conditions compared to the desired future conditions guidelines as trees per acre by DBH age/size class (adapted from the SOFRC Treatment Themes). The greater tree densities of current conditions in gray compared to the desired future conditions in blue indicate a need to thin.

During implementation of treatment prescriptions, a hybrid of **Single Tree Selection** and **Group Selection** will be used when marking trees for removal or retention. In the **Group Selection** method, small groups of trees are selected for harvest creating a mosaic of forest seral stages with small forest openings known as **Skips and Gaps**. **Skips and gaps** should be gradual transitions from forest to openings rather than abrupt edges. Clumps and paired trees provide structural diversity, will not be targeted for removal, and will be retained in greater numbers in areas managed as Complex Forest. With the **Single Tree Selection** method, individual trees are selected for harvest based on tree species, age class, and health. By harvesting individual trees, the species composition and age class of the **stand** can be altered while enhancing the **vigor** of the remaining trees by reducing **competition**.

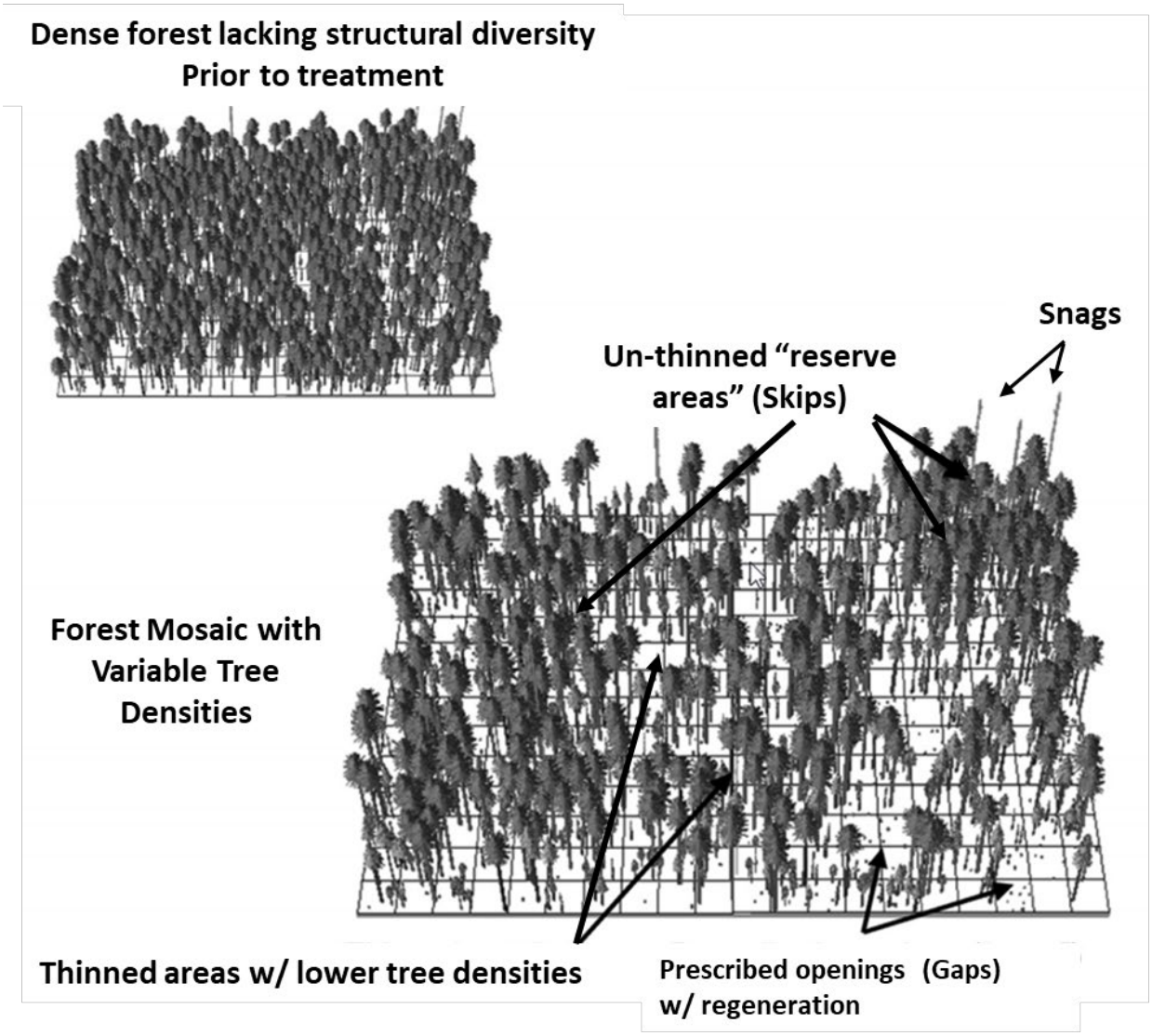


Figure 11. Transition to a mosaic of desired forest structure. Diagram illustrating the transition to the current conditions from a dense homogenous forest to a mosaic of desired forest structure with variable tree densities and skips & gaps. Adapted from figure in Harrington, C. (2009). Let's mix it up! The benefits of variable-density thinning. *Science Findings 112. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station. 5 p., 112,* Leslie Brodie.

iii. Tree Species Composition Guidelines

To promote a forest with enduring health and the ability to protect water resources, native tree species must be encouraged that are fire, drought and disease resistant. Ponderosa pines meet all these criteria and will be promoted as a significant component of forest species composition across the Commission's property. Sugar pines are an increasingly rare species and will be prioritized for retention and planting when needed. In drier and more fire prone areas, pines and oaks will be retained and encouraged as the dominant species. Cedars are drought resistant but more susceptible to fire than pines; they will be prioritized for retention on dry sites at lower stocking levels than pines.

Douglas-fir is the dominant species on Commission's land and an integral component of a healthy mixed conifer forest. They are fire resistant at larger sizes and currently the most important species from a revenue perspective. They are, however, more susceptible to drought and **root rot** than pines. A warmer future climate could put them at risk for drought and disease stress. Under forest management, Douglas-fir will remain a large component of species composition with retention prioritized in cooler moister areas, but they may be selected for reduction on warmer, drier sites to prevent future mortality.

White fir is the least drought and fire resistant of the major conifer species occurring on the Commission's land. White firs, being shade tolerant, are currently at undesirable levels in the smaller age classes and will be prioritized for removal with retention limited to the coolest and wettest areas managed as *Complex Forest*.

Hardwoods make up a small but important component of a mixed conifer forest. They provide critical wildlife habitat and add to the aesthetic quality of the forest. Oaks and Madrones are especially drought resistant and can provide critical cover and soil stability by quickly re-sprouting after a wildfire. These **hardwoods** will be maintained as a minor component of forest **stands** and promoted in drier, less productive sites. Madrones can reach undesirable levels following disturbances from fire and forest operations and must be monitored and managed accordingly. Other **hardwoods** are found on cooler, moister sites including maples and hazelnut. These species will be prioritized for retention in cool moist sites under the *Complex Forest* theme and occupy a smaller component of the *Eco Resilience* theme.

C. Forest Operations

Forest operations refer to activities that are used to achieve the desired forest conditions. In general, forest operations consist of commercial and **non-commercial thinning**, along with ecological restoration activities. All operations will follow the best management practices outlined in subsequent sections and the requirements listed in Appendix C (Commission Logging Operation Requirements) and Appendix D (Commission Non-commercial Thinning and Fuels Treatment Regulations).

i. Commercial Thinning

Timber harvests as **commercial thinning** operations will be used to:

- Reduce tree densities to healthy and sustainable levels
- Reduce canopy fuel loads and canopy fuel continuity
- Create openings and areas of **regeneration**
- Reduce resource **competition**
- Enhance tree **vigor**
- Shift species composition
- Generate revenue (as a byproduct of the list above)

Using the **stand** structure and species guidelines of the Treatment Themes above, **commercial thinning** will remove a significant amount of **merchantable timber** from a given **stand**. **Commercial thinning** will be used when the inventory of a **stand** indicates overstocking in the **merchantable timber** age classes greater than 10" **DBH**. **Commercial thinning** can capture and prevent tree mortality caused by disease, infestation and **competition** by removing some **dominant** and **co-dominant trees**. By harvesting some medium and large trees, more growing space between the remaining trees is created and conditions for **stand** replacing crown fires are reduced. The harvested trees can then be sold and milled into forest product, generating revenue to fund additional restoration.

Commercial thinning will be heaviest in areas managed for *Eco Resilience* to create an open forest, and lighter under the *Complex Forest* theme to promote a dense cooler forest.

Timber harvests as commercial thinning operations will be used to:

- Reduce tree densities
- Reduce canopy fuel loads
- Create openings and areas of regeneration
- Reduce resource competition
- Enhance tree vigor
- Shift species composition
- Generate revenue

ii. Non-Commercial Thinning and Fuels Treatment

Non-commercial thinning and fuels treatment will be used as tools to:

- **Reduce small trees densities**
- **Reduce ladder and surface fuel loads**
- **Create opening and fuel breaks**
- **Reduce resource competition**
- **Enhance tree vigor**
- **Shift species composition**

Non-commercial thinning and **fuels treatment** will be used as tools to:

- Reduce small trees densities to healthy and sustainable levels
- Reduce ladder and surface fuel loads (horizontal and vertical fuel continuity)
- Create opening and fuel breaks with sparse woody vegetation
- Reduce resource **competition**
- Enhance tree **vigor**
- Shift species composition

Non-commercial thinning, using the **stand** structure and species guidelines of the *Treatment Themes* above will be used to reduce fire risk and improve forest health by reducing the densities of smaller non-merchantable trees and shrubs from a **stand**. With fewer small trees and shrubs, tree mortality due to disease, insect infestation and **competition** can be minimized, and the probability of high severity wildfire caused by overstocking and **ladder fuels** can be greatly reduced. **Non-commercial thinning** will be used in **stands** overstocked in the non-merchantable timber age classes less than 10" **DBH** or **stands** where surface fuel loads need reduction. **Non-commercial thinning** will be heavier under the *Eco Resilience* theme creating a more open forest and lighter under the *Complex Forest* theme to promote a multi-layered canopy.

Non-commercial thinning, prescribed to alter the species composition and thin out **regeneration**, will use **single tree selection** to select for the desired species following the species guidelines above. **Non-commercial thinning** prescribed to create openings and **fuel breaks** will use **group selection** to remove most and sometimes all the **understory** from an area creating horizontal discontinuity in surface **fuels**.

Non-commercial thinning treatments can be combined with other forestry and restoration efforts to maximize their potential. Additional **fuels treatments** such as pruning the limbs of the larger trees surrounding openings, on steep slopes and ridges, and in dry areas of oaks can be used as lightly thinned, vegetated **fuel breaks**.

Prioritization of **non-commercial thinning** will focus on areas with the greatest potential risk from fire such as those surrounding infrastructure and residences, roads and campgrounds.

iii. Logging Techniques

During commercial **timber harvest** the Commission will use traditional and **mechanized logging** techniques as cost-effective **timber harvest** methods. In general, **whole tree harvest** will be the method of choice to reduce **slash** build up in the **stand**. To protect aquatic and timber resources from degradation the techniques and best management practices outlined below will be used. A more complete set of best management practices is presented in Appendix C.

Traditional Logging using loggers on foot will **fell** trees with chainsaws far from designated **skid trails**. Trees will be cabled and dragged back to designated skid trials to be transported to **landings**. By limiting the use of heavy equipment to roads and designated skid trials, soil compaction, erosion, and damage to the remaining trees can be reduced. When feasible, **traditional logging** will be the method of choice.

Mechanized Logging will use a **feller buncher** on tracks to drive out into the **stands** to **fell** trees. To protect **residual trees** and minimize soil disturbances, all logging equipment including **feller bunchers** will only operate on pre-designated and approved **skid trails** and logs will be long-lined or pulled back to **yarding** equipment operating from the designated **skid trails**.

Traditional and **Mechanized logging** will adhere to the following requirements when feasible:

- **Felling** methods will be selected to minimize damage to timber and **residual trees**.
- Logs will be skidded with limbs and tops attached to minimize soil disturbance and consolidate **slash** at **landings**.
- All logging equipment including **feller bunchers** will be confined to pre-designated and approved **skid trails**.
- All logs will be long-lined to **yarding** equipment operating from the designated **skid trails**.
- One end suspension will be used during **yarding** of logs to **landings** to prevent damage to soil resources.

Other Logging techniques such as cable and helicopter logging are cost prohibitive and not necessary on the Commission's lands given the existing road network and relatively flat terrain. **Horse logging** may be employed in very sensitive or tight areas with proper animal waste management to control the spread of noxious weeds. Future opportunities for **Cut-to-Length mechanized logging** will also be evaluated.

Logging Equipment and Machinery - Given the Commission's principles pertaining to the use of chemicals, invasive species and protecting soils, heavy equipment will be used under the following requirements:

- Equipment will be limited to designated and preapproved roads, **skid trails** and **landings**.
- Equipment will be clean, and free of leaks and sources of invasive species.
- Equipment will not operate within 100 feet of streams, springs and wet areas.
- Equipment will not be operated in **stands** when soils are excessively wet.
- When not in use, equipment will be parked on approved oil absorbent mats.
- No fuel will be stored on site.

Roads, Skid Trails and Landings construction and use are necessary components of forestry activities that can have unintended negative impacts. These disturbances will be planned and executed to minimize erosion, soil compaction, noxious weed colonization and tree damage, and incorporated into forest openings and **fuel breaks** when possible.

All road, skid trail and **landing** construction and use will adhere to the following requirements:

- The location of all **landings** and **skid trails** will be approved by the Commission prior to their construction.
- **Skid trails** will be located at least 100 feet apart except where the trails enter the **landings**.

- **Landings** will be kept to the minimum size needed for safe and efficient operations.
- All **skid trails**, clearings and **landings** will be constructed for proper drainage.
- After operations, all **skid trails**, clearings and **landings** will be restored to prevent erosion.

The decommissioning of existing roads may be used in conjunction with other restoration strategies detailed below.

iv. Slash Management

Commercial and **non-commercial thinning** operations generate considerable amounts of tree limbs and debris called **slash**. If not properly managed, the increase in woody debris can elevate fire risk and attract harmful insects. Given the Commission's forestry objectives to reduce fire risk and maintain forest health, the Commission will use **lop and scatter** and **piling and burning slash** disposal techniques to minimize these fire and insect risks. Figure 12 shows a typical **slash** disposal operation.

Figure 12. Slash disposal after a commercial thinning project. Slash disposal in a landing at the Willow Basket commercial thinning project in 2018-2019. Slash was piled and covered, prior to be burning the next year.

Lop & Scatter manages **slash** by hand cutting the limbs into small lengths and scattering it evenly across the forest floor. This method reduces fire risk by increasing the packing ratio and accelerating the decomposition of the **fuels**. **Lop and scatter** is cost effective and suitable for areas with lower fire risk under *Eco Resilience* and *Complex Forest* treatment themes. All **slash** should be no more than 24 inches above ground height except for large logs left on site as **large woody debris**, detailed below.

Piling and Burning manages **slash** by gathering the debris into piles to be dried and subsequently burned. In the dry forests of the region, **slash** can take years to decompose. By consuming the **slash** in a controlled fire, piling and burning is a more effective approach to reducing surface **fuels** and fire risk. Care must be taken to ensure that fires don't spread from the piles into the **stand**. **Slash** in areas of higher fire risk, along roads, campgrounds and sites considered for future prescribed burns should also be piled and burned to reduce the severity of future prescribed under-burns or possible wildfires.

All **slash** management will adhere to the following requirements:

- All **slash** within 100 feet of the public roads will be removed or piled for burning.
- Piles will be firelined at least three feet around the full perimeter of each pile.
- Large **landing slash** piles will be firelined 10 feet around the pile.
- All **slash** will be lopped so that no material is more than 24 inches above ground height.
- Stump height remaining after **slash** and **fuels treatments** will be less than 3 inches.
- Piles will be sufficiently covered for proper drying and subsequent burning.
- Biodegradable material will be used to cover piles when feasible.

Bark beetles are attracted to green Doug-fir logs greater than 10" and smaller pine **slash** 3-8" in diameter. In order to prevent attracting **bark beetles** ODF recommends managing **slash** to be disposed of or drying the **slash** before spring beetle activity in April. Small pine **slash** created October through December will be dry by April and suitable for **lop and scatter** without beetle risk. When feasible, **slash** created December through April should be removed or destroyed before April or one month after treatment to prevent beetle infestation. Piles should be burned before April when possible to avoid beetle risks in accordance with ODF pine **slash** disposal guidelines outlined in Figure 13.

Figure 13. Slash Management Timeline. Excerpt from ODF Slash Management for Bark Beetle Prevention illustrates the time frame for destroying pine slash (January-September) and when it is appropriate to leave it on the ground to dry (October-December).

Downed Logs are an important forest component that provides a long-term source of nutrients, wildlife habitat and erosion control. Large downed logs do contribute to surface **fuels** but pose less fire risk than finer **fuels**. Some logs and other **slash** material will be left on the forest floor after a thinning as a **Large Woody Debris Ecological Restoration Strategy** described in further detail below. When using green logs, pine and cedar should be favored for **large woody debris** retention over firs to minimize insect infestation.

v. Prescribed Fire

Prescribed Fire is the use of controlled "**underburns**", ignited under specific conditions to consume surface and ground **fuels** with low severity fire across the forest floor. Given the historical mixed-severity fire regime of the Southern Cascades, the ecological benefits of fire and the need to reduce the risk of catastrophic fire, **prescribed fire** may be used as a tool to reintroduce fire under controlled, low risk conditions. Used for **fuels** management, **prescribed fire** is an effective tool for reducing surface and ground **fuels** and subsequent wildfire risk. Low risk areas under the Fuels Management Treatment and Eco Resilience themes will be the first areas evaluated for the use of **prescribed fire**.

Prescribed fire, used in conjunction with other restoration strategies, has other ecological benefits, such as reducing the **understory** growth of shrubs and fire sensitive species, promoting fire adaptive species, maintaining meadows and forest nutrient cycling.

Prescribed fire takes careful preparation and planning to ensure a low severity fire that won't damage remaining trees or become a crown fire. Figure 14 shows the immediate aftermath of a prescribed burn on USFS land adjacent to Commission land. **Fuels treatments** with pile burning should be previously conducted in areas planned for a prescribed burn to ensure a successful burn. The risk of a **prescribed fire** escaping containment must be close to zero and it will only be employed by professionals under safe and optimal conditions. Partnering with the USFS, TNC and others will be key to the successful use of **prescribed fire** on the Commission's property.

Figure 14. Example of Effective Prescribed Burn (Underburning). The results of a well-executed Prescribed Fire (Underburning) on Forest Service Land adjacent to Commission land (off F.S. Road 100) that cleared out the understory and reduced surface fuels. Few of the larger trees were injured in the fire, and competitive understory vegetation was greatly reduced.

D. Ecological Restoration Strategies

In conjunction with the traditional forest management methods described above, additional ecological restoration efforts are necessary to fully achieve Commission goals and desired future conditions. The opportunities presented in this section highlight the value of these additional efforts.

i. Meadow Preservation & Restoration

Figure 15. Large Wet Meadow on Commission Property. Meadow on Commission property near Whiskey Springs. This meadow serves many ecologically valuable roles – infiltration, habitat, and as a fuel break to reduce fire spread.

Given the importance of meadows as a component of a forested landscape managed for source water protection, the Commission will preserve and restore meadows when opportunities arise. Meadows or large openings in the forest canopy, as shown in Figure 15, function as important areas of snow accumulation and groundwater recharge. Wet meadows can act as **fuel breaks** when surrounded by low densities of large trees and reduced **ladder fuels**. Forested **stands** surrounding meadows will be managed to limit forest encroachment and invasive species will be eradicated to preserve their ecological integrity and wildlife habitat value. Earth works and canals constructed to drain meadows will be evaluated for removal. Streams in meadows can be reconnected to historic flood plains by **large woody debris** placement and by encouraging beaver recolonization. **Prescribed fire** may be used to maintain meadows and promote desired species composition.

ii. Large Trees, Hardwoods and Snag Retention

Figure 16. Typical Habitat Tree (Snag) retained after harvest. Snag retained in Commission stand near Willow Lake, harvested in 2019. Note cavities near the top, likely excavated by woodpeckers, but often used by a wide variety of animals.

Given the principles to promote a fire and drought resilient forest and protect wildlife habitat, large old trees and **snags** will be prioritized for retention. With thick bark and higher canopies, larger trees are in general more fire resistant and should be prioritized for retention in all treatment themes. Large trees are also critical wildlife habitat, as shown in Figure 16, and large **hardwoods** are especially valuable. **Snags**, **defect** and **broken topped** trees also provide critical habitat for many of the sensitive species, such as spotted owls and bald eagles, found in the watershed. When **snags** and large trees fall, the benefits are continued as they contribute to the **large woody debris** needed in streams and on forest floors. **Snags** and large old trees can pose potential safety risks, and their retention or removal will be evaluated during a prescription, planning and marking process.

iii. Large Woody Debris Placement

Large woody debris on the forest floor provides wildlife habitat and long-term sources of nutrients. In streams, **large woody debris** provides fish habitat, bank stabilization, encourages beaver recolonization and can help reconnect streams to floodplains. In intermittent drainage channels, swales and riparian **buffers**, large debris can help slow overland sheet and channel flow and reduce erosion and sediment transport. Smaller **slash** placement created by **lop and scatter** is also beneficial in these cooler wet areas. Logging operations will provide ample surplus logs to furnish these efforts and prescriptions for treatments will evaluate if opportunities exist to implement these techniques as part of forest treatments. Green fir logs are the least desirable species for large debris placement due to insect infestation.

iv. Riparian Management Areas, Buffers and Restoration

Healthy riparian zones, as shown in Figure 17, are crucial for source water protection. The Commission will retain expanded riparian **buffers** of at least 100' feet from all streams, wetlands and lakes as **Riparian Management Areas (RMA)** under careful management. The *Complex Forest* treatment theme will often be used adjacent to **RMA**s as areas where logging is either excluded or carefully executed as a tool for riparian zone enhancement and restoration. Riparian management will incorporate and combine many of the strategies described in this section such as **large woody debris** placement, reconnecting streams to floodplains, beaver recolonization, plantings and snag retention.

Figure 17. Healthy, Shaded Riparian Area on Rogue River. Large trees and dense vegetation near streams provide many benefits including shade to prevent solar heating, erosion prevention and habitat for fish and wildlife.

v. Road Decommissioning

The Commission's private road network allows for easy property access, logging operations, and potential fire-fighting efforts. However, roads can increase water runoff and act as sources of erosion and sediment input into streams. New roads created during logging operations and existing roads that no longer serve a purpose or have no foreseeable use will be evaluated for

decommissioning. Meadow and riparian restoration efforts will look for opportunities for road decommissioning.

vi. Tree Plantation Restoration

Pine seedlings planted in some areas during previous forest management came from poor genetic stock not well suited for the region. These trees have generally not grown well, and the removal and/or replacement of the trees will be considered to increase productivity and prevent the spread of the inferior genetics. Site evaluations will be conducted before **non-commercial thinning** to determine if these areas are better suited as forest openings or restored as meadows instead of being replanted.

vii. Fencing

Maintaining sound fencing around the perimeter of Commission lands is critical for the delineation of ownership, restriction of public access and the exclusion of cattle from sensitive areas. However, there is a large amount of old derelict fencing within Commission lands that no longer serves a purpose. To minimize negative effects on logging equipment and wildlife passage, the decommissioning and removal of old fence lines will be incorporated into other ecological restoration efforts such as meadow and riparian restoration. New, temporary fencing may be used to protect sensitive resources during restoration efforts.

VII. Project Implementation

The implementation of this plan will follow a standard set of procedures applicable to the specific type of management activity. Every management activity (harvest, **fuels treatments** or other **stand** manipulation) will start with a written, **stand**-specific prescription, including current conditions, treatment recommendations, and future desired conditions. These prescriptions will be reviewed and discussed by the Commission staff and the forest management consultants prior to implementation. The prescription will be approved by the Commission before implementation begins.

For a typical **commercial thinning** operation, the forestry consultant will mark and **cruise** the **stand**. The logging contractor will begin operations after an onsite meeting with the consultant and the Commission, to review the goals and requirements of the Commission and the specific guidelines for the individual **stand**. The consultant will work closely with the logger to ensure strict adherence to Commission standards and will communicate frequently with the Commission.

During the logging operation, the forestry consultant is charged with log sales accounting, record-keeping of logging and hauling and payment advice. After completion of the log sale, the consultant prepares a summary report of total volume harvested, species composition and revenue, both gross and net.

Slash disposal and other appropriate **understory thinning** and **fuels treatment** work will follow harvest operations. Other **non-commercial thinning** and **fuels treatment** of non-harvested **stands** will be stand-alone treatments. These projects will also be initiated by an approved written prescription with specific areas mapped out for treatment. Prescriptions for **non-commercial thinning** and **fuels treatments** are less detailed than **commercial thinning** prescriptions and rely on site visits and monitoring by the forest consultant to ensure the optimal type and degree of **thinning**.

Thinning to achieve ecological resilience is complex, and requires a nuanced selection for **thinning**, e.g., certain desirable species are usually retained (oak, yew, chinquapin, sugar pine, etc.), clumps ("skips") are retained, and more piling and ladder fuel removal is required in areas of greater fire risk.

Timber can be harvested in late winter through early spring or late fall-early winter. To maximize revenue, it is often desirable to sell timber in the first half of the year. Timber prices are typically higher early in the year when supplies are lower, and purchasers have more flexibility to schedule the volume into their inventories. But depending on market conditions, prices can rise later in the year, and there are other factors that can make **timber harvest** in the fall and early winter desirable, such as less chance of beetle infestation in **slash**, and potentially greater availability of loggers and haulers in late fall.

Fuels treatment contractors are generally more available in the spring and fall. These contractors are usually busy planting seedlings in the winter and fighting fire in the summer, so they conduct **fuels treatment** and **thinning** in the other seasons. **Fuels treatment** activities generally are limited in the summer months anyway because of fire restrictions on operation of power saws in the woods.

This management plan is a dynamic and evolving instrument, and adaptations and adjustments will be made as management strategies evolve based on changing conditions, results of treatments, and new information.

A. Prescriptions

All forest management activities will begin after the Commission's approval of a written prescription of pending forest treatments, following the guidelines presented in this document. Prescriptions will:

1. Provide details about the planned operation.
2. Address all relevant principles.
3. Consider opportunities for Ecological Restoration Strategies.
4. Consider implications of adjacent lands, **stands**, conditions and management.
5. Include a map and **stand** table.
6. Describe current conditions and expected conditions after treatment.
7. List qualitatively the desired future conditions, referencing the Treatment theme target densities and guidelines above.

B. Commercial Thinning (Timber Harvest) Priorities

Using the information from the Inventory and additional **stand** location considerations, a detailed, **stand**-specific harvest schedule has been developed for the first ten years - 2020-2030. Less detailed schedules have been developed out to 30 years to allow for adjustment as market and forest conditions evolve over time.

Harvest decisions will be based on meeting the stated goals and objectives and harvest levels may be adjusted up or down for any given year due to market conditions or changing forest conditions. The management plan will initially assume a targeted average annual harvest of between 750,000 and 1,000,000 **board feet** per year (750-1,000 **MBF**). One truck load of logs contains approximately 4 **MBF**; 1,000 **MBF** is about 250 truckloads.

i. Risk/Priority Assessment Process

Utilizing a decision process based on **stand** conditions and risk factors, **stands** have been selected for harvest during the 10-year planning horizon. The **stand** data was sorted by tree count per acre, **basal area** per acre and volume per acre to determine a set of **stands** in need of a **timber harvest** as treatment. Other **stands** on the Big Butte Springs Watershed property have younger age class trees and/or low volume per acre and are not yet suited for commercial harvest.

ii. Commercial Thinning Priorities for 2018-2024

The Commission initiated early action projects in 2018 ("Willow Basket") and 2019 ("Willow Lake"). These projects included both **commercial thinning** as well as **fuels treatment** work. These projects were initiated first because of the high priority of these **stands** in terms of fire risk reduction and overstocking of trees.

The projects completed in 2018-2019, in addition to the other high priority projects scheduled over the next five years, are shown in Figure 18 on the next page and described further in Table 5.

Outflow at
Big Butte Springs – 1927 Intake

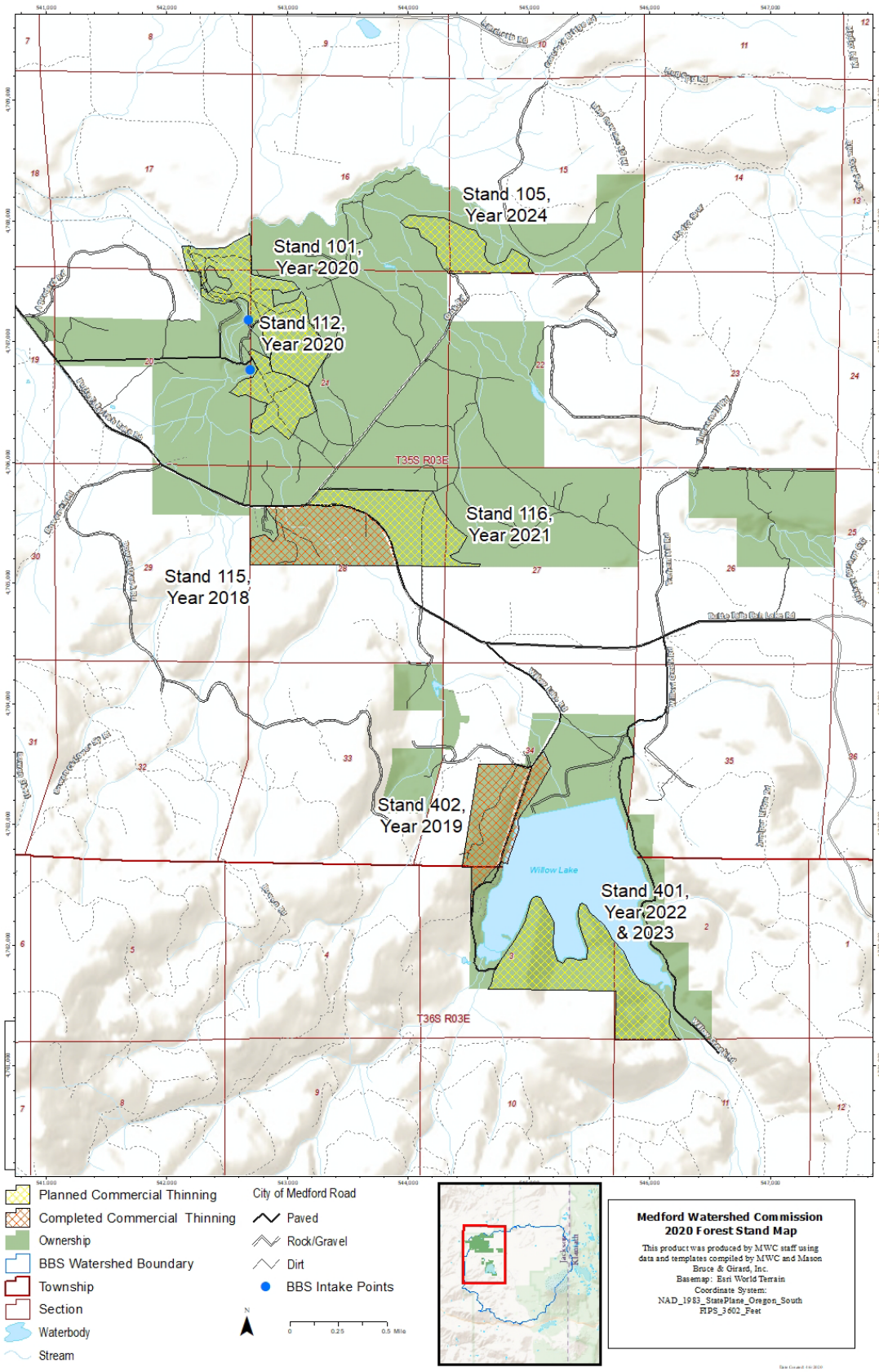


Figure 18. Map of Initial Projects and Future Implementation. Highlighted stands have already been treated or will be treated in the first five years of Plan implementation.

For the purposes of the planning process, approximately one-half of the present **standing volume** in each **stand** is considered the harvest volume. Harvest volume will be adjusted after **stand** layout, on-the-ground evaluations, and tree marking take place, but these assumptions will serve as initial guidelines for harvest planning. The **stands** prioritized for treatment in the first five-year period are summarized in Table 5 and described in further detail below.

Table 5. Commercial Thinning Priorities 2020-2024. These stands were selected based on several factors including risk of fire, forest health and trees per acres.

Year	Stand #'s	Location	Acres	Treatment Description	Risk/Priority Assessment Criteria
2020	101/112	Area around main water intake infrastructure area	100	Commercial thinning timber harvest with related post-harvest slash and fuels treatment. Harvest volume estimated at 1,000 MBF*.	Protection of critical water system infrastructure from fire and damage from falling snags and blowdown.
2021	116	Adjacent to Butte Falls/Fish Lake Highway	104	Commercial thinning timber harvest with related post-harvest slash and fuels treatment. Harvest volume estimated at 1,100 MBF.	Location adjacent to a well-traveled public road where risk of human-caused fire is high.
2022 2023	401	South end of Willow Lake	175	Commercial thinning timber harvest with related post-harvest slash and fuels treatment. Harvest volume estimated at 850 MBF/year (1700 MBF total).	Southern end of Watershed Property, bordering National Forest Land. Present lack of access for fire protection and management and high use public recreation area with high risk of human-caused fire with limited access to control.
2024	105	North end of Watershed Property	57	Commercial thinning timber harvest with related post-harvest slash and fuels treatment. Harvest volume estimated at 725 MBF.	Stand thinning and fuels treatment on an area directly adjacent to public (National Forest) and other private (primarily ranch) lands where public access is permitted and risk of human-caused fire is high.

Year 2020: **Stands** 101 and 112, 100 acres. These **stands** surround the main springs intake, maintenance, treatment and transport infrastructure. **Blowdown** is a greater concern here than other areas; therefore, management of these **stands** will focus on thinning of intermediate and **suppressed trees**, and retention of more dominant, large trees, unless they present a hazard to infrastructure. The Commission will identify and treat approximately 100 acres near the Big Butte Springs (BBS) infrastructure in 2020. The remainder of these **stands** will be treated in the 6-10 year planning horizon with other adjacent **stands**.

Year 2021: **Stand** 116, 104 acres. This **stand** meets all the criteria for a priority treatment. The standing timber volume and tree count per acre is in the top five of each category, and the **stand** is also located along Butte Falls/Fish Lake Highway. The estimated harvestable volume is 1,093 **MBF**.

Years 2022-2023: **Stand** 401, 175 acres. This **stand** lies south of Willow Lake. There is minimal road access into the **stand**. The nearest National Forest road is more than ½ mile to the south of the southern property line. The present **stand** condition, combined with the lack of access and proximity to National Forest lands, presents a fire risk both from spread of a fire from the south, and from recreational use along the lake shore. If a fire were to start within this **stand** or enter the **stand** from the south, ODF would have a difficult time accessing the area for fire suppression. The lack of a road also limits **stand** treatment opportunities and maintenance work such as maintaining the property line fence along the south boundary. There was some thinning of intermediate and **suppressed trees** (thinning from below) performed on this **stand** in 2007. That treatment was difficult and had to be performed with limited access.

A new road could be constructed into this **stand** at the southwest end of Willow Lake to facilitate thinning and fire suppression, but this will be evaluated prior to prescription development.

The harvest prescription would be like the other planned harvests but would emphasize more thinning from below and large tree retention, for aesthetic reasons, near Willow Lake. This **stand** also has some cool north slopes that will be managed as Complex Forest to retain the high-quality wildlife habitat of the area. The estimated harvest volume for this **stand** is 1,705 **MBF**. In keeping with the estimated average annual harvest target, this **stand** would be harvested over a two-year period with approximately 850 **MBF** harvested each year.

If a road is constructed it could be removed or graded for proper drainage and gated to prevent unauthorized vehicle travel after treatment. The road could provide recreational opportunities for hiking and mountain biking but would not be open to vehicle travel except for limited travel by Commission vehicles and personnel performing maintenance or monitoring duties, or for fire suppression.

Year 2024: **Stand** 105, 57 acres. This **stand** had the highest **standing volume** per acre on the watershed property at the time of the Inventory. It is located on the north end of the property and bounded by both private ranch lands and National Forest land. The surrounding vegetation type is managed pasture and hay fields as well as unmanaged and unirrigated grasslands. The grass dries in the summer and presents a significant fire risk for ignition and spread during fire season. Harvest will thin the dense **stand**, open the area to promote natural **regeneration** and development of uneven-age **stand** conditions. Aggressive **fuels** management and fewer **trees per acre** will develop a **stand** more resistant to fire spread, and more advantageous for fire control and suppression.

iii. Commercial Thinning Priorities 2025-2029

During the second 5-year planning phase (2025-2029), treatment will continue to concentrate on high priority risk areas. Priority scheduling and ordering of **stands** will be subject to revision depending on changing conditions, unplanned alteration of other **stands**, log markets and other factors. Planning beyond the first five years is necessarily a flexible process that will work toward stated goals and objectives and follow the annual harvest volume targets but will adapt to changing conditions. Monitoring, discussed in further detail below, will be implemented to determine systematic growth and changes in **fuels**, species composition, and **skips and gaps**, which will provide valuable information for adaptive management.

The general **timber harvest stand** prioritization for years 6-10 is:

Year 2025, **Stands** 101 and 112. Continue in a concentric radius pattern to treat areas around the BBS infrastructure area. The initial area near the infrastructure will be treated in 2020.

Year 2026, **Stand** 405 along the east side of Willow Lake. This will continue the process of treating high public use and recreation areas around the Lake. Parts of this area were treated with a stand-alone **fuels treatment** in 2019. By 2025, much of this **understory** will have re-grown and will need maintenance. The **stand** will have approximately 950 **MBF** of **merchantable timber**, and the **fuels** can be treated as part of a **commercial thinning** operation.

Year 2027, **Stand** 406 near the north side of the lake. This **stand** ranks second on the inventory list by volume per acre. The USFS thinned and adjacent area to the north of this **stand**. The Commission completed an **understory fuels treatment** project in 2019, but by 2027 the **understory** will be ready for follow-up maintenance treatment, the timber volume will have grown, and the **stand** will be ready for **commercial thinning**.

Year 2028, **Stand** 104. This **stand** is unique in that, while it has a high volume per acre, it does not meet other high-risk criteria. By 2028, numerous other high-risk **stands** will have been treated. This **stand** has an overstory of Ponderosa pine that appears to have been planted many years ago. The pine seedlings were from poor genetic stock, which exhibits forked tops in almost all the trees, off-color crowns and other indications of poor-quality genetics. The **understory** is very dense with a mixture of this same pine stock that is seeding in, as well as natural Douglas-fir and white fir in varying age classes from saplings to small merchantable trees. Harvest will remove most or all the overstory pine to eliminate poor genetic stock and thin the **understory** to favor a more desirable species mix and stocking. **Understory thinning** and **fuels treatment** before harvest of the overstory pine is not recommended because the **defective** overstory pine will continue to regenerate and occupy openings created by **understory** treatment.

Year 2029, **Stand** 102. This **stand** is a good candidate **stand** for harvest in 2029 due to its high volume per acre. The **stand** would respond well to a harvest treatment for stocking and species control to meet the goals and objectives.

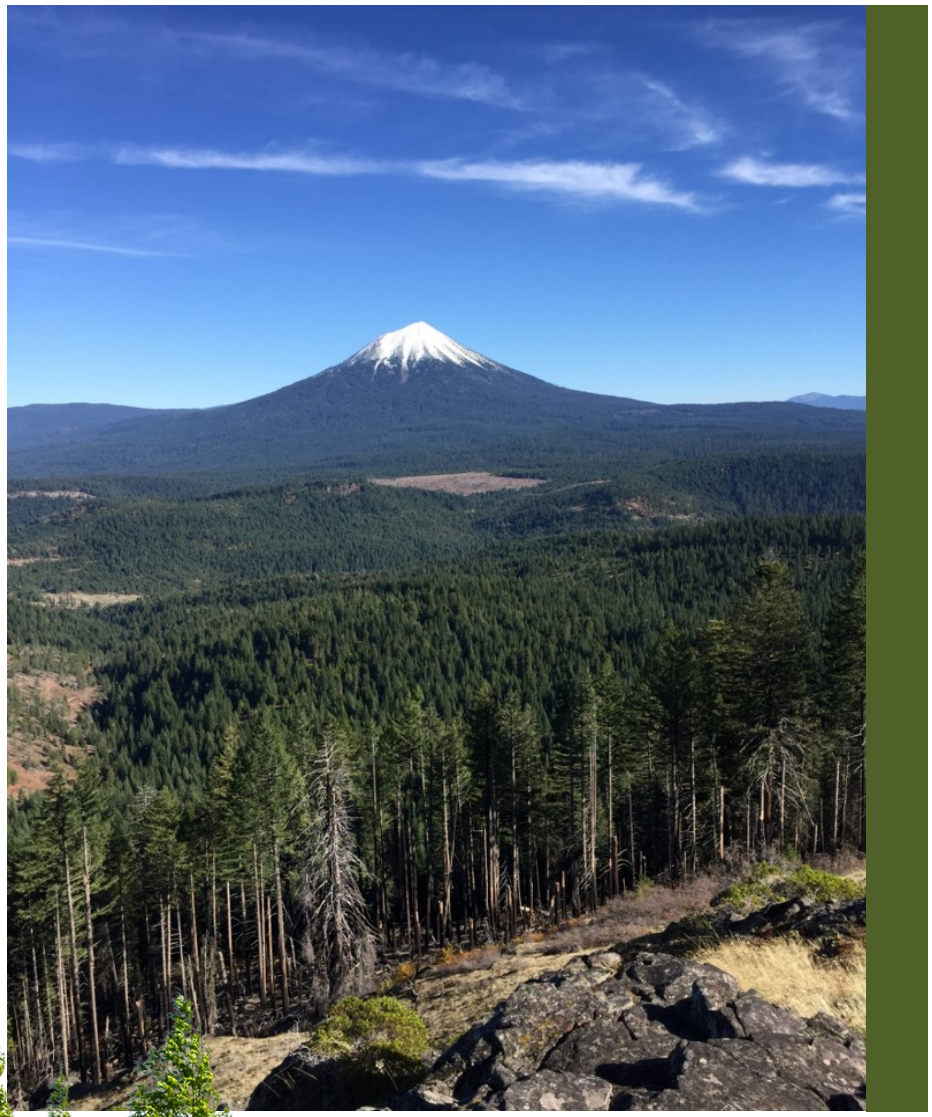
iv. Commercial Thinning Priorities 2030-2049

Commercial thinning projects will continue in years 2030-2049 and beyond to meet goals and objectives as in earlier planning periods. At the end of 2029 (Year 10 of the Plan), some **stands** that have not been treated in the initial harvest projects will be ready for harvest. Projecting harvest ready **stand** past 10 years is difficult due to variations in growth rates and other factors, but **stands** that appear to be good candidates for **commercial thinning** after 2029 are those with relatively high **Stand Density Index, Basal Area** and **Net Volume Per Acre** numbers, such as

Stands 201, 103, 108 and 503. These **stands** and others will continue to be monitored for prioritization, and a combination of commercial and **non-commercial thinning** will likely be used for most of these **stands**.

C. Non-Commercial Thinning and Fuels Treatment Priorities

The risk and priority rating system for Non-Commercial and **Fuels Treatments** is similar to that used for **Commercial Thinning**. Figure 19 on the following page shows the **stands** that were treated in 2019 and **stands** that will be treated in the first five years. The Inventory data were used to identify **stands** with high tree counts per acre of smaller size classes, which is a primary risk factor for fire.



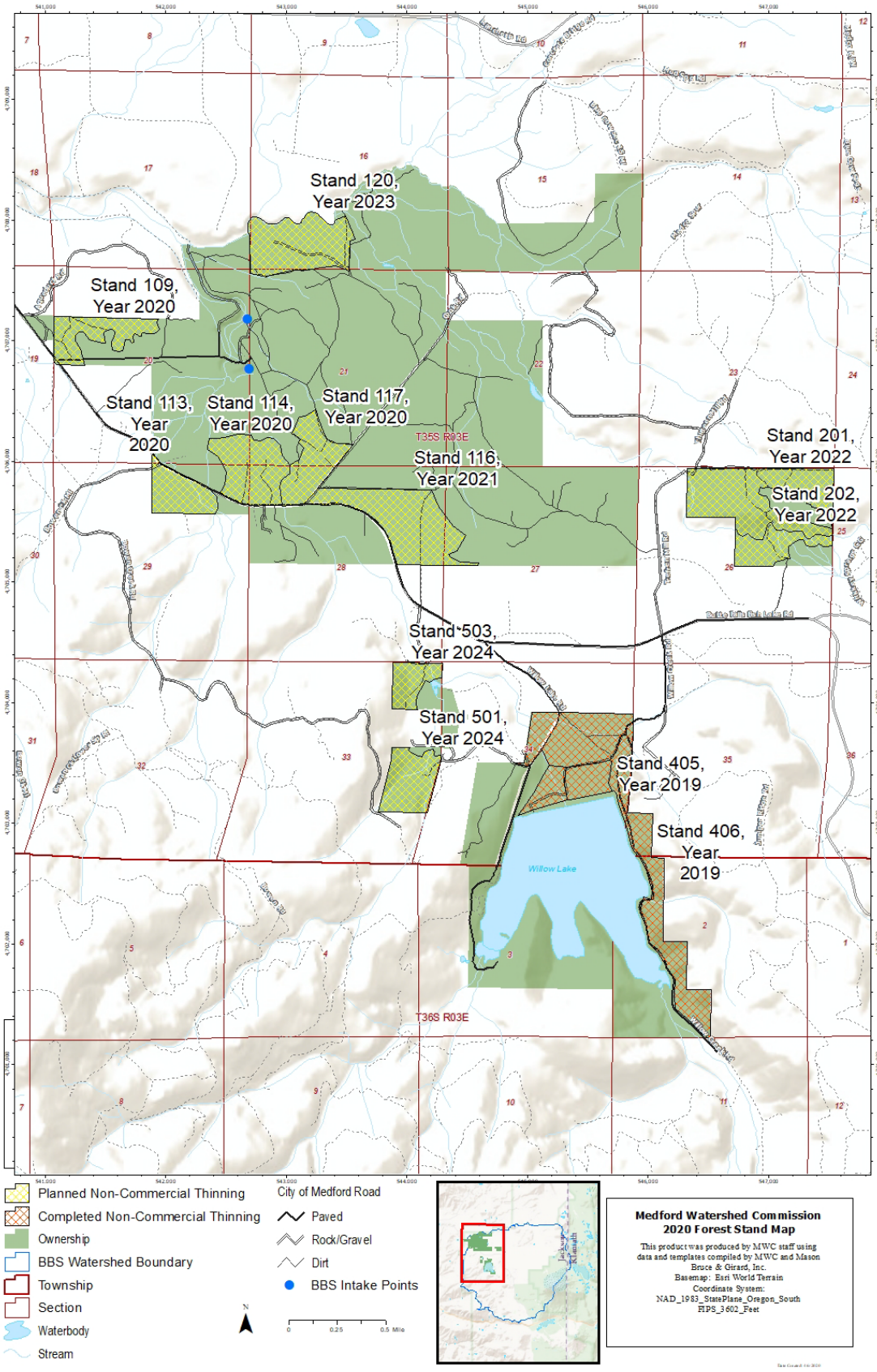


Figure 19. Map & Schedule of Near-term Non-Commercial Thinning Projects Through 2024. Highlighted stands will be treated in the order shown.

i. Prioritization and stand selection methodology

Areas with dense **understory** and overpopulation of smaller trees will be selected for stand-alone **fuels treatment** not associated with commercial **timber harvest**. **Fuels treatment** project areas may be selected based on location and risk, not completely based on inventory data or **stand** boundaries.

After **stands** are harvested follow-up **slash** treatments reduce fuel loadings, which will accomplish the fire risk reduction goal in those areas. In a few instances, **stands** slated for **commercial thinning** also have dense understories, and the follow-up treatment after harvest will include both harvest-related **slash** treatment and a component of **non-commercial thinning** and brush treatment.

ii. Stand selection for the first five years (2020-2024)

Fuels treatment projects will follow a systematic treatment schedule to cover the highest risk areas, mostly around the perimeter of the property, and/or where public access and other land ownership patterns present a risk of fire ignition and spread. Following those initial treatments (within the first five-year period) treatments will work from the perimeter of Commission property inward to protect against fire spread from neighboring properties, reduce **fuels** and use **thinning** and **fuels treatment** to work toward desired future **stand** conditions.

The **stands** prioritized for treatment in the first five-year period are summarized in Table 6 and described in further detail below.

Table 6. Non-Commercial Thinning Priorities – First Five Years of the Plan. Stands were selected primarily on fire risk and overpopulation of trees and shrubs.

Year	Stand #'s	Location	Acres	Treatment Description	Risk/Priority Assessment Criteria
2020	109, 113, 114, 117	Directly adjacent to Butte Falls/Fish Lake Road	150	Non-commercial thinning of young dense conifer patches, cutting of understory brush, lopping and scattering of cut materials and 100% disposal of slash within 100 feet of the paved public road.	High risk, directly adjacent to a paved well-traveled public road.
2021	116	Directly adjacent to Butte Falls/Fish Lake Road	104	Post-harvest slash treatment and non-commercial thinning of young dense patches of conifer understory. Lopping and scattering of slash and 100% removal of slash within 100 feet of the paved public road.	High risk, directly adjacent to a paved well-traveled public road.
2022	201/202	Eastern block of Watershed Property	132	Non-commercial thinning of young stands for stocking and species mix control.	Medium risk, surrounded by public lands that allow for open public access. Risk of human-caused fire is moderate to high.

2023	120	North end of Watershed property	75	Non-commercial thinning of young stands for stocking and species mix control	Directly adjacent to public access National Forest land where risk of human-caused fire is moderate to high.
2024	501/503	Isolated blocks at southwest portion of Watershed property.	60	Non-commercial thinning of young stands for stocking and species mix control	Surrounded by public and other private land where public access is open and risk of human-caused fire is moderate to high.

Year 2020: **Stands** 109, 113, 114, 117, 150 acres, treat the remaining **stands** along the Butte Falls/Fish Lake road where public access and travel pose the greatest exposure to human-caused fire. **Stand** 115 was treated with post-harvest **slash** disposal in 2018. **Stand** 116 is scheduled for harvest and follow-up **slash** and non-harvest related **fuels treatment** in 2021. This leaves **stands** 113, 114, 117 and the west end of **stand** 109 for treatment in a 2020 project, and portions of **Stands** 101 and 112 in association with harvest and hazard tree removal activities.

Year 2021: **Stand** 116, 104 acres. As stated, **stand** 116 will be harvested in 2021. Post-harvest treatments will include treatment of **slash** generated by logging, **non-commercial thinning** of the dense **understory stand** and **fuels treatment**.

Year 2022: **Stands** 201 and 202, 132 acres. These **stands** are separated from the main property and surrounded by USFS lands with open public access, and so are at higher risk from human-caused fire. These **stands** have a high component of white fir and ponderosa pine trees smaller than 10" **DBH**. Within the **stands** there is also a pine plantation that was planted in 2008 to replace a **stand** that was harvested to remove **root rot**. The pine plantation needs **non-commercial thinning**, so the two **stands** and the plantation will be treated as one **block**.

Year 2023: **Stand** 120, 75 acres. This **stand** is on the north end of the Watershed property, adjacent to USFS and other land where public access and use is very heavy, with a resultant high fire risk. This **stand** has a very large component of ponderosa pine advanced **regeneration** in the under-10" **DBH** classes, as well as a high component of white fir in the 10" to 12" **DBH** range. This **stand** will be non-commercially thinned.

Year 2024: **Stands** 501 and 503, 60 acres. These **stands** are isolated blocks at the southwest end of the watershed property and are adjacent to private residences. The **stands** have a heavy **understory** of advance **regeneration** in the less than 10" **DBH** classes and need **non-commercial thinning** and **fuels treatment**.

iii. Fuels Treatment Priorities, Years 6-10 (2025-2029)

Two primary areas of concern will be focused on for **fuels treatment** in 2025-2029.

The first priority is to conduct follow-up treatment as needed on **understory** vegetation in the areas around the main BBS infrastructure, in areas scheduled for harvest in 2020 and 2025, to maintain fire-safe and healthy **stand** conditions in this critical area.

The second priority is **stand** 102, as discussed in the **Commercial Thinning** section. Treatment of this **stand** will be conducted in the second five-year planning horizon, to be followed by some

intensive **thinning** and disposal of high amounts of **slash** that will be created by **thinning** activities.

Other priorities for **fuels** work will develop as the plan is implemented. Monitoring will be needed for areas treated early in the management process, as brush grows back, and advance **regeneration** begins to fill in the **understory**. Some areas will grow faster than others, and conditions will change within five to ten years, making it difficult to determine specific **stands** that will need treatment. Ongoing monitoring and assessment will determine these needs and projects will be planned accordingly.

iv. Fuels Treatment Priorities, Years 11-30 (2030-2049)

By 2030, many of the areas in need of **fuels treatment** will have been treated. Implementation in 2030-2049 will largely consist of **fuels treatment** maintenance. As time passes, areas that have been treated will begin to grow back and need treatment to maintain the conditions that were achieved by the initial treatments. As **stands** are harvested and **fuels** are treated during the first decade, the area will gradually begin to homogenize and **stand** boundaries will become less distinct. **Fuels** management activities following the initial 10-year treatment will follow periodic **timber harvest** of approximately the average annual growth rate, to reduce fuel loads and thin advanced natural **regeneration**.

D. Ecological Restoration Project Implementation

Ten potential high priority restoration projects have been identified on or near Commission land. Some of the projects will require extensive coordination with partners to plan, obtain funding, design and implement; other projects can be conducted solely by the Commission. Additional potential projects lie on neighboring properties, particularly USFS land, and the Commission may be able to collaborate with them to implement restoration projects that will help meet the Commission's goals.

Meadow restoration, riparian restoration and prescribed burns are all considered major projects. Major restoration projects will be prioritized when opportunities for implementation in conjunction with forest management activities are presented, such as forest **stands** adjacent to meadows. Others may occur as stand-alone projects. Strategies such as snag retention and **large woody debris** placement will be implemented as components of forest management activities and are not considered major projects.

The following is a list of the projects, locations of which are shown on the map in Figure 20. Projects are listed in a possible sequence of implementation, but the exact schedule will be determined based on other factors such as synergy with other projects which will result in a flexible implementation schedule. This is not a comprehensive list, rather a short list of current needs and priorities.

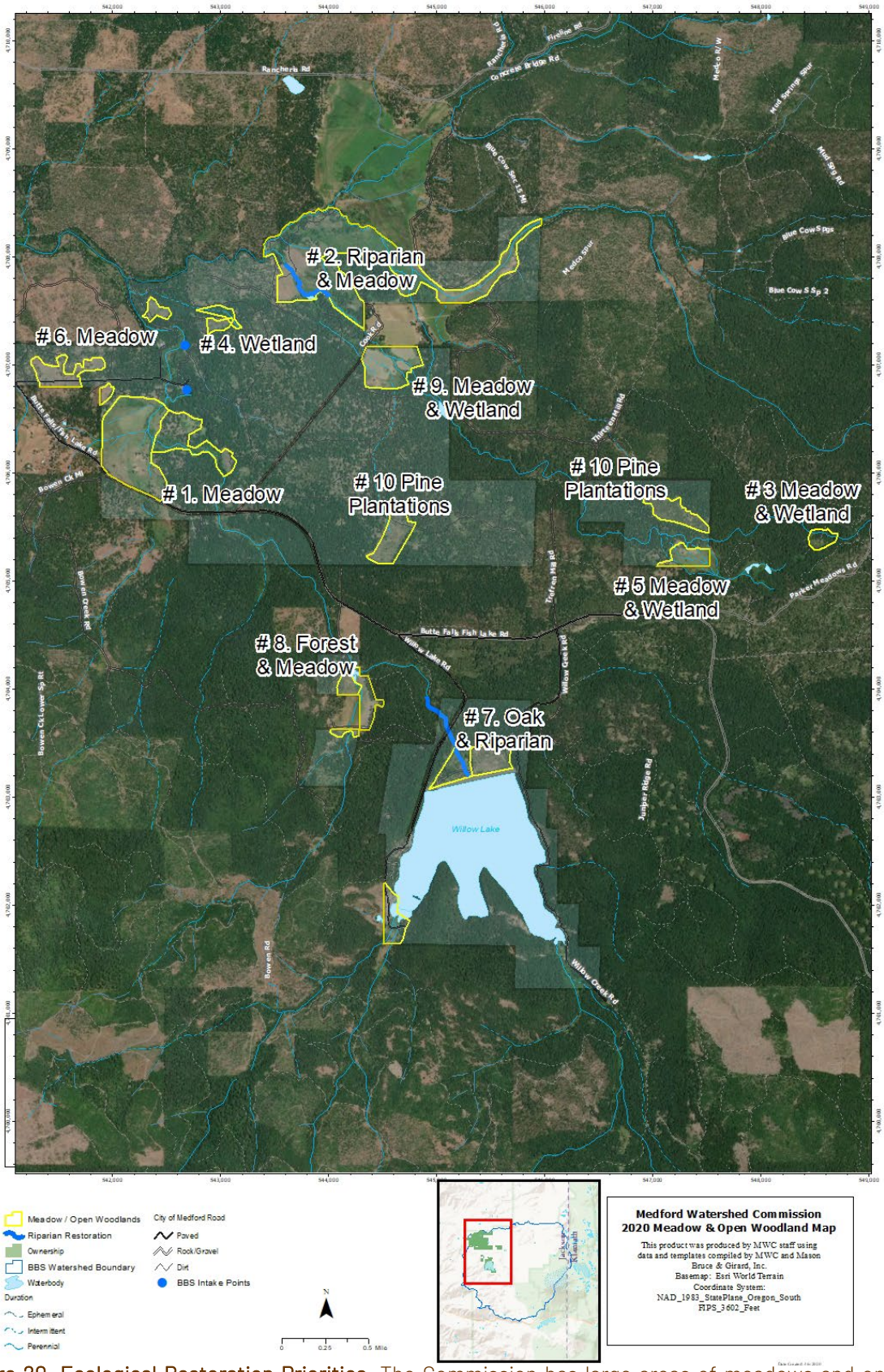


Figure 20. Ecological Restoration Priorities. The Commission has large areas of meadows and open woodlands on the property outlined in yellow. Locations of prioritized Ecological Restoration strategies labeled 1-10. Prioritized Riparian Restoration zones highlighted with dark blue lines.

1. Meadow Restoration – Wet Meadow ½ mile south of Springs complex. This large meadow is also classified as a wetland and is a very sensitive area due to the immediate proximity to the Springs. Historically, fire-maintained meadows by limiting conifer growth. Conifers are now encroaching on the meadow and should be thinned to the edge of the drier surrounding forests.

2. Riparian & Meadow Restoration – Ringer Field. Ringer Field is about one-mile ENE of the Springs. Fourbit Creek, which runs through this field, has been channelized and is deficient of riparian habitat and vegetation. Riparian planting will provide more shade on the stream and **large woody debris** placement will provide structure that could help reconnect the stream to its historic floodplain.

3. Wetland and Wet Meadow Restoration – NE of Whiskey Springs Campground on USFS land. Although this project is not on Commission land an opportunity to partner with the Forest Service and the Watershed Council has gained momentum. This small wetland directly adjacent to Fourbit Creek is severely degraded due to concentrated livestock activity. Fencing off and replanting this area would directly contribute to protecting the water quality of Fourbit Creek.

4. Wetland Enhancement – Wetland-riparian area ENE of Springs. This wetland results from springs surfacing at the location. After the 1927 Intake was constructed, a tunnel connecting this area to the Intake was dug and pipe was placed to carry additional flow to the Intake. The effectiveness of that effort is uncertain, but nonetheless the wetland and associated springs likely contribute flow to Rancheria Springs, Willow Creek and So. Fk. Big Butte Creek. This area is intact with healthy vegetation, but the Commission should carefully monitor and manage it to preserve and enhance its character and functions, including water yield.

5. Meadow Restoration – Stanley Ranch meadow. The former Stanley Ranch is immediately downstream of Whiskey Springs Campground, about 1¼ miles east of the Springs. Although generally highly functioning, defunct culverts and ditches impede the natural flow of water, the former ranch house foundation, old sheds and debris piles litter the area and some invasive weeds have taken hold. Removal of the debris, ditches and invasive weeds along with riparian planting will restore this area back to its natural state.

6. Meadow Restoration – Wet meadow along driveway into Big Butte Springs. This meadow has been channelized and is bisected by the access road. In wet years it still functions as a wetland and is often used by wetland species like Sandhill Cranes. While protecting the roadbed from inundation, this meadow could be restored to allow water to be detained and infiltrated into groundwater instead of being drained off with existing ditches. This would support baseflow into area streams later in the year.

7. Riparian and Oak Woodland Restoration – Area north of Willow Lake Dam. This area, immediately north of the dam, was originally intended to be part of the Willow Lake reservoir and the entire area was denuded of vegetation and the soil was badly disturbed in preparation for construction. Dam placement changed but the area remains sparsely vegetated, and the riparian area is devoid of shade. Riparian planting is needed to provide shade, and oaks and pine could be planted in the meadow to provide habitat.

8. Forest and Meadow Restoration – Former Church Camp. This area, about ¾ mile NW of Willow Lake, was a church camp before the Commission acquired it. The buildings have been removed, but the area is still degraded by the former development – concrete foundations, heavily compacted roads and parking areas, invasive plants, sparse vegetation and debris. The foundations, debris and invasive plants should be removed, most of the roads and parking areas removed and restored, and native vegetation reestablished to enhance the forest and meadow characteristics of the area.

9. Meadow and Wetland Restoration – NE end of Cook Rd. wet meadow – This wet meadow area is about 1¼ mile east of Big Butte Springs. Currently water is drained off the field to reduce inundation. The Commission should consider removing the drainage ditches allowing water to flow across the wet meadow. Then the surface flow in winter high precipitation and runoff events will infiltrate to groundwater and be released as baseflow later in the year.

10. Forest, Oak Woodland and Meadow Restoration – Pine Plantations. In several sites across Commission property pine plantations have been established, either to replace Doug-fir removed because of **root rot** or planted in former meadows or agricultural fields. In some instances, this was an appropriate measure, but in others it may have been unnecessary or unsuitable for the area. Each of these plantations should be carefully examined and monitored to determine the best course of action, e.g., removal of **defective** off-site stock and replanting, heavy **thinning** and replacement with gaps and sparse vegetation including **hardwoods** like oak or aspen, or re-establishment of meadows.

VIII. Monitoring

The Commission's Forest Monitoring will include monitoring for:

- Treatment Effectiveness
- Effects on Water Resources
- Forest Health
- Wildfire Risk

A systematic method of monitoring growth and yield over time should be implemented as management changes take effect. The Commission will use the permanent growth plots established during the inventory to periodically monitor and refine the growth projections. This will provide valuable information on how forest management is meeting the goals and objectives and help drive decision-making and the management direction.

Successful active management of a natural ecosystem must include a monitoring plan that evaluates the efficacy of treatments and monitors for potential unintended consequences. Given the Commission's forest management goals for source water protection, a monitoring plan is needed that incorporates more than traditional silvicultural parameters and includes forest conditions pertaining to watershed health. A forest monitoring plan will be developed that encompasses these needs and will provide qualitative and

The Commission's Forest Monitoring will include monitoring for:

- **Treatment Effectiveness**
- **Effects on Water Resources**
- **Forest Health**
- **Wildfire Risk**

quantitative content to be included in a forest management report. This report will serve as documentation of the Commission's forestry activities and used as a tool to apply adaptive management of forestry treatments.

As a continuation of the existing forest photo point monitoring program, all forest management activities will be documented by "before and after" photos taken from established photo points. Subsequent inventory reports similar to the 2019 inventory will be conducted at least every 15 years to provide a detailed property wide site assessment.

In addition to these efforts, the Commission's Watershed Department will develop an internal monitoring plan to establish baseline conditions, detect change and inform management decisions. The following outline categorizes the parameters that will be detailed in the Forest Monitoring Plan document and are reflective of the Goals, Principles and desired future conditions of the Commission's Forest Management.

1. Treatment Activities – All treatment activities will be documented and numerated by treatment type, dates, methods, goals, and outcomes.

2. Log Sales – Post harvest reports list volume of **merchantable timber**, species types and volumes, sizes and revenue. These records will be compared from harvest to harvest to evaluate pre-harvest conditions and forecast future conditions.

3. Publicly Available Information – The Commission will continue to monitor public notices, such as Notifications of Operations/Permits to Operate Power-Driven Machinery (NOAPs), which are issued by ODF and are available to interested parties. The Commission is required to notify ODF about any forest treatments, and conversely, the Commission is on a list-serve to receive NOAPs regarding forest practices on neighboring properties. The Commission will monitor these notices, as well as notices of public forest management activities, media information, conservation organization reports, and other outlets to learn of harvest activities, fires, herbicide applications, road building and maintenance and other activities that could affect Commission operations.

4. Stand Characteristics – To ensure that **commercial thinning** treatments reflect the guidelines of the forest management plan and are executed as prescribed, the standard forest **stand** metrics of **TPA**, **SDI** and species composition will be coarsely evaluated after harvests with a more detailed evaluation completed with the next 15 year inventory. Additional **stand** characteristics such as **tree density variability and tree clusters** will be included to provide metric of a **stand**'s structure.

5. Tree **Vigor** / Health – Tree **vigor** will be monitored to evaluate the growing conditions of the forest and used as metric of productivity and disease resistance. Tree health parameters may include: Percent Crown, Radial Growth and Leaf Growth Index.

6. Soil Conditions - Crucial for source water protection, soil conditions will be monitored for excessive disturbance, compaction, and erosion caused by roads, **skid trails** and logging equipment.

7. Forest Fire **Fuels –** Given the risks associated with fire and the potential for **slash** from forest management to elevate these risks, the monitoring of the **fuels** load in the forest is critical to protecting source water. Important **fuels** parameters to be monitored

include **stand fuels** classification, packing ratio, moisture content and crown base height.

8. **Invasive Species** – Given the potential for the spread of invasive and noxious weeds during management activities, and the habitat degradation and fire risk they pose, the monitoring for invasive species of concern such as scotch broom will be included in the Forest Monitoring plan.

9. **Wildlife Habitat** – Given the management principle to protect and improve wildlife habitat, parameters such as snag, **defect** and **Large woody debris** retention will be monitored.

10. **Pest and Disease** – Infestations of pests and disease such as bark beetle or **root rot** have significant implications on forest management. Pest and disease monitoring will be included in the monitoring plan to prevent widespread damage and adapt management.

11. **Residual Tree Damage** – Negative impacts from mechanical treatments and **slash** management will be monitored and used to improve subsequent treatment techniques. Common impacts to **residual trees** include damage to **residual trees**, excessive **blowdown,** and tree scorch from pile burns or prescribed under burns.

IX. Partnerships and Outreach

The Commission places great value on partnerships, public involvement and input to its Forest Management Program. Participation of the community and knowledge of the Commission's approach to forest management promotes successful management and understanding of the benefits of active forest management for drinking water source protection.

The Commission works closely with the Rogue River Watershed Council and The Freshwater Trust on stream restoration projects in the upper Rogue and BBS Watershed, and works with the Jackson Soil & Water Conservation District on agricultural best management practices, and water quality and education projects. The Commission also works with the Rogue Drinking Water Partnership, the Rogue Valley Council of Governments, the Rogue Basin Partnership and others on water quality-related projects.

The Commission additionally collaborates with partners like the USFS, SOFRC, and Blue Forest Conservation to seek grants and other resources to support ecological forestry in the Big Butte Springs Watershed and other areas in the Rogue River Basin. The Commission has applied directly for grants and provided letters of support and in-kind and cash match for partners. Highlights of recent examples of collaboration include the following:

- Provided logs and root wads for a streambank and instream restoration project on lower Elk Creek by the Rogue River Watershed Council.
- Submitted a proposal to the US Forest Service Innovative Financing for National Forests grant program in partnership with SOFRC and Blue Forest Conservation to establish a Forest Resiliency Bond project in the Rogue Basin to provide alternative funding for forest **thinning** on USFS land and neighboring properties in the Big Butte Creek watershed.
- Supported a grant proposal to the Collaborative Forest Landscape Restoration Program (CFLRP), in collaboration with the USFS, BLM and the Rogue Forest Restoration Initiative, to conduct extensive forest **thinning** projects, similar to the recent work

done in the Ashland municipal watershed, on eight to ten large projects throughout the middle and upper Rogue areas (approx. 20,000 acres in Big Butte Springs watershed; 150,000 acres total). CFLRP is for $40 million over a 10-year period.

- Participated on the Oregon Governor's Council on Wildfire Response, Suppression Committee. The Committee was one of three that developed recommendations that comprised the Wildfire Council's *Report and Recommendations* to the Governor in 2019. Draft legislation to address wildfire response is being proposed in the Oregon Legislature.
- Submitted a letter to the Oregon Dept. of Forestry encouraging adoption of the Western Oregon Riparian **Buffers** to streams in the Siskiyou Region of southern Oregon. As of early 2020, riparian setbacks on forested land in the Siskiyous are narrower than **buffers** in the rest of western Oregon.

Although the Commission property is generally off limits to the public, the Commission sponsors numerous opportunities for the public to view its property and view its forest management operations. Every year the Commission hosts two public tours of the Robert A. Duff Water Treatment Plant and the Big Butte Springs watershed. These are bus tours and are attended by dozens of citizens each year. The Commission also hosts academic classes and other tours of the Springs. These tours are often co-hosted with conservation or forestry organizations like the Rogue River Watershed Council, Southern Oregon Land Conservancy, Oregon Small Woodlands Association and Southern Oregon Forest Collaborative. The Commission has also lead tours of timber industry companies and customers like homebuilders, construction suppliers and local mills. A photograph of timber product purchasers is shown in Figure 21. Some mills are certified to Sustainable Forestry Initiative (SFI) standards for "Fiber Sourcing" and "Chain of Custody," which ensures that the National Association of State Foresters Best Management Practices (BMPs) are followed. The Commission forests exceed those standards.

Figure 21. Public Tour of Timber Harvest Area. Timber product customers at Willow Lake in November 2019 witnessing Commission forestry BMPs. Some timber product customers care about the sourcing of wood that is purchased.

X. Summary and Future Opportunities

One of the most important ways to ensure water quality and quantity is through careful and strategic forest management. This Forest Management Plan outlines a clear strategy for forest management well into the future, which will help protect the high quality and quantity of water from Big Butte Springs.

Studies show that forest **thinning** increases water yield from watersheds by decreasing evapotranspiration from trees and allows more precipitation to reach the forest floor and infiltrate to groundwater, which is anticipated to increase the yield of the Commission's springs. The forest inventory estimated that the Commission had approximately 40 million **board feet** of **merchantable timber** in 2019, and, barring any major disturbances like widespread fire or **timber harvest**, the total will be 60 million **board feet** by 2050. Comparing these conditions to the SOFRC reference conditions of a healthy forest highlights the need for active management to prevent over-crowding, die-off, insect infestation and catastrophic fire. This management plan describes a continuous program of **fuels treatment**, commercial and **non-commercial thinning**, and other restoration and protection measures designed to protect water quality and quantity to achieve the Commission's goals.

Climate change is affecting forests throughout the West, including the BBS Watershed. Snowpacks are shrinking, tree species composition is shifting, and fires are becoming larger and more frequent. The Commission will carefully monitor climate change's effects on its forests and other resources and will manage appropriately and adaptively.

Partnerships are essential for the Commission to meet its goals. The U.S. Forest Service owns 75% of the BBS Watershed, and private timber owns another 17%. The Commission will continue to work closely with the Forest Service, will collaborate openly and frequently with private timber, and will support the work of natural resource agencies and conservation groups like the Southern Oregon Forest Restoration Collaborative, Rogue River Watershed Council, The Freshwater Trust and Blue Forest Conservation. The Commission will also explore new initiatives like Forest Resiliency Bonds (alternative source of funding for forest management), Carbon Credits (under a cap and trade scenario or other framework), and Forest Certification, e.g., Forest Stewardship Council or Programme for the Endorsement of Forest Certification.

XI. Appendices

Appendix A. Sensitive Wildlife and Plant Species Found in the BBS Watershed

Some of the species shown below are listed under the Endangered Species Act, but most are sensitive indicator species. Presence of resilient, healthy populations of a diverse set of species indicates watershed health.

Sensitive Wildlife and Plants in the BBS Watershed (Species Names)
Endangered Species
Gray Wolf (*Canis lupus familiaris)*
Threatened Species
Northern spotted owl (*Strix occidentalis caurina)*
Oregon spotted frog (*Rana pretiosa)*
Pacific fisher (*Martes pennant*)
Franklin's bumble bee (*Bombus franklini)*
Forest Service Sensitive Species
Sierra Nevada red fox (*Vulpes vulpes necator*)
Wolverine (*Gulo gulo)*
American marten (*Martes americana*)
American Pika (*Ochotona princeps)*
Ringtail (*Bassariscus astutus)*
Beaver (*Castor anadensis)*
Fringed Myotis (*Myotis thysanodes)*
Long-legged Myotis (*Myotis volans)*
Hoary Bat (*Lasiurus cinereus)*
Pacific pallid bat (*Antrozous pallidus pacificus)*
Silver-haired Bat (*Lasionycteris noctivagans)*
Townsend's big-eared bat (*Corynorhinus townsendii)*
Pacific fringe-tailed bat (*Myotis thysanodes vespertinus)*
Bull Trout (*Salvelinus confluentus)*
Coho Salmon (*Oncorhynchus kisutch*)
Spring and Fall-run Chinook Salmon (*Oncorhynchus tshawytscha*)
Steelhead – Summer and Winter-run (*Onchorhynchus mykiss*)
Pacific Lamprey (*Entosphenus trudentatus*)
Northern bald eagle (*Haliaeetus leucocephalus)*
American peregrine falcon (*Falco peregrinus*)
Northern waterthrush (*Parkesia noveboracensis*)
Northern Goshawk (*Accipiter gentilis*)
Lewis' woodpecker (*Melanerpes lewis*)
White-headed woodpecker (*Picoides albolarvatus*)
Greater Sandhill Crane (*Grus canadensis)*
Olive-sided Flycatcher (*Contopus cooperi)*
Foothill yellow-legged frog (*Rana boylii*)
Western pond turtle (*Actinemys marmorata*)
California Mountain Kingsnake (*Lampropeltis zonata*)
Cascades Frog (*Rana Cascadae*)

Sensitive Wildlife and Plants in the BBS Watershed (Species Names)
Northern Red-legged Frog (*Rana aurora*)
Western Toad (*Anaxyrus boreas*)
Evening fieldslug (*Deroceras hesperium*)
Oregon shoulderband (*Helminthoglypta hertleini*)
Traveling sideband (*Monadenia fidelis celeuthia*)
Crater Lake tightcoil (*Pristiloma arcticum crateris*)
Siskiyou Hesperian (*Vespericola sierranus*)
Johnson's hairstreak (*Callophrys johnsoni*)
Western bumble bee (*Bombus occidentalis*)
Gray blue butterfly (*Agriades podarce*)
Monarch Butterfly (*Danaus plexippus*)
Coronis fritillary (*Speyeria coronis*)
Siskiyou short-horned grasshopper (*Chloealtis aspasma*)
Howell's false-caraway (*Periderdia howelli*)
Pygmy monkeyflower (*Mimulus pygmaeus*)
Clustered lady's slipper (*Cypripedium fasciculatum*)
Green-flowered ginger (*Asarum wagneri*)
Mt. Mazama collomia (*Collomia mazama*)
Delting's microseris (*Micoseris laciniata ssp. detlingii*)
Mountain lady's slipper (*Cyripedium montanum*)
Ground rose (*Rosa spithamea* var. *spithamea*)
Forest Service Indicator Species
Roosevelt elk (*Cervus canadensis roosevelti*)
Black tailed deer (*Odocoileus hemionus columbianus*)
Red tree vole (*Arborimus longicaudus*)
Osprey (*Pandion haliaetus*)
Great gray owl (*Strix nebulosi*)
Pileated woodpecker (*Dryocopus pileatus*)
Hairy woodpecker (*Leuconotopicus villosus*)
Downy woodpecker (*Picoides pubescens*)
Northern flicker (*Colaptes auratus*)
Chace sideband (*Monadenia chaceana*)
Crater Lake tightcoil (*Pristiloma arcticum crateris*)

Appendix B. BBS Watershed Forest Inventory Report, Mason, Bruce & Girard, Inc. and Excerpts of Early Action Forest Management Projects – 2018-2020

Big Butte Springs Watershed Forest Inventory Report

Prepared for:
Medford Water Commission

Prepared by:
Jason Dorn

March 5, 2019

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Big Butte Springs Watershed
Forest Inventory Report

1.0 Executive Summary

The Inventory and Biometrics Group (I&B) within Mason, Bruce & Girard (MB&G) was asked to design and execute a timber cruise on lands owned by the City of Medford and managed by the Medford Water Commission. The land base contributes to the city's municipal water supply and is referred to as the "Big Butte Springs Watershed." The purpose of this cruise was to establish a baseline forest inventory for forest management and long-term planning being conducted by MB&G foresters. MB&G handled the cruise design, layout, check cruising, and data management associated with the cruise. The cruise data collection was sub-contracted out to JM Forestry, of Etna, CA.

All commercial forest stands seen as having the potential for beneficial management activities over the next 5-10 years were cruised. The total net volume on all cruised stands is an estimated 38,781 thousand board feet (MBF), ±6.5% at the 95% confidence interval. This volume was calculated for net acres only, which excludes riparian management zones, and road buffers.

2.0 Cruise Overview

A total of 26 stands were selected for the cruise. In each stand, a systematic grid of plots with a random starting point was mapped within the net acres only. Net acres were calculated by buffering known streams and roads and removing those acres from the total gross acres of the stand. Road buffers range from 12-25' across the ownership, depending on road type and usage. All streams have a 100' buffer, regardless of fish presence.

A total of 422 plots were measured across the 26 cruise stands, covering approximately 2,310 acres. Three plots were not measured due to the plot location being outside of the cruise stand (this happens when mapped stands and actual forest cover do not perfectly align). Plots were assigned to stands based on the perceived degree of variation within each stand, using an assumed coefficient of variation and desired confidence interval. The total number of plots in some stands was then adjusted to achieve more reasonable plot spacing and consistency between stands. The average plot intensity across the entire cruise was approximately 1:5 (one plot per every five acres) but ranged from 1:1.5 to 1:9.5. A summary of plot intensity by stand is provided in Table 1., along with other stand details. Maps for each individual cruise stand can be found in Appendix A.

Each cruise plot consisted of a variable radius plot and nested fixed radius plot. Trees with diameter at breast height (DBH) of 4.6" and larger were cruised on the variable radius plot, using a basal area factor (BAF) selected by the cruiser based on overstory conditions and

current stocking levels observed in each stand. Trees with DBH of 4.5" and less were cruised on the fixed radius plot. A fixed plot with radius of 11.78' was used in every stand, which equates to a total plot area of 1/100th of an acre. Only trees taller than breast height were tallied.

A standard set of tree measurements was recorded for all trees on the cruise, with the purpose of developing statistically sound estimates of common stand metrics, including basal area per acre, trees per acre, and board foot volume per acre, among others. Site tree data was collected, along with current 5- and 10-year growth data. The complete set of cruise procedures can be found in Appendix B.

Table 1. Summary of cruise stands

Stand ID	Net Acres	Planned Cruise Plots	Plot Intensity (ac/plot)	BAF Used	Avg. Trees/Plot (var. radius)
101	98.7	16	6.2	27.78	4.8
102	156.0	17	9.2	33.61	5.2
103	81.9	15	5.5	27.78	6.5
104	23.4	15	1.6	33.61	4.9
105	56.7	12	4.7	33.61	5.4
106	54.3	12	4.5	20.00	5.1
107	46.1	13	3.5	20.00	4.9
108	61.2	15	4.1	40.00	4.5
109	46.1	15	3.1	33.61	3.9
112	52.0	15	3.5	33.61	5.5
113	32.3	12	2.7	27.78	4.5
114	61.3	18	3.4	27.78	5.3
115	99.5	15	6.6	27.78	5.3
116	104.2	14	7.4	27.78	5.4
117	49.4	15	3.3	33.61	3.9
118	217.6	23	9.5	27.78	4.9
119	385.8	40	9.6	33.61	3.5
120	75.4	20	3.8	20.00	3.6
201	110.4	15	7.4	33.61	5.1
202	22.0	9	2.4	27.78	5.2
401	174.7	23	7.6	33.61	5.7
402	97.0	15	6.5	20.00	5.6
405	93.4	19	4.9	33.61	5.4
406	60.2	15	4.0	33.61	6.1
501	35.5	15	2.4	33.61	3.6
503	24.1	12	2.0	33.61	4.9

3.0 Quality Assurance/Control

Quality assurance and control (QA/QC) measures are taken to ensure that a certain level of quality is maintained in both the data collection procedures, and the data itself. Two primary forms of QA/QC were employed on this cruise. First, checks are performed on all incoming data prior to any compilation. Checks on data involve looking for errant measurements, incomplete tree records, and proper use of codes. This is done through a combination of automated checks in an Access database, and manual checks by an inventory analyst and/or cruise manager. The second QA/QC process is to conduct plot audits, which is commonly referred to as "check cruising." While data checks are used to ensure that all incoming tree data is "clean," they do not necessarily tell the cruise manager whether data was collected properly, which is where check cruising becomes valuable. During a check cruise, the auditor will visit plots and attempt to re-create the cruiser's measurements. Tolerances are provided for most measurements on the cruise; if the cruiser's and auditor's measurements do not match up, these tolerances are used to determine the acceptability of the variance. Differences in measurements are common, but differences that are repeatedly found to be outside of a given tolerance indicate an issue with the cruising work that must be corrected. The check cruising procedures and tolerances used for this cruise are described in the cruise procedures manual found in Appendix B.

Approximately 5% of the plots on this cruise were audited, all by MB&G forester Mike Delegan. Cruisers were asked to re-work one stand with a smaller BAF, in order to collect more cruise trees, and some plots were re-visited for the purpose of collecting more site tree or growth data. In general, however, no significant issues with the cruising work were noted.

4.0 Cruise Data Analysis and Volumes

Cruise data was compiled using MBGTools version 20190211. A list of key stand-level metrics for all cruise stands is found in Table 2, and property-level roll-up of all volume can be found in Table 3. Volume was calculated using the following merchandizing specifications:

- Stump height of 1 foot
- Allowable Trim of 8 inches
- Nominal log length of 32 feet
- Minimum log length of 16 feet
- Minimum small end diameter (inside bark) of 6 inches
- Minimum merchantable DBH of 10 inches
- Hidden defect of 5%
- Scribner Long Log Board Foot Volume Rule
- SIS Taper Equations

Big Butte Springs Watershed
Forest inventory Report

Table 2. Cruise stands

Block	Stand ID	Net Acres	Trees per Acre	Basal Area (ft^2/ac)	Stand Density Index	Site Index	Net Vol/Ac (Bd. Ft.)	Total MBF
A	101	98.7	208	135.4	240	67	18,801	1,855.3
A	102	156.0	593	180.7	372	65	21,379	3,335.1
A	103	81.9	350	184.3	340	72	19,096	1,563.3
A	104	23.4	446	169.2	333	55	16,809	393.6
A	105	56.7	194	202.0	326	62	25,474	1,445.0
A	106	54.3	209	102.6	192	74	7,064	383.8
A	107	46.1	266	100.9	199	68	5,151	237.2
A	108	61.2	276	180.0	319	55	19,306	1,180.6
A	109	46.1	88	132.5	199	66	14,358	661.8
A	112	52.0	240	186.7	319	72	23,331	1,213.0
A	113	32.3	262	127.0	238	62	13,016	420.7
A	114	61.3	344	150.8	289	61	14,912	913.7
A	115	99.5	135	146.4	234	74	16,936	1,685.5
A	116	104.2	611	154.8	330	71	20,973	2,186.2
A	117	49.4	274	132.9	250	74	15,404	760.3
A	118	217.6	458	139.8	287	71	14,268	3,104.8
A	119	385.8	161	117.9	204	69	14,024	5,411.0
A	120	75.4	170	72.6	140	50	3,670	276.5
B	201	110.4	353	174.4	326	63	17,917	1,977.2
B	202	22.0	205	146.6	255	71	16,968	373.5
D	401	174.7	236	192.7	326	74	19,525	3,410.4
D	402	92.3	377	134.2	268	70	19,907	1,837.0
D	405	93.4	300	184.4	330	70	20,463	1,910.4
D	406	56.0	371	216.8	392	69	25,465	1,425.3
E	501	35.5	378	126.4	255	47	11,313	401.2
E	503	24.1	407	167.8	325	70	17,395	418.5

Table 3. Property-wide volume

DBH Class (in.)	Douglas-fir MBF	White fir MBF	Ponderosa pine MBF	Sugar pine MBF	Incense cedar MBF	Other spp. MBF	All Species MBF
10-16	2,901.7	589.0	839.8	-	185.8	18.3	4,534.6
16-22	5,272.1	805.9	2,120.4	15.9	387.6	70.4	8,672.3
22-28	6,135.7	990.1	3,823.6	42.8	348.7	39.1	11,379.9
28-34	3,941.0	599.4	3,604.1	13.7	253.5	-	8,411.7
34-40	1,551.3	90.9	1,818.3	124.0	108.7	-	3,693.1
>40	976.2	53.2	445.2	404.7	210.0	-	2,089.3
Total	**20,777.9**	**3,128.5**	**12,651.4**	**601.1**	**1,494.3**	**127.7**	**38,780.9**

Individual stand reports can be found in Appendix C.

5.0 Cruise Statistics

The forest inventory approach used here relies on sampling techniques to arrive at an *estimation* of the current stocking and volume at the stand level. As a result of the sampling techniques used, the presentation of stand level estimates must be accompanied by statements about the variability and uncertainty surrounding them. Stand level estimates are also aggregated at the cruise, or property level; we can calculate and report variability and uncertainty here, as well. Statistical statements related to inventory estimates are typically based on net volume.

As stated in the Executive Summary section of this report, we estimate that the Big Butte Springs Watershed currently has a total net volume of 38,781 MBF, +/-6.5%, at the 95% confidence interval. Our estimate of the average board foot volume per acre across the watershed is 16,788; this estimate ranges from 15,690 to 17,887 BdFt/ac, at the 95% confidence interval. Stand level estimates were calculated at the 80% confidence interval, and variability of board foot volume per acre ranges from +/-12% to +/-33%.

The degree of variability seen in an estimate of forest inventory is based on the sampling method or cruise design used, and the inherent variability of the stands being measured. In the case of the Big Butte Springs Watershed, variability within stands is perhaps the greatest contributor to the variability of the results presented here.

6.0 Site Index and Growth

The cruise design called for a minimum of five Site Index and growth sample trees to be measured in all cruise stands. This was not possible in every stand however, as current stand conditions posed challenges to finding good candidate site trees. We were able to collect a total of 106 site trees and 126 growth sample trees, providing us with site index estimates for 25 of the 26 total cruise stands, as well as incremental growth estimates for the entire property.

Site Index was calculated from site tree data using Dunning and Reineke's (1933) equations, simply referred to as "Dunning's Site Index." Dunning's Site Index provides us with a 50-year base age value and can be calculated across a mix of Douglas-fir, Ponderosa pine, and white fir, using tree height and breast height age. Table 4. provides a summary of the expressed site index observed across the watershed. Dunning's Site Index spans a range of values from a low of approximately 25 feet to a high value of approximately 110 feet. Most of the acres on the watershed fall in the middle-to-high end of the mid-range values, or what would commonly be considered "Site II" or "Site III." It is important to recognize that these expressed values are influenced by current stand conditions, and that carefully-planned management activities over time could effectively improve these values.

Table 4. Net Acres and Volume by Site Class

Site Index Group	Net Acres	Total MBF	DF	WF	PP	SP	IC	Other
<50	35	401	194	7	111	22	62	5
50-60	160	1,851	706	261	769	-	114	-
60-70	1,049	17,682	8,352	1,418	6,866	136	898	13
70-80	1,065	18,847	11,526	1,442	4,905	443	420	110
Total	**2,310**	**38,781**	**20,778**	**3,129**	**12,651**	**601**	**1,494**	**128**

Incremental growth was measured on all site trees. An additional 20 growth sample trees were measured that did not meet site tree requirements but were still sound enough for collecting growth data. For each growth sample tree, both 5- and 10-year growth was measured, to the 1/10th-inch. From the measurements taken, we estimate that annual diameter growth over the previous ten years (2008-2018), averaged approximately 0.17 in/year across the watershed, while growth over the past five years (2013-2018) averaged just over 0.16 in/year. The difference in these rates indicates a small, but noticeable slowing trend in diameter growth.

In addition to the growth calculations obtained from cruise data, we have also used the Inland California and Southern Cascades (CA) Variant of the USFS Forest Vegetation Simulator (FVS) to grow the inventory over a 100-year planning horizon. We have used the growth results from FVS to derive the annual growth rates shown in Table 5. Similar to what was observed with the diameter growth measured, FVS volume growth shows a slowing trend over time. When considering the growth rates presented in this table, it is important to keep in mind that the model is intended to mimic the behavior of the stands as they respond to natural processes only, using the current inventory as a baseline. No management activities are considered in this type of analysis. Management activities should, over time, result in an improvement in the average growth observed across the watershed. Obtaining a new forest inventory at some point in the future is the best means by which to observe and quantify this effect.

Over the next ten growth cycles, the average volume growth rate across the Big Butte Springs Watershed is projected to be approximately 1.5%. Individual stand growth rates across this same time period range from -0.3% to 6.5%, in any given year (negative rates occur when mortality exceeds growth during a single period).

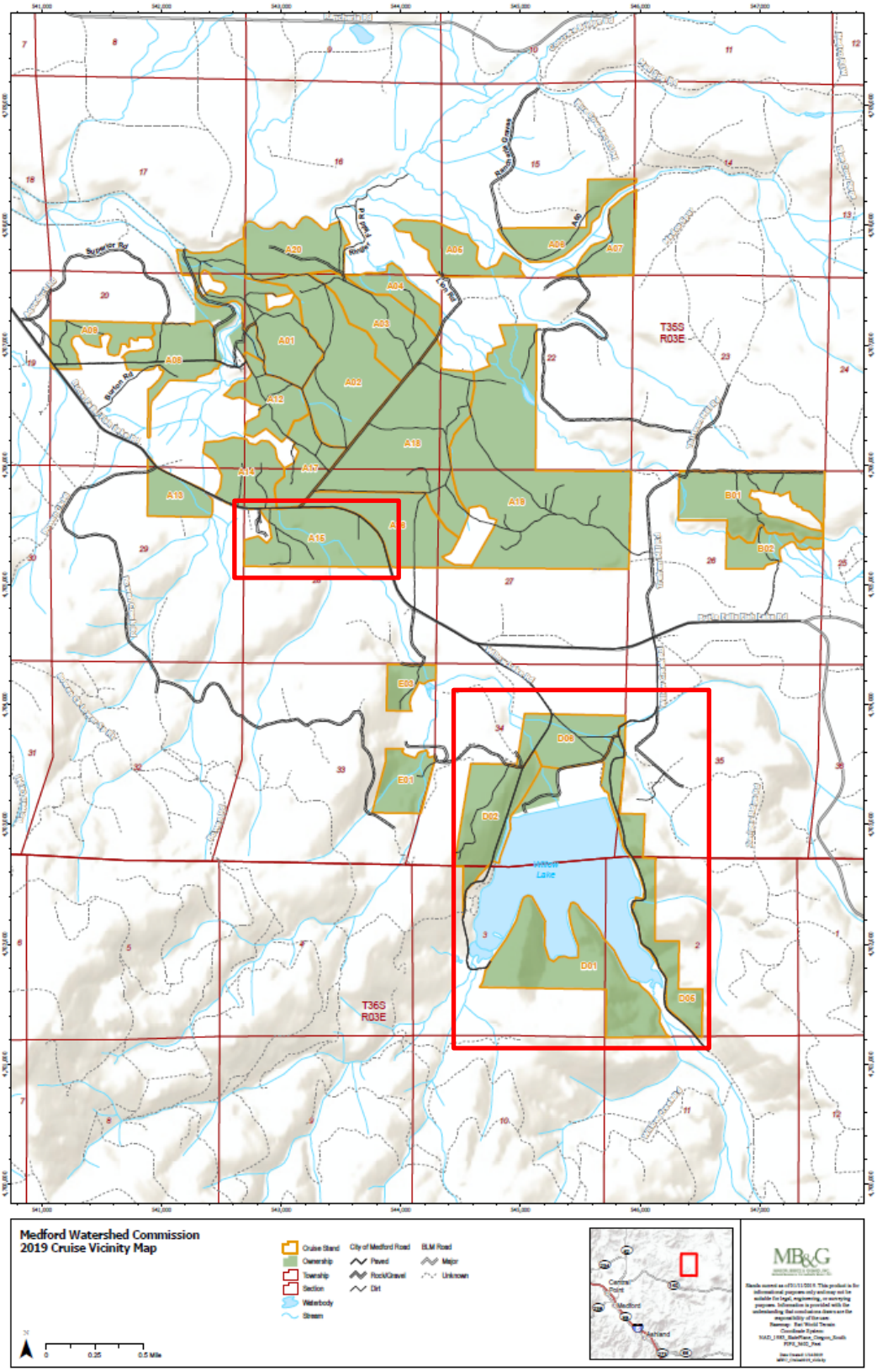
Table 5. FVS-CA 100-year growth outlook

Year	MBF	PAI (bdft/ac)	% Growth
2018	38,781	*n/a*	*n/a*
2019	39,542	329	2.0%
2020	40,086	235	1.4%
2021	40,690	261	1.5%
2022	41,308	268	1.5%
2023	41,830	226	1.3%
2024	42,587	328	1.8%
2025	43,253	288	1.6%
2026	43,862	264	1.4%
2027	44,483	269	1.4%
2028	45,089	262	1.4%
2038	51,852	293	1.5%
2048	59,238	320	1.4%
2058	66,547	316	1.2%
2068	73,497	301	1.0%
2078	80,026	283	0.9%
2088	85,425	234	0.7%
2098	90,625	225	0.6%
2108	94,822	182	0.5%
2118	98,770	171	0.4%

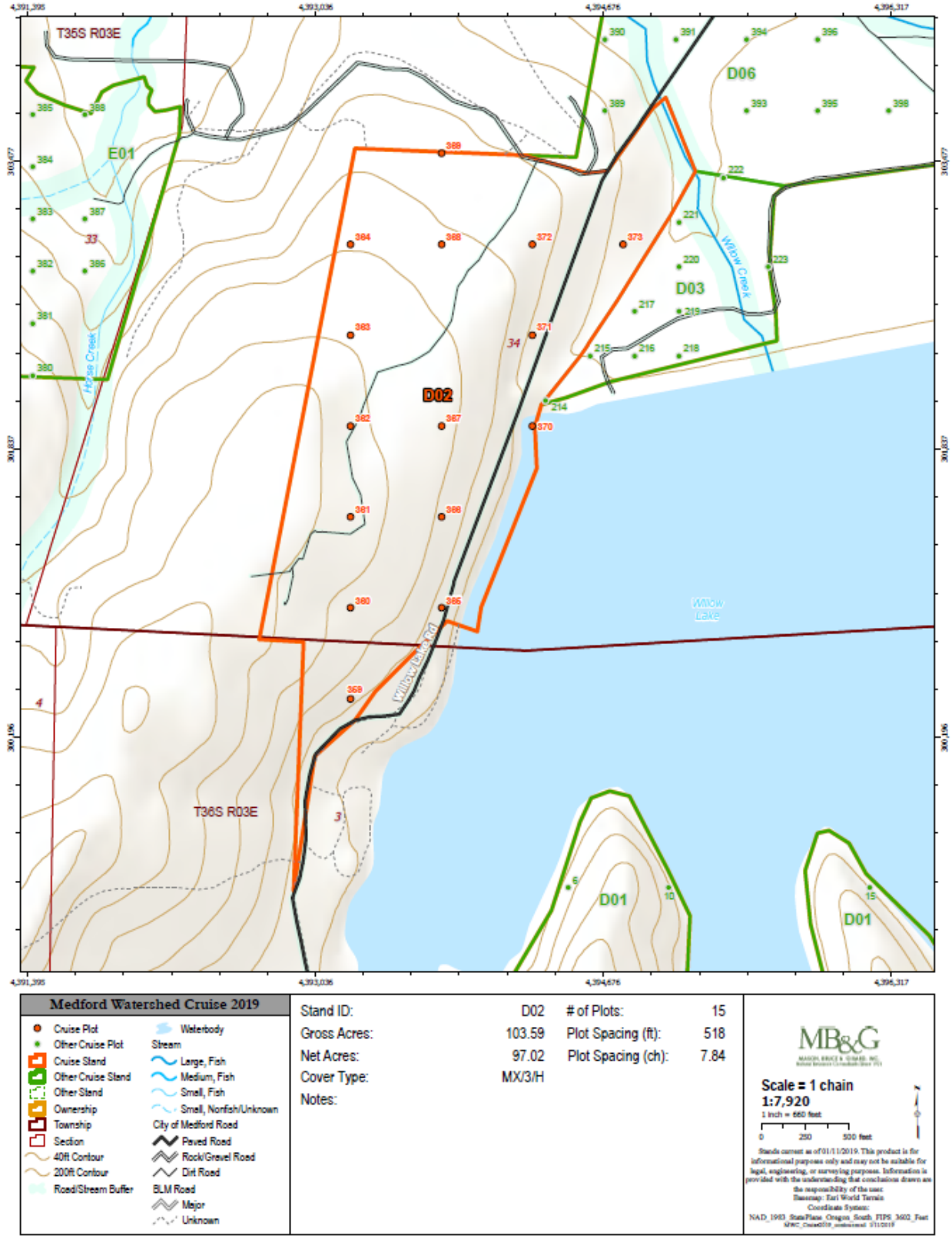
7.0 References

Dunning, Duncan, and Reineke, L.H. 1933. Preliminary Yield Tables for Second Growth Stands in the California Pine Region. U.S. Department of Agriculture, technical Bulletin No. 354. 23p.

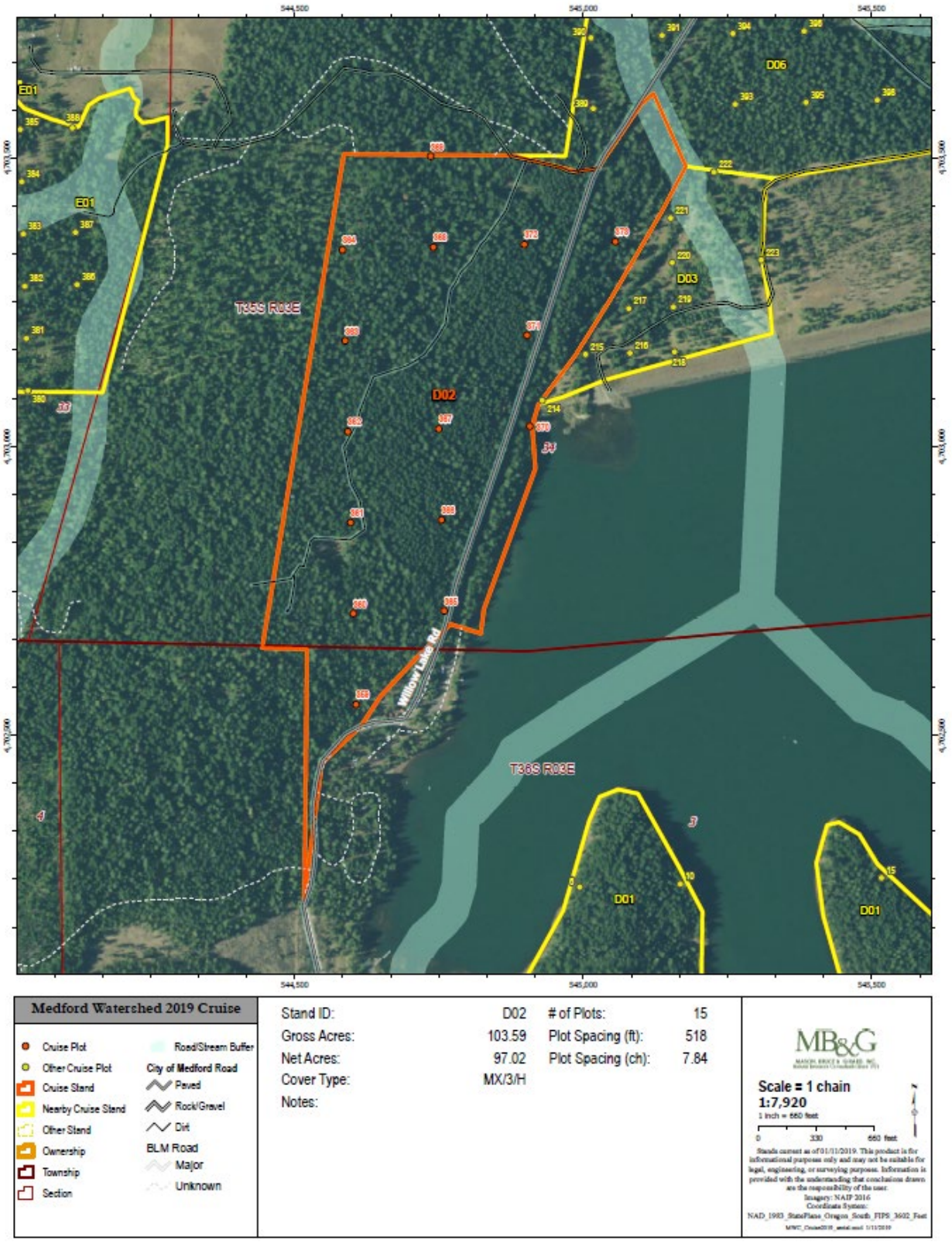
Keyser, Chad E. comp. 2008 (revised May 9, 2012). Inland California and Southern Cascades (CA) Variant Overview – Forest Vegetation Simulator. Internal Rep. Fort Collins, CO: U. S. Department of Agriculture, Forest Service, Forest Management Service Center. 56p.



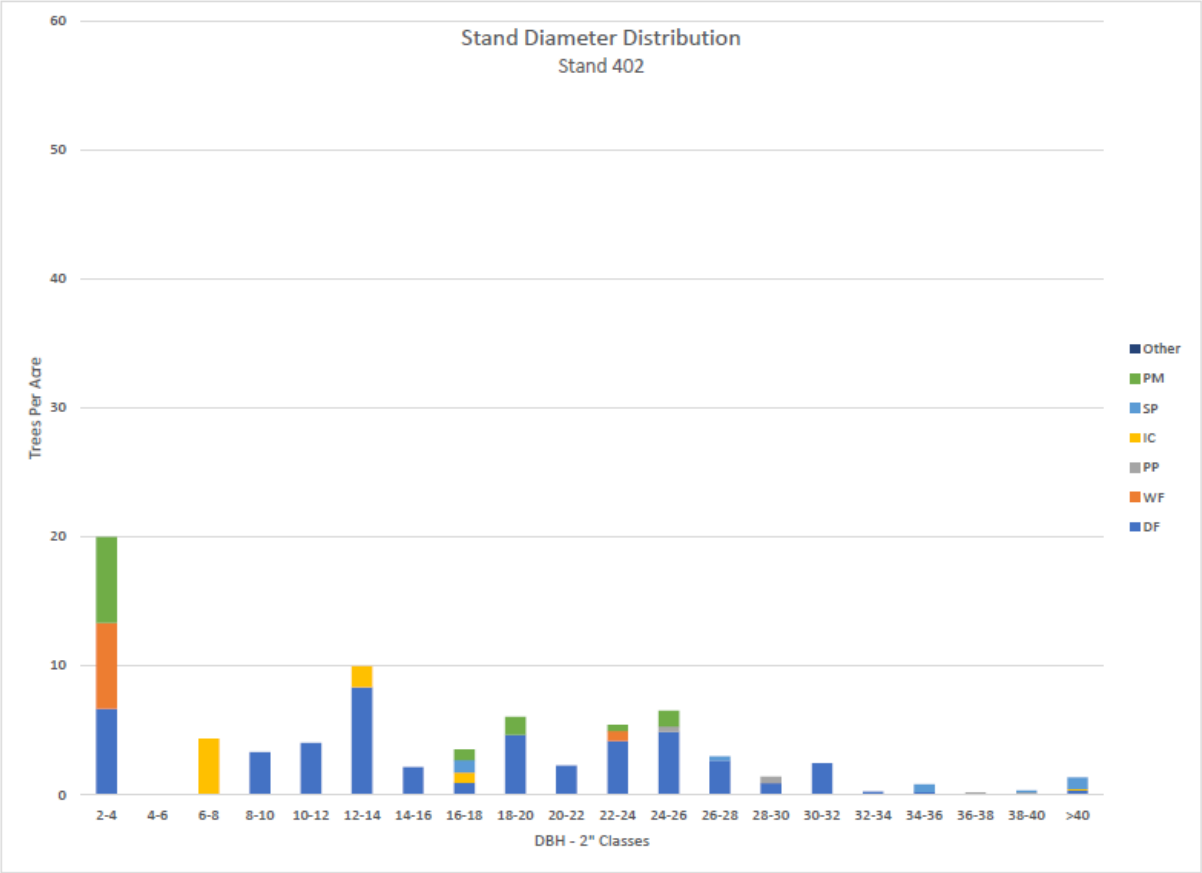
Early Action Project Areas



West Willow Lake Commercial Thinning Project



West Willow Lake – Prior To harvest



West Willow Lake Forest Stand Distribution - Prior to Harvest

Tree Species Index: PM=Pacific Madrone, SP=Sugar Pine, IC=Incense Cedar, PP=Ponderosa Pine, WF=White Fir, DF=Douglas-fir

Appendix C. Commission Logging Operation Requirements

1. CONDUCT OF LOGGING: Unless otherwise specifically provided herein, CONTRACTOR shall **fell** trees designated for cutting and shall remove the portions that meet utilization standards prior to acceptance of subdivision for completion of logging.

2. INCLUDED TIMBER: Included timber consists of live and dead trees and portions thereof that meet utilization standards under 2. Volume Estimates and are designated for cutting. Included timber shall be removed, prior to acceptance of subdivision for completion of logging. There shall be no charge to the COMMISSION when the leaving of incidental material is justified under existing conditions.

3. INDIVIDUAL TREE DESIGNATION: All trees painted with blue paint which meet the minimum tree diameter stated in Section 2 are designated for cutting. Additional timber to be cut, if any, will be designated for cutting by the COMMISSION Representative. Leave trees damaged by CONTRACTOR's operations will be replaced with a tree originally designated for removal and as closely located to the damaged tree as possible

4. **FELLING** AND **BUCKING**: **Felling** shall be done to minimize breakage of included timber and damage to residual timber. **Bucking** shall be done to permit removal of all minimum pieces. CONTRACTOR will **buck** out cull material when necessary to obtain greatest merchantability.

5. **FELLING** REQUIREMENTS: **Felling** objectives shall be accomplished by the type of **felling** methods and equipment listed herein. Methods or equipment other than those specified may be approved.

   FELLING METHODS
   - **Felling** to or from predesignated **skid trails** is required.
   - Stage **felling** in two (2) or more stages may be required to minimize log breakage and protect the residual **stands**.
   - Directional **felling** by wedging, jacking, lining or other appropriate methods is required to prevent or minimize log breakage, and to minimize damage to **residual trees**, riparian areas, and soils.

6. **BUCKING** REQUIREMENTS: Unless otherwise agreed, in all units, all logs will be skidded with limbs and tops attached. If necessary to protect **residual trees**, at least one log will be **bucked** off the tree prior to skidding. Trees shall be **bucked** in various lengths to obtain the greatest utilization of material.

7. SKIDDING AND **YARDING**: All logging equipment including **feller bunchers** shall be confined to pre-designated and approved **skid trails**. All logs will be long-lined to **yarding** equipment operating from the designated **skid trails**. Designated trails shall be no closer than an average of 100 feet apart except where the trails enter the **landings**. Location of all **landings** and **skid trails** shall be agreed upon prior to their construction. The cleared or excavated size of **landings** shall not exceed that needed for safe and efficient skidding and loading operations.

8. SPECIAL **YARDING**/SKIDDING OBJECTIVES AND REQUIREMENTS: CONTRACTOR and COMMISSION Representative will agree on a **yarding**/skidding plan prior to the start of **felling** operations for COMMISSION acceptance.

   Yarding/Skidding Objectives:
   - Pre-locate skid roads to minimize soil compaction and protect residual **stands**.
   - One end suspension required during **yarding** of logs to **landings** to prevent damage to soil resources.
   - Long-lining of trees which are hand **felled** to predesignated skid roads to prevent damage to soils and residual **stand**.
   - Logs may need to be winched up to 100' from skid roads.
   - Skidding equipment restriction limited to 10.5' maximum width to prevent damage to soils and residual **stand**.
   - Machines used for skidding are restricted to existing skid roads.
   - Skidding equipment will not operate within 100 feet of streams, springs and wet areas.
   - Skidding, and loading equipment and log trucks will not be operated on **skid trails**, **landings** or haul roads when soils are excessively wet or during continuous periods of significant rainfall. Indications of excessive soil moisture include but are not limited to; visible standing or puddling water, continuous rutting greater than 6" deep, pumping or berming of mud.

9. STUMP HEIGHTS: Stump heights shall not exceed 12 inches or 1/3 of cut stump diameter on the side adjacent to the highest ground, except that occasional stumps of greater heights shall be acceptable when necessary for safe and efficient conduct of logging.

10. **SLASH**: As used in the following subsections, the term "**slash**" is all vegetative material including, but not limited to cull logs, blasted or pushed-out stumps, chunks, broken tops, limbs, branches, rotten wood, damaged or destroyed reproduction, saplings or poles, which is created or disturbed as a result of CONTRACTOR's operation, including construction of roads or other improvements under this contract. Existing debris (vegetative material defined above) will be considered **slash** under this contract where the disposal of such debris is necessary to reduce fire hazard.

11. **SLASH** TREATMENT REQUIREMENTS: CONTRACTOR shall pile all **slash** accumulated at the **landing** that is brought to the **landing** with yarded logs. **Landing slash** shall be piled with a log **loader** and will be free of dirt and compacted to facilitate burning. **Landing slash** piles will have a fire break cleared to mineral soil a minimum of 10 feet wide completely around the pile to prevent spread of fire. CONTRACTOR will not be responsible for **slash** treatment in the general harvest unit area and will not be responsible for burning or further disposal treatment of **landing slash**.

12. EROSION PREVENTION AND CONTROL: CONTRACTOR's operations shall be conducted reasonably to minimize soil erosion. Equipment shall not be operated when ground conditions are such that excessive damage will result. The kinds of intensity of erosion control work done by CONTRACTOR shall be adjusted to ground and weather conditions and the need for controlling runoff. Erosion controls shall be maintained immediately preceding expected seasonal periods of precipitation or runoff.

CONTRACTOR shall construct cross ditches and waterbars on tractor roads and **skid trails**, as designated by the COMMISSION Representative, to prevent erosion.

13. RESTORATION OF **LANDINGS**: At completion of **yarding**, loading and **slash** piling at **landings**, CONTRACTOR shall contour the **landing** surface for drainage and shall loosen compacted **landing** surface soil with rippers, **loader** grapples or other acceptable means. Unless agreed otherwise, cut and fill banks around **landings** shall be sloped to remove overhangs and otherwise minimize erosion.

14. BRANDING: CONTRACTOR will plainly brand logs as required by the State of Oregon with a state registered brand provided by the COMMISSION.

15. LOG LOAD TICKETS: Each truck load of logs will be accompanied by a consecutively numbered log load ticket. "Mule Train" (short log trucks or truck and trailer) will have one ticket for the truck and one for the trailer. Trip tickets will be multi-part. One copy shall be stapled to the front of the bunk log on the driver's side of the truck, one part will be given to the truck driver for his records, one part will be presented at the log scaling location, one part will remain with the CONTRACTOR and one part will remain in the used ticket book. Log load ticket books will be issued to the CONTRACTOR as needed. Completely or partially used ticket books will be returned to COMMISSION on completion of use. Ticket books will be signed for when issued and signed out when returned. Missing tickets may at the discretion of the COMMISSION be charged for at a rate of the average net board foot per load of loads delivered in the previous pay period for each missing ticket.

16. FIRE PRECAUTIONARY PERIOD: April 1 to October 31, inclusive. Actual Fire Season may vary within this period, determined and regulated by the Oregon Dept. of Forestry.

17. OPERATING SCHEDULE: CONTRACTOR shall, before commencing operations, provide in writing an annual Operating Schedule of anticipated major activities and needs for logging operations. Upon reasonable notice to COMMISSION, such schedule shall be subject to modifications necessitated by weather, markets, or other unpredictable circumstances.

    ABNORMAL DELAY: Unless otherwise agreed, logging shall be conducted by CONTRACTOR pursuant to Section 21 within the time period indicated in the preceding logging schedule. Failure to conduct logging within the required time limits will be considered abnormal delay.

18. CONTRACT TERM ADJUSTMENT: The contract term may be adjusted in writing to include additional calendar days outside the Normal Operating Season.

19. To qualify for such adjustment, CONTRACTOR shall give written notice at least 10 days before Termination Date. The COMMISSION shall make prompt written acknowledgment of such notice or the number of days the COMMISSION considers as qualifying for the adjustment.

    PROTECTION OF **RESIDUAL TREES**: CONTRACTOR'S operations shall not unnecessarily damage young growth or other trees to be reserved.

PROTECTION OF IMPROVEMENTS: So far as practicable, CONTRACTOR shall protect improvements such as rocked & paved roads, road ditches, fences, cattle guards, gates, irrigation ditches, telephone and powerlines, water pumping facilities, water stand pipes, monitoring wells and survey monuments that exist in the Logging Area and designated on the Project Map.

SANITATION AND SERVICING: CONTRACTOR shall take precautions to prevent pollution of air, soil and water by CONTRACTOR'S operations. CONTRACTOR shall supply for employees, portable toilets, supplied and maintained by a qualified vendor. They shall be operated in a sanitary manner. CONTRACTOR shall not service equipment on Commission land.

20. PETROLEUM PRODUCTS: CONTRACTOR shall immediately notify COMMISSION of all spills or leaks or other releases of petroleum products or other hazardous substances on or in the vicinity of Commission land that are caused by CONTRACTOR'S employees directly or indirectly as a result of CONTRACTOR'S operations. Failure to notify the COMMISSION immediately will result in immediate suspension of operations and removal of operator from Sale Area. CONTRACTOR will be responsible for all expenses associated with cleaning up of any spill to the satisfaction of the COMMISSION. CONTRACTOR shall properly dispose of all contaminated soil in accordance with local, state, and federal regulations off of Commission land and shall transport such soil in accordance with State and Federal regulations.

    No fuel storage will be allowed on Commission land. Fueling of equipment will be completed at the work site in the morning. Fuel tanks in any form with a capacity of more than 100 gallons will not be parked un-attended on Commission lands at any time. CONTRACTOR shall maintain all equipment operating on Sale Area in good repair and free of leakage of lubricants, fuel, coolants and hydraulic fluid. CONTRACTOR shall furnish and use oil-absorbing or oil-containing mats approved by the COMMISSION for parking equipment. At any time during extended periods of non-operation of any piece of heavy equipment (e.g., nights, weekends or times when a piece of equipment would not be actively operating), the equipment shall be parked on the oil-absorbing or oil-containing mats.

21. SPECIAL LOGGING REQUIREMENTS: CONTRACTOR and COMMISSION Representative will agree on a plan prior to the start of logging operations, including:

22. Equipment will not operate within 100 feet of streams, springs and wet areas.

    Heavy equipment will not be operated on **skid trails**, **landings** or haul roads when soils are excessively wet or during continuous periods of significant rainfall. Indications of excessive soil moisture include, but are not limited to, visible standing or puddling water, continuous rutting greater than 6 inches deep, pumping or berming of mud.

    CLEANING OF EQUIPMENT: Unless otherwise agreed, to prevent the introduction of the seeds of noxious weeds onto COMMISSION lands, CONTRACTOR shall ensure all equipment moved onto COMMISSION lands is free of soil, seeds, vegetative matter, or other debris that could contain or hold seeds. CONTRACTOR shall employ whatever cleaning methods necessary to ensure compliance with the terms of this provision and shall notify COMMISSION prior to moving each piece of equipment onto COMMISSION lands, unless otherwise agreed. Notification will include identifying the location of the equipment's most recent operations. Upon request of COMMISSION, arrangements

will be made for COMMISSION to inspect each piece of equipment prior to it being moved onto COMMISSION lands. CONTRACTOR shall certify in writing, compliance with the terms of this provision prior to each start-up of operations. For the purposes of this provision, "equipment" includes all logging machinery and vehicles.

23. ROAD MAINTENANCE: CONTRACTOR shall maintain all roads controlled by COMMISSION or under permit to COMMISSION commensurate to CONTRACTOR'S use of those roads for **timber harvest** operations. Roads shall be maintained to best management practice standards to maintain surface condition, adequate drainage and stability and control excessive dust. At completion of harvest operations, all roads used for **timber harvest** activities will receive post-haul maintenance to leave them in at least as good of condition as roads were found prior to the start of operations.

24. CONTRACTOR will be required to abate dust on COMMISSION roads using only water when deemed necessary by the COMMISSION.

25. TRAFFIC CONTROL PLAN: Unless otherwise agreed, traffic warning signs will be required to provide adequate warning of hazards for users of roads adjacent to or on COMMISSION controlled lands.

Appendix D. Commission Non-commercial Thinning and Fuels Treatment Regulations

1. All **slash** created from recent harvest activities within 100 feet of the public road and within 100 feet of the property boundaries, as shown in Project Map 1, shall be 100 percent removed or piled for burning.

2. All **slash** in the reminder of the harvest area shall be lopped and scattered to break up concentration and evenly distribute the **slash** across the site. All **slash** shall be lopped so that no material is more than 24 inches above ground height.

3. The maximum stump height remaining after **fuels** are treated shall be no higher than 3 inches on the side adjacent to the highest ground.

4. All **slash** piles created by the **Fuels Treatment** Contractor during harvest operations, and all **slash** piles created under this contract in the 100% disposal zones will be trimmed and covered. Pile covering will consist of a 10 feet X 10 feet biodegradable covering, paper or other suitable substitute, or 4-mil polyethylene plastic if necessary, on the machine piles, and a minimum of 5 feet X 5 feet on the hand piles. Protruding limbs that prevent the cover material from lying flat on top of the pile will be trimmed before covering. Larger limbs and branches will be placed on top of the covering sheet to hold the sheet in place, or corners will be tied down with twine to prevent the covering from blowing off.

5. All piles will be firelined by removing **slash** for a minimum distance of three feet around the full perimeter of each pile.

6. Advanced **regeneration** will be thinned to leave appropriate leave trees at approximately a 12-foot average spacing. **Thinning** specifications will remove undesirable trees and species to retain the best species mix and the healthiest and most dominant advanced trees. Tree retention/removal priorities are:

   To the greatest extent possible, leave dominant, healthy trees for advance **regeneration**. Leave Species in order of desirability and tree health, growth and dominance in the following order:

   Ponderosa pine
   Sugar pine
   Douglas-Fir
   Oak (Black and Oregon White)
   Chinquapin
   Pacific yew
   Incense-cedar
   White fir

   Remove all damaged, diseased, slow growing and poor form trees and retain the best growing trees on the site. A few large **snags** will be retained. They will be marked with ribbon as leave trees.

XII. Glossary

Definitions for select terms as used in this document.

Bark beetles – Several species of small beetles that bore under the bark of trees and are capable of causing significant damage. Bark beetles are natural forest pests that usually do not pose a threat to healthy forests.

Basal area – The cross-sectional area (in square feet) occupied by tree trunks at breast height (4.5 feet above the ground) of a given unit, usually per acre.

Block – A group of forest **stands** grouped together based on their geographic location.

Blowdown – **Residual trees** of otherwise good health that are blown over in high winds, which can be the result of heavy **thinning**.

Board Feet – A measurement of timber volume; One board foot equals a board one inch thick by 12 inches square.

Broken topped – Large living trees with a portion of the top broken off from wind or lightning that provide critical nesting habitat for sensitive species.

Buck – Cutting a tree into desired **log** lengths, including the removal of tops and limbs.

Buffers – see **Riparian Management Area**.

Canopy base height – A vertical measure of the forest canopy in relation to distance from ground level. Reflects the ability of **ladder fuels** and a surface fire to move into the forest canopy.

Canopy cover – A horizontal measure of the fullness of the forest canopy usually expressed as a percentage of space occupied. 100% canopy cover = complete cover and no direct sunlight reaching the forest floor.

Co-dominant trees – Trees occupying the upper canopy of a **stand** or group and receiving nearly full sunlight.

Cohort – A single **size/age class** of trees growing together in a group following a disturbance such as a harvest, **blowdown** or fire.

Commercial thinning – A forest **thinning** also called a **timber harvest** that removes merchantable trees to be sold.

Competition – The struggle between trees for the limited available resources of sunlight, nutrients, water, and growing space.

Cruise – A survey of forestland to estimate the quantity of timber by species, products, size, quality, merchantability or other characteristics.

Cut to Length – A commercial harvest technique where trees are **limbed** and **bucked** into logs in the **stand** before being transported to a **landing**.

Cutting Cycle – The interval of time between **commercial thinnings** for a given **stand**. The time it takes for a **stand** to regrow after a harvest to a volume suitable for the next commercial harvest.

DBH (diameter at breast height) – A measure of tree size as the diameter in inches of the tree trunk at breast height or 4.5 feet above ground.

Defect – A tree form abnormality that decreases the commercial value but can enhance the wildlife habitat value.

Distribution curve – A graphical summary of forest density, tree size and character produced by charting the number of trees in established **size/age classes** per acre.

Dominant trees – Trees extending above the upper canopy of a **stand** or group and receiving full sunlight.

Ecological restoration strategy – A land management technique or activity other than traditional forestry that is intended to

restore or enhance a deteriorated ecological function or **ecosystem service**.

Ecosystem service – A function, resource or process beneficial to society and provided by the natural environment, e.g., timber and clean water.

Even-aged management – A forestry system that manages forest **stands** as single **cohorts** of trees of the same **size/age class** and often species.

Fell – The act of mechanically cutting down an individual tree.

Feller buncher – A motorized vehicle with an attachment that can rapidly gather and cut a tree before **felling** it.

Fuel break – A vertical or horizontal area devoid of, or containing sparse, vegetation with the potential to slow the spread of fire.

Fuels – Combustible herbaceous and woody material that contributes to forest fire behavior.

Fuels treatment – A subset of **non-commercial thinning** that removes smaller trees, shrubs and brush of little or no commercial value with the intent to improve forest health and/or reduce fire risk.

Group selection – A harvest tree selection methodology that chooses groups or clusters of trees to be removed, rather than individual trees, creating forest openings. Groups can be a few trees or cover more than an acre.

Hardwoods – Non-coniferous tree and large shrub species, including oak, madrone, manzanita, maple, hazelnut, chinquapin, alder, ash, and others.

Insolation – The amount of sun energy reaching the ground due to land aspect and slope, which affects the availability of water for plant growth.

Intermediate trees – Trees occupying a subordinate position in the canopy of a **stand** or group and receiving sunlight from above but limited light from the sides.

Ladder fuels – Woody, dead or living, vegetation in the **understory** with the potential to carry a ground or surface fire up into the forest canopy, including shrubs, small trees, and limbs of larger trees.

Landing – A designated area in a **stand** where logs or trees are **bucked**, piled and loaded onto log trucks.

Large woody debris – Large wood placed in a stream to provide complex structure, bank stability, hydrologic flow modifications and habitat.

Late seral forest – An advanced or mature stage of forest development analogous to "Old Growth" that can be open or dense but includes a high percentage of large old trees.

Limb – The removal of limbs from a tree. **Limbing** typically occurs after a tree is **felled** to produce a **log** but can also be used on the lower branches of live trees to reduce **ladder fuels**.

Loader – Heavy equipment used to pick up logs or trees in a **landing** for final processing and piling or loading onto log trucks.

Lop and scatter – A **slash** management technique that cuts **slash** into smaller pieces to be laid flat and distributed evenly throughout the **stand**.

Max Stand Density – The **SDI** representing a fully-stocked **stand** where all growing space is occupied.

MBF – A measurement of timber volume in a log, **stand** or tree; one thousand **board feet**. One board foot equals a board one inch thick by 12 inches square.

Mechanized logging – A logging technique using heavy equipment such as **feller bunchers** to **fell** trees.

Merchantable timber – Trees of a species, size and condition to potentially be harvested and sold to generate revenue.

Net volume per acre – The quantity, usually in **MBF**, of commercial timber in an area potentially suitable for harvest in a given area. Net volume/acre = **net volume per acre**.

Non-commercial thinning – A forest **thinning** that removes smaller trees, shrubs and brush of little or no commercial value with the intent to improve forest health and/or reduce fire risk.

Pile and burn – A **slash** management technique that gathers, piles and covers **slash** to be subsequently burned after a drying period.

Prescribed fire – The use of controlled fire as a tool for ecological restoration and **fuels** reduction as **underburns** broadcast across the surface of a forest, woodland or meadow.

Quadratic Mean Diameter (QMD) – The geometric average tree size as diameter at breast height in inches for a given area.

Regeneration – Tree seedlings or saplings of a species with commercial value.

Relative Density Index (RDI) – Tree density index based on the percentage of the maximum **stand** density. **SDI/maximum stand density** = **RDI**. Used to approximate healthy stocking levels for a given **stand**.

Residual tree damage – Physical damage to the remaining trees in a treated forest directly or indirectly caused by a forest activity such as **felling**, **yarding**, equipment operations or burning.

Residual trees – Trees left in a **stand** after a **thinning**.

Riparian Management Area (RMA) – An area adjacent to a stream, lake or wetland in which vegetation is generally excluded from commercial harvest and managed to protect water quality and habitat. **RMA**s are also called **buffers** or **setbacks**.

Root rot – A tree disease that often kills trees by attacking their roots. Doug-fir and White fir are particularly susceptible.

Single tree selection – A methodology of selecting harvest trees that chooses individual trees to be removed rather than groups or clusters of trees.

Site index – A relative measure of the quality of a given forest site based on the height of the **dominant trees** at a specific age. The higher the **site index** the better the growing conditions.

Size/age class – A tree classification based on the size of a tree as the **DBH** corresponding to the age of the tree for a given species.

Skid trails – Temporary paths of travel to be used by logging equipment during mechanical forest management.

Skidder – Heavy equipment used to pull logs and trees from where they were **felled** to a **landing.**

Skips and gaps – A forestry technique that creates horizontal diversity and **variable tree densities** by selecting areas or sections of a **stand** to be thinned while leaving other areas un-thinned or lightly thinned.

Slash – non-**merchantable** woody debris including limbs and logs generated as a byproduct of forest **thinning**.

Snags – Medium to large standing dead trees that provide important wildlife habitat.

Stand Density Index (SDI) – A measure of the stocking level of a given **stand** of trees based on the number of trees per unit area and average tree size as the **QMD.** Higher **SDI** equates to a more crowded forest and the amount of occupied **growing space.**

Stand – An area of the forest that is relatively uniform in character, such as species composition, size or age, to be managed as a single unit.

Standing volume – A measurement of potential commercial timber volume in an area of forest, such as a **stand**, usually expressed in **MBF**.

Suppressed trees – Trees below the general level of the canopy of a **stand** or group and receiving limited or no direct sunlight.

Thinning – The practice of removing some trees from a **stand**, reducing the tree density

and **competition** for resources. In general, **thinning** enhances the **vigor** of remaining trees and reduces fire risk.

Timber harvest – see **commercial thinning.**

Trees per Acre (TPA) – A measure of tree densities as the average number of trees by tree **size/age class** per acre in a forest unit or **stand**. Number of trees/acres = **TPA**.

Traditional logging – Logging technique using loggers on foot with chainsaws to **fell** trees, limiting the use of heavy equipment to designated **skid trails**.

Tree clusters – Groups or clumps of trees that function as units of forest structure and habitat.

Tree plantation – Area of forest previously devoid of trees and planted or replanted with a **cohort** of trees, usually of a single species and age.

Underburns – Fire broadcast across the land surface as opposed to individual fires used in **pile and burn slash** management.

Understory – Forest plant community including smaller trees, shrubs and herbaceous plants growing under the forest canopy.

Uneven-aged management – A forestry system that maintains forest cover and manages forest **stands** as multiple **cohorts** of trees of varying **size/age classes** and species diversity.

Variable tree density – A fine-scale gradient of tree stocking levels; a **stand** condition of varying degrees of the number of trees per unit area with some areas having few, widely spaced trees transitioning to areas of denser clusters of trees.

Vigor – Tree health, growth potential and or resistance to stressors.

Whole tree harvest – A logging technique of transporting trees after **felling** to **landings** with limbs and tops attached. **Limbing** and **bucking** occur at the **landing**.

Yarding – The harvest operation of moving logs or trees to a **landing**, usually by cable. Horses can be used in some circumstances.

XIII.Citations

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