Little White Salmon National Fish Hatchery Habitat Stewardship Plan

An Assessment and Framework for Ecological Restoration

July 2009

INTEGRATED RESOURCE MANAGEMENT, INC.
Consulting Foresters & Restoration Ecologists

Little White Salmon National Fish Hatchery Habitat Stewardship Plan

Prepared for:

Speros Doulos,
Complex Manager
Little White Salmon National Fish Hatchery
56961 SR14
Cook, WA 98605
Phone: (509) 538-2755

Prepared by:

Darin Stringer,
Restoration Ecologist and Senior Project Manager
Integrated Resource Management
1420 E. 22nd Avenue
Eugene, Oregon 97403
Phone: (541) 484-1217
Fax: (316) 221-0331
http://www.irmforestry.com
darin@irmforestry.com

CITE AS:
Stringer, D. 2009. Little White Salmon Fish Hatchery Habitat Stewardship Plan. Report to the U.S. Fish and Wildlife Service. 132 pp.

PHOTOGRAPHS: All photos by Darin Stringer.

Printed on FSC certified paper

INTEGRATED RESOURCE MANAGEMENT, INC.
Consulting Foresters & Restoration Ecologists

TABLE OF CONTENTS

EXECUTIVE SUMMARY **5**

OWNERSHIP SUMMARY INFORMATION **6**

INTRODUCTION **7**

OVERVIEW AND CONSERVATION ROLE 7
HISTORIC AND CURRENT LAND USE 9
THE PURPOSE AND NEED FOR HABITAT PLANNING 10

RESOURCE ASSESSMENT **12**

PHYSICAL ENVIRONMENT 12
Climate *12*
Geology, Topography and Soils *12*
Hydrology *17*
VEGETATION 19
Structure/Composition and Vegetation Trends *19*
Forest Types *20*
Woodland Types *25*
Open Types *27*
Current Disturbance Regimes *32*
Fuels and Fire Risk Assessment *35*
Dead Wood Resources *38*
Invasive Weeds *40*
Rare and Listed Plant Species and Habitats *42*
Summary of Disturbance Regime and Vegetation Change *43*
FISH AND WILDLIFE 45
Listed Fish and Wildlife Species *47*
Summary of Wildlife Species/Habitat Trends *54*
INFRASTRUCTURE 56
Roads and Access *56*
Structures and Utilities *58*
CULTURAL RESOURCES 59

HABITAT MANAGEMENT SYNTHESIS AND RECOMMENDATIONS **60**

MANAGEMENT GOALS AND OBJECTIVES 60
DESIRED FUTURE CONDITIONS 62
Fir/Hardwood Forest *62*
Fir/Oak Woodland *68*
Oak Woodland *69*
Oak Mosaic *70*
Bunchgrass Prairie *71*
Other Habitats *72*
MANAGEMENT PATHWAYS TO ACHIEVE AND MAINTAIN DESIRED FUTURE CONDITIONS 73

IMPLEMENTATION PLAN **82**

RECOMMENDED TREATMENTS (PHASE 1) 82
RECOMMENDED TREATMENTS (PHASE 2 AND 3) 88
MAINTENANCE TREATMENTS (ALL PHASES) 88
MONITORING 89
Treatment Effectiveness Monitoring *89*
DFC Monitoring *89*

APPENDICES **91**

A. Literature Cited 91
B. Fish Passage Codes 93
C. Vegetation Polygon Types and Acreage 94
D. Vegetation Polygons and Current Attributes 95
E. Oak Succession Classification 102
F. Wildlife Species Known or Associated with Ownership Habitats 103
G. Desired Future Conditions for Vegetation Types 111
H. Vegetation Polygons (DFC and Prescriptions) 113
I. Stewardship Actions for Focal Wildlife Species 119
J. Douglas-fir/Hardwood DFC Management Pathways 121
K. Oak Mosaic, Oak Woodland and Fir/Oak Woodland DFC Management Pathways 123
L. Bunchgrass Prairie DFC Management Pathways 125
M. Monitoring Components, Methods, and Timeline 127
N. Snag Management Guidelines 128
O. Vegetation Polygon Photos 129

Maps, Figures, and Tables

Map 1. Little White Salmon National Fish Hatchery and Vicinity 6
Map 2. Soil types on the LWS National Fish Hatchery 14
Map 3. Water and Fish Passage Status on the LWS National Fish Hatchery 16
Map 4. Vegetation Types on the LWS National Fish Hatchery 20
Map 5. Level of Douglas-fir Encroachment of Oregon White Oak 26
Map 6. Stands With Remnant Old Growth Trees 29
Map 7. Roads and Access on the LWS National Fish Hatchery 55
Map 8. Desired Future Conditions 65
Map 9. Treatment Phases 81

Table 1. Soil Types, Properties and Site Productivity 11
Table 2. Summary of Vegetation Cover Types 17
Table 3. State Listed Noxious Weeds 39
Table 4. State, Federal and Priority habitat listed wildlife species 47
Table 5. Roads and Conditions 54
Table 6. Phase 1 Recommended Treatments (Year 1-10) 83

Figure 1. Desired Future Conditions Decision Flow chart 62
Figure 2. Desired Future Conditions for Fir/Oak Woodlands 66

Executive Summary

The Little White Salmon National Fish Hatchery, in the Eastern Columbia Gorge in Washington State, contains 417 acres owned and managed by the United States Fish and Wildlife Service (USFWS). The ownership is comprised mostly of moderate to steep canyon slopes and scattered benches above the confluence of the Little White Salmon and Columbia Rivers. Vegetation cover is dominated by Douglas-fir and bigleaf maple forest, oak and Douglas-fir woodlands and scattered remnant prairies. Remaining lands are rocky slopes, fields, water, and hatchery facilities. An estimated 111 bird species, 14 amphibian species, 12 reptiles, and 44 mammal species may occur on the ownership. Included in this total are 11 Federal and 16 State listed or candidate species. These lands are being managed primarily to protect water quality to support hatchery operations. Secondary goals are to provide quality habitat for at-risk wildlife species and plant communities. This plan was initiated to assess habitat conditions, determine future desired conditions, identify restoration priorities and design a stewardship strategy.

The ownership contains predominantly forest and woodland cover types, covering 61 and 19% of total acreage, respectively. These plant communities have been altered since the contact period and Euro-settlement of the Columbia Gorge. A mixed-fire regime featured both high frequency fires which shaped and maintained open vegetation featuring oak, Douglas-fir, ponderosa pine and bunchgrass prairie, and more infrequent and higher severity fires on moister sites, which supported more dense conifer stands. The resulting landscape contained many patches of various sizes with varying vegetation structure and composition. With the cessation of fires, trees have encroached all vegetation communities, resulting in changes in species composition and structure most prominent in the oak and prairie types. This conversion has included the replacement of oak and pine dominated savanna and woodlands to Douglas-fir woodlands and forests. Dense oak woodlands have replaced savannas on poorer soils. With increasing canopy cover, plant understories have shifted to more shade tolerant species. Native bunchgrass and forb communities on remnant prairies and rocky terrain have been replaced largely with Eurasian grasses. Logging in the early to mid 1900s removed many large Douglas fir, reducing structural diversity in conifer forest types on the most productive sites, with younger second growth stands now occurring. With the above vegetation changes, the risk of more extreme fire behavior and undesirable effects has increased.

Desired future conditions (DFC) for the ownership include a mosaic of native vegetation communities, using reference era conditions as a general template. Some former oak sites, now conifer dominated may remain converted. DFC will feature open oak and pine woodlands on 73 acres and 17% of total land, mature conifer stands with high levels of structural diversity on moist sites on 210 acres (50%), a mix of the above species in edge interface types on 49 acres (12%), and prairies dominated by native perennial bunchgrass and forbs on 22 acres (5%). Remaining acreage includes riparian areas, developed land and water. To achieve this vision, active restoration including thinning, prescribed fire, snag and down wood creation, control of invasive weeds and re-establishment of native vegetation are recommended. Three phases are designed to guide implementation of prescriptions. Phase 1, scheduled for completion in a 10 year management window, includes 113 acres of various restoration treatments. Treatments are prioritized where oaks are most threatened by Douglas-fir and access is least limiting.

Ownership Summary Information

Date:	June 30, 2009
Landowner:	Little White Salmon National Fish Hatchery USFW 56961 State Route 14 Cook, Washington 98605
Legal Description:	Section 26 and 27. Township 3 North, Range 9 East, W.M. Skamania County, WA
Total Acreage:	417 acres
Fire Protection Entity:	Washington Department of Natural Resources
Special Zoning:	Columbia Gorge National Scenic Area, General Management Area and Special Management Area
Elevation:	80 to 1,000 feet
Vegetation Types:	Woodland and Forest (Primarily Douglas-fir, bigleaf maple and Oregon white oak), and scattered Prairie
Soil Types:	1- McElroy Gravelly Loam (28% of total area) 2- Washougal Gravelly Loam (6%) 3- Rock Outcrop and Rubble Land Complex (<1%) 4- Rock/Xerothents Complex (60%), remainder of area is water.
Water Resources:	Little White Salmon River, Drano Lake, several small perennial and seasonal creeks
Watershed:	Moss Creek Sub-Watershed, Little White Salmon Watershed, Columbia River Basin
Road System:	Cook-Underwood Road, Paved hatchery and residence roads, several unsurfaced skid and old roads
Known or Potential Listed T&E Species:	11 Federal, 16 State listed (see Table 4)
Focal Management Species:	See Table 4

Introduction

Overview and Conservation Role

The Little White Salmon National Fish Hatchery is a 417 acre ownership at the confluence of the Little White Salmon and Columbia Rivers[1]. These lands are administered by the United States Fish and Wildlife Service (USFWS). The ownership is approximately 12 miles east of Stevenson in Skamania County, Washington and falls within the General and Special Management Areas of the Columbia River Gorge National Scenic Area. These lands are located within the Little White Salmon Watershed of the Columbia River Basin. Vegetation cover is dominated by forest and woodlands, which combined cover approximately 86% of the ownership. The remaining acreage includes steep, rocky sparsely treed terrain, fields, water and hatchery facilities.

Little White Salmon National Fish Hatchery

The LWS NFH, though limited in size, are important in the context of landscape level conservation of at-risk vegetation communities and associated wildlife populations. The key conservation functions of this ownership include:

1- Linking of Oregon white oak (*Quercus garryana*) and ponderosa pine (*Pinus ponderosa*) habitats in the eastern Columbia Gorge with those remnant similar habitats occurring in the inner gorge and the west side of Cascade Mountains.

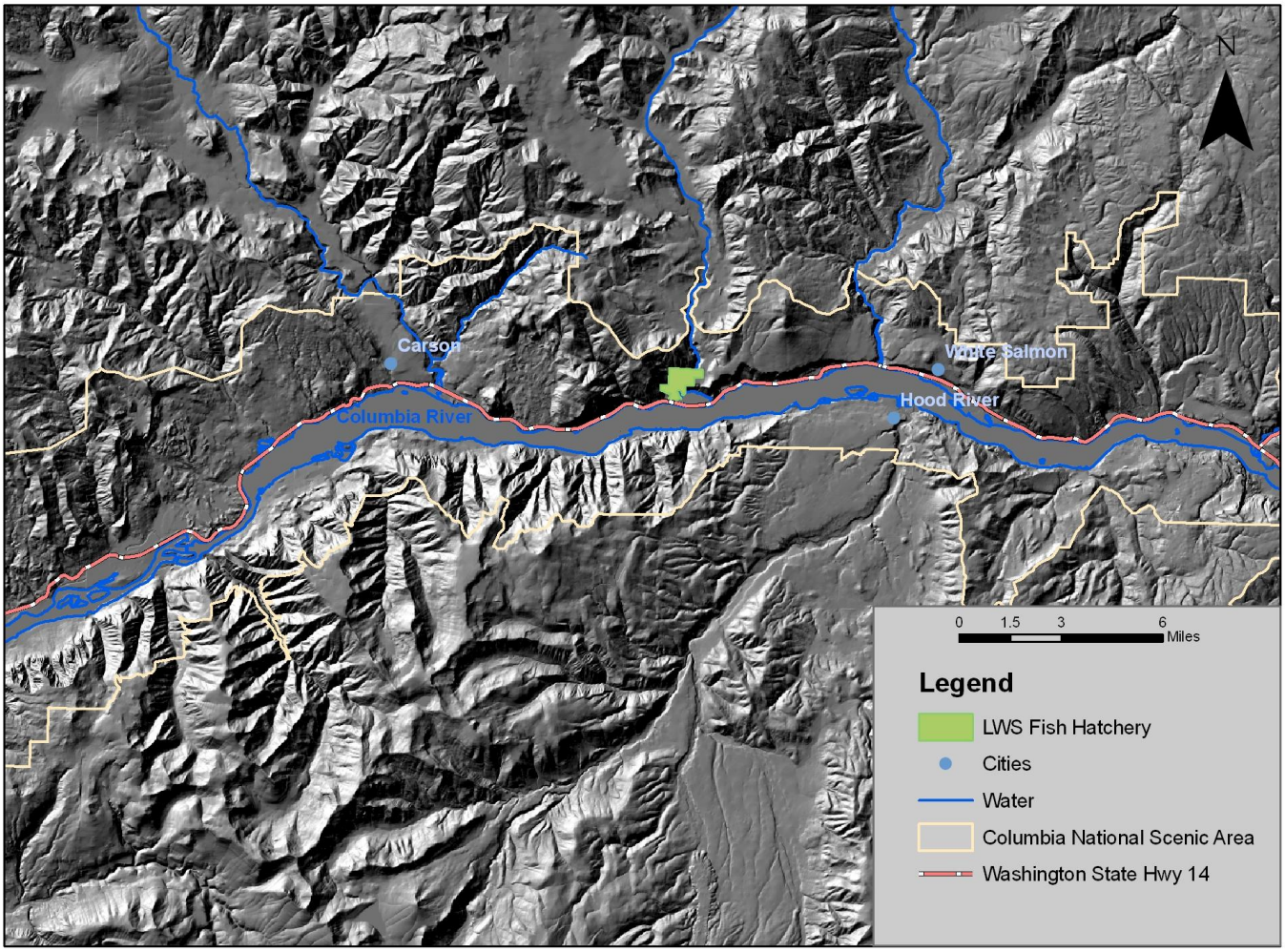
2- Providing anchor habitat for oak, prairie and mature conifer dependant species.

3- Providing examples of remnant oak, cliff, and prairie plant communities to guide restoration efforts on other lands, and native plant seed collection sources.

[1] Also referred to in this document as "ownership", and "LWS NFH".

4- Enhancing the quality of habitats on the adjacent Little White Salmon Biodiversity Preserve. This 200-acre ownership combined with hatchery lands forms a block of protected oak and conifer habitats. These lands have high conservation value because they contain a river confluence and plant community /Ecoregional interfaces in a concentrated area.

5- Providing potential dispersal habitat to Northern spotted owl (NSO). Coniferous stands along the Columbia River provide habitat to facilitate owl movement between Oregon and Washington.



Map 1. Little White Salmon National Fish Hatchery and Vicinity

Historic and Current Land Use

The LWS NFH has a long history of human use. The confluence of the Little White Salmon River was used for millennia by Chinookan tribes for fishing and habitation. There is a documented archeological ruin on the gravel bar on the north shore of Drano Lake at the mouth of the Little White Salmon. This was the location of a fishing village, much of which is now underwater. Prior to damming of the Columbia River, "hordes" of salmon came to spawn along the confluence of the Little White Salmon River. It was difficult to cross the river during high water so a trail went up the slope on the east side of the river, and followed the flat (near Chenowith Road) to the upper valley where one could cross the river at the confluence with Moss Creek. This trail was also used to gain access to the huckleberry fields on Big Huckleberry and Little Huckleberry Mountains in the upper watershed, to the northwest.

Modern settlement by Euro-Americans began in the late 1800s. Lands in the vicinity of the hatchery residence and the flat lands along the Cook-Underwood road were cleared for orchards and farms. Upland prairies and oak savannas were likely heavily grazed during this time. The first white settlement in the area occurred a few miles north of the ownership by John Dark, near Willard around 1885 (Dewater 1985).

Photo 1 - Broughton log flume just east of the ownership.

The Little White Salmon Watershed has a long history of logging that apparently initiated in the late 1800s. The Wind River and Oregon Lumber Companies logged old growth in the Little White Salmon drainage and moved rough cut lumber to the Columbia River via log flumes. The lumber was finished and railed at Viento and Hood River, Oregon from mills upriver. The historic Broughton Flume, located just east of the hatchery boundary bears evidence to the extensive logging that occurred in the area (*see Photo 1*). The flume operated between 1923 and 1986, and carried rough cut lumber produced by the Wind River and later Broughton Lumber Company at Willard to a mill and rail facility in Hood, Washington, just west of Bingen. It took fifty-five minutes for the rough lumber and cants to float the nine miles length of the flume. An 1898 photo at the hatchery office shows another flume running along the Little White Salmon, indicating logging activity well before the Broughton flume was in place. A flume came down off the Wind Rim and apparently was used to transport firewood to barges in Drano to help power steam ships.

The Little White Salmon National Fish Hatchery was established in 1896 and is the oldest federal hatchery on the Columbia River. Congressional authorization was based on the intent to supplement the commercial fishing industry. The hatchery's role expanded during the 1930's with the enactment of the Mitchell Act and further amendments in 1946. The Mitchell Act was enacted to mitigate for fisheries lost due to the construction and operation of Columbia River hydroelectric projects. The hatchery produces upriver

bright fall chinook, spring chinook, and coho salmon. Today, more than 9.4 million young salmon are released into the Columbia River or transferred to other sites for release each year.

Current land use in the vicinity of the hatchery lands varies widely with ownership. Industrial timberlands north of the ownership are managed for wood production and clearcut approximately every 40-70 years. Most of the forestland directly east of the ownership is owned by various conservation interests including the Columbia Land Trust, Cold Springs Conservancy, and World Steward. These lands are permanently protected and are being managed to promote habitat with some minor agricultural use. Further east is a mix of industrial timberlands, farms and woodlots. Lands directly to the west are part of the Gifford Pinchot National Forest, much of which is managed for recreation use and/or part of the Wind Late Successional Reserve. The Columbia River forms the southern boundary.

The Purpose and Need For Habitat Planning

Habitats on the ownership are clearly important both in local and landscape contexts. Though protected from development, these lands remain threatened by a combination of past practices and lack of active stewardship. The primary vegetation type of concern on the ownership is Oregon white oak woodland. Though often overshadowed by the more dominant Douglas-fir (*Pseudotsuga menziesii)*, Oregon white oak are common throughout portions of the ownership, and were historically much more prevalent. The ownership provides one of a few protected examples of oak habitat occurring at the western edge of Oak/Conifer Foothills Ecoregions. These remnant trees and communities are host to many species, have a limited distribution, and are declining and priority habitats in Washington State (Larsen and Morgan 1998). Approximately 200 species of birds, mammals, reptiles, and amphibians use oak habitats in Washington. These trees are host to a rich assemblage of invertebrates including moths, wasps, spiders, and butterflies, some of which are obligate on oaks. Unlike many forest types in the state, oak habitats require active stewardship on most sites to maintain species composition and desired structure. Another declining plant community, bunchgrass prairies, are scattered throughout on the ownership. Remnant prairies and open oak habitats have been severely degraded in places by invasive annual grasses. On more productive soils on the ownership, Douglas-fir trees and stands contribute to forest biodiversity by providing examples of low-elevation Westside coniferous forest, which are relatively poorly protected regionally. While components of mature forest structure are found in some of these stands, past logging has reduced habitat quality and forest function.

The current body of science and consensus of restoration ecologists that active management is warranted in the management of most of these plant communities if desired function is to be restored. This plan was initiated in response to the need to assess and actively restore these important habitats. This plan will provide a framework for stewardship and a basis for recommended treatments, which will help managers to focus limited resources to priority areas, and build support for upland habitat management on

USFW lands. The need for this plan is also driven by a desire to coordinate management efforts with the Columbia Land Trust, whose adjacent lands have similar goals.

The plan is structured to achieve the following goals:

1- To assess natural resources on the ownership including descriptions of plant communities, rare habitats and species, while identifying past disturbance regimes, processes, and land use practices and associated degradation and other effects/threats.

2- To identify management goals and objectives including a set of desirable habitat conditions and ecosystem processes and stewardship actions that will foster them.

3- To develop a well-defined and elucidated management strategy to achieve these goals and objectives.

Resource Assessment

Physical Environment

Climate

The ownership occurs in a maritime climate that is influenced by Continental weather patterns, and the unique geography of the Columbia Gorge. In this constricted topography, winter storms from the Pacific Ocean deliver heavy precipitation, however the Cascade Mountains act as a barrier to the movement of this moisture. Precipitation levels at the hatchery are likely midpoint in a steep precipitation gradient that peaks in the inner gorge with 80" + of moisture annually, and is at its lowest point east of the Dalles, Oregon at 10-15" per year. Precipitation on higher elevation lands just a few miles northwest of the ownership reaches well over 100" per year. We estimate annual precipitation on the reserve averages approximately 50-60", mostly as rainfall between November and March. Temperatures range from a mean of 68 degrees Fahrenheit in July, to 32 degrees in January. Prevailing winds are generally from the west in the summer, and east in the winter. Wind and ice storms are frequent weather events that influence forest vegetation by causing windthrow and tree stem breakage.

Geology, Topography and Soils

The ownership occurs in the Cascade Range uplift, an area whose present physiography is due to the combined geological processes of uplifting, successive volcanic flows of basalt and andesite, and pyroclastic eruptions, coupled with numerous floods. Soil types on the hatchery lands formed mostly through colluvial processes, and in residuum. There are three major soil types on the ownership (*see Map 2 and Table 1*). These types are mapped and described in the Soil Survey of Skamania County Area, Washington, produced by the USDA Soil Conservation Service. Soil types in the survey are coarsely delineated, but useful to see general patterns of soil characteristics. More intricate mapping would reveal variation within the current polygons.

The LWS NFH occur on mostly moderate to steep canyon above the Little White Salmon River. Steep slopes (some well over 100%) occur mostly in the inner canyon. Most of the ownership is situated on south, west and east facing slopes. Flat to gradual topography occurs on benches along Cook-Underwood and Chenowith Roads.

Soil maps show over 60% of the ownership consisting of thin and rocky soil types. Many of these areas are readily visible as rock outcrops or sparely treed slopes with grass and moss cover. Most of this acreage is in the Rock Outcrop-Xerorthents complex, which includes about 25% Xerorthents containing well-drained soils varying from 10-60 inches to bedrock. Due to the intricate intermingling of rock and soil patches in these mountain back-slopes, fine scale mapping was impractical. Examining the forest inventory and aerial photos indicates the proportion of Xerothents to rock outcrops is higher than the

county-wide average reported in the soil survey. Highly variable patterns of soil productivity is evidenced by the closely arranged but distinct vegetation type breaks. Some stands delineated as Rock Outcrop-Xerorthents complex support some of the largest remnant Douglas-fir trees on the ownership. The most productive soils on the ownership (McElroy and Washougal) have a surface layer of volcanic ash, which increases moisture retention capacity and rooting area for vegetation.

Slope stability is a concern in portions of the ownership, particularly in the inner canyon above the Little White Salmon River. These areas contain topographic features identified in the Washington Forest Practices Manual (2004) as potentially unstable landforms. These rule-identified unstable landforms include convergent headwalls and inner gorges with slopes > 70% and outer edges of meander bends. Unstable slopes have caused landslides along Cook-Underwood Road in the past. Slides in and above Bailey Creek have occurred. Because the tendency of slopes to fail may increase with forest practices such as road building and tree cutting, special considerations should be made when planning these operations on the ownership.

A description of soil types on the ownership is provided below.

Table 1. Soil Types, Properties and Site Productivity

						Erosion Hazard	
#	**Name**	**Acres**	**Properties**	**50-Yr SI**	**Type**	**Off-road**	**Roads**
66	McElroy (gradual slopes)	27	Very deep, well-drained colluvial soil (5-15% slopes)	100	Gravelly Loam from basalt and volcanic ash	Slight	Moderate
68	McElroy (steep slopes)	88	Very deep, well-drained colluvial soil (30-65%) slopes)	100	Gravelly Loam from basalt and volcanic ash	Severe	Severe
92	Rock Outcrop/Rubble	3	Rocky Cliffs and rubble	NA	Basalt/Andesite	Very Severe	Severe
93	Rock Outcrop/Xerothents	250	Rock or shallow to deep colluvial soils (50-90% slopes)	80	Basalt/Andesite	Very Severe	Severe
158	Washougal	25	Very deep, well-drained colluvial soil (2-8% slopes)	119	Gravelly Loam from basalt/andesite and volcanic ash	Slight	Slight
177		23	Water				
Total		**417**					

[#= Soil Series Number, 50-Yr SI= 50 year site index heights for dominant Douglas-fir trees]

McElroy Gravelly Loam (5-15 % and 30-65% slopes) is found on 115 acres and 28% of the ownership (*see Figure 3*). Most of the forest in this soil type occurs in the northeast portions of the ownership; areas dominated by heavy conifer and bigleaf maple (*Acer macrophyllum*) cover. Two additional soil polygons totaling about 40 acres occur along the west edge of the ownership. McElroy is a very deep, well-drained colluvial-based soil formed on mountain slopes. Permeability of this soil is moderate, with moderate water capacity. Typically, the surface layer is strong brown gravelly loam 23 inches thick. The subsoil is strong brown very gravelly loam to 60 inches or more. Effective rooting depth is more than 60 inches. The erosion hazard on and off roads is slight to moderate on gradual slopes and severe on steep slopes (*see Table 1*). The soil is not listed as a hydric.

McElroy soils can exhibit some wetness but is usually droughty with a cemented hard pan below. This soil type is moderate in site productivity as indicated by DF-SI_{50} (50-year Douglas-fir site index) of 100 (low site 3). The Mean Annual Increment (MAI) for Douglas fir is 134 cubic feet/acre per year at age 70. Equipment limitations are suggested for forestry operations conducted during wet weather to prevent rutting. Regeneration and seedling mortality are the principal concerns for timber production on this soil due to drought (particularly on south and southwest facing slopes) and competition from shrubs. Windthrow potential is limited due to deep rooting depths of soil. Vegetation competition during tree regeneration is moderate due to shrub development.

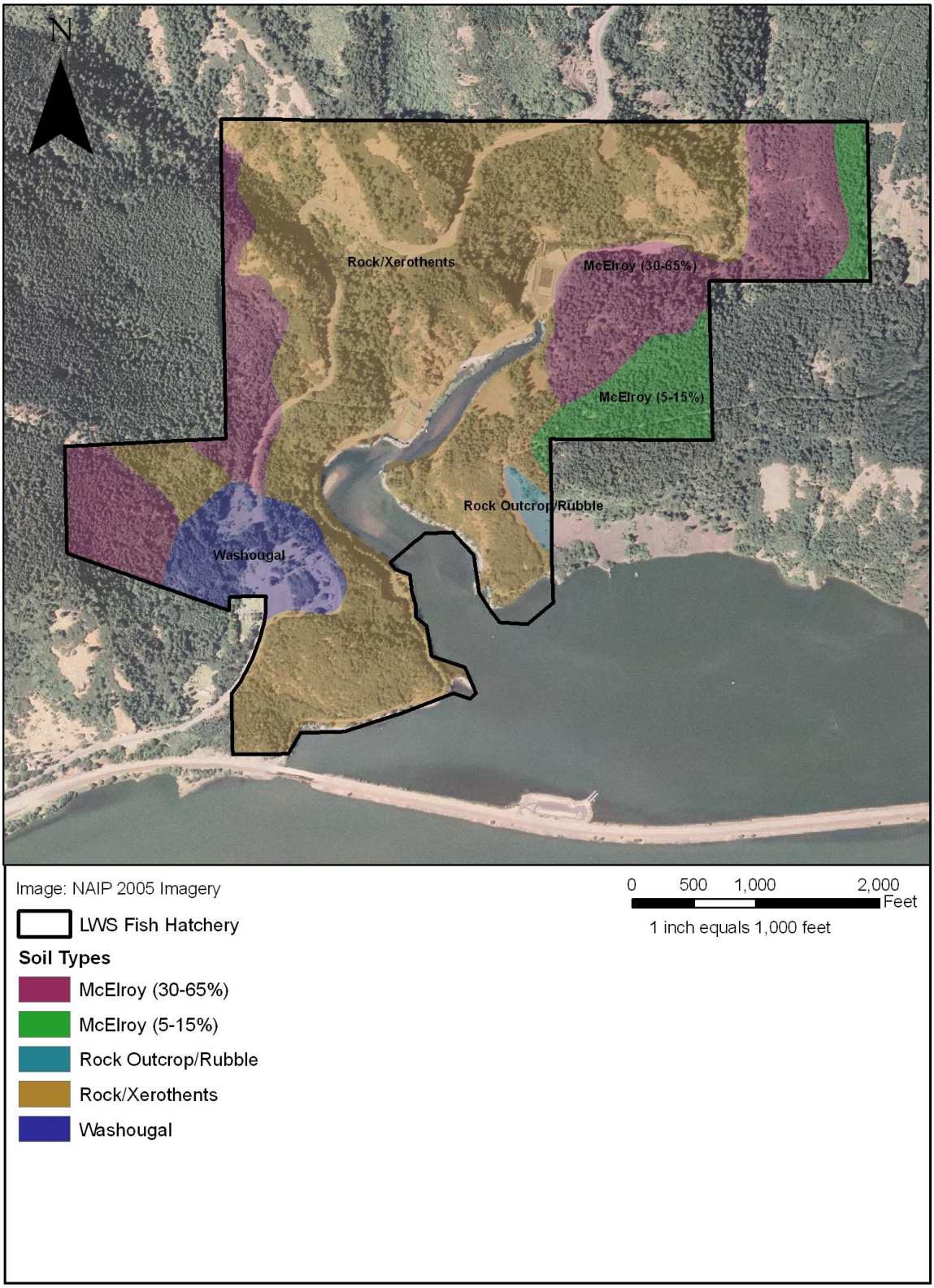
Washougal Gravelly Loam (2-8 % slopes) covers 25 acres and about 6% of the ownership (*see Figure 3*). This soil type occurs in the flat to gradually sloped bench just west of the Cook-Underwood Road east to the hatchery residence. The Washougal series contains very deep, well-drained alluvial-based soils formed on terraces and derived from basalt, andesite and volcanic ash. Permeability of this soil is moderate, with moderate water capacity. Typically, the surface layer is black gravelly loam 11 inches thick with a lower layer being dark brown very gravelly loam 25 inches thick. The subsoil is dark yellowish brown very gravelly sandy loam to 60 inches or more. Effective rooting depth is more than 60 inches. Runoff is slow and the erosion hazard on and off roads is slight.

Washougal gravelly loams apparently are the most productive soil types on the ownership, as indicated by DF-SI_{50} (50-year Douglas-fir site index) of 119 (low site 2). The culmination of Mean Annual Increment (MAI) for Douglas fir occurs at age 65 at 168 cubic feet per acre per year. Equipment limitations are suggested for forestry operations conducted during wet weather to prevent rutting and soil compaction. Windthrow potential is limited due to deep rooting depths of soil. Vegetation competition during regeneration period is moderate due to shrub development. Vegetation in these areas is currently field dominated by domestic grasses (tall oats) and Douglas-fir woodland on the upper slopes.

Rock outcrop/Rubble lands are mapped on 3 acres (<1% of ownership) on the south slope just north of Drano Lake, though other smaller areas of this type occur (see Figure 3). Soils classified as rubble land consist of areas of stones and boulders. Rubble lands occur on steep to very steep side slopes and commonly occur at the base of rock outcrops. Rock outcrops are bare, exposed, and composed of basalt and andesite. Vegetation is sparse and typically limited to moss, lichens, scattered grass, shrubs and trees. These sites are very poorly suited for timber production but provide important habitat for some species and aesthetic value.

Rock Outcrop/Xerorthents complex (50-90% slopes) is the most extensive series on the ownership covering 250 acres and 60% of total acreage (see Figure 3). Xerothents typically comprise 65% of this complex, and are a diverse soil type with shallow to deep soil accumulation, formed in colluvium mainly from basalt, andesite and volcanic ash. A typical soil profile has a surface layer of very dark grayish brown gravelly loam 6 inches thick. The upper 13 inches of the underlying material is dark brown very gravelly loam, and the lower part to a depth of 31 inches is brown extremely gravelly clay loam over bedrock. Depth to bedrock ranges from 10 to 60 inches. Permeability of this soil is moderate in the subsoil and rapid in the substratum. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. Also included in this complex are small areas of the McElroy soil types (described above). This soil complex includes most lands west of the Little White Salmon River.

Xerothents and McElroy soils support varied vegetation from oak woodlands to dense coniferous and mixed hardwood forests. Rocky cliffs composed of basalt and andesite are scattered throughout this complex and are sparsely vegetated by moss, lichens, scattered grass, shrubs, and trees. No site productivity or tree growth data is provided for this series in the soil survey. The erosion hazard on roads of these soils is severe and very severe off roads. The soil is not listed as a hydric.



Map 2. Soil Types on the LWS National Fish Hatchery Lands

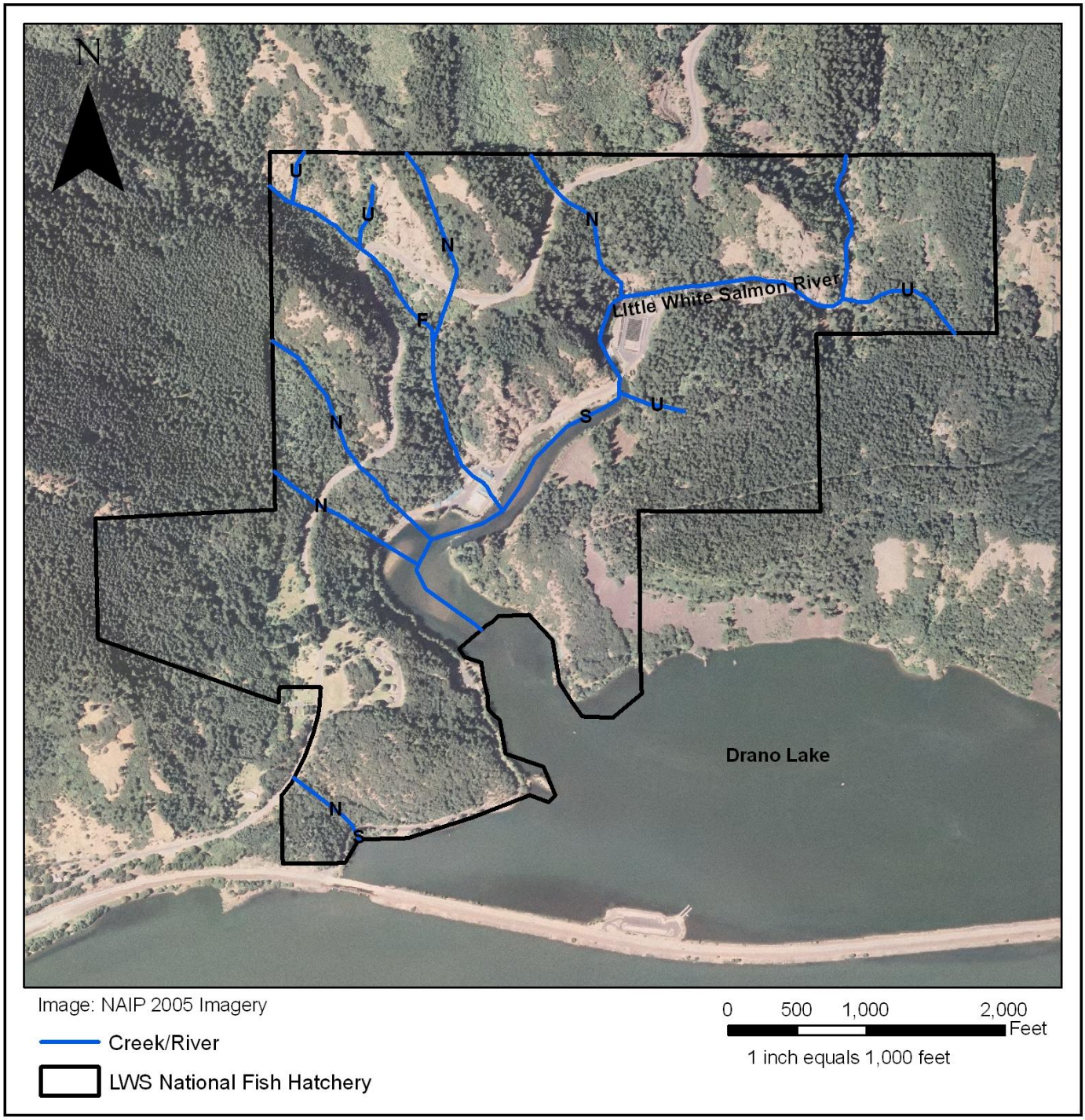
Hydrology

The ownership is situated within the Moss Creek Sub-watershed of the 86,462 acre Little White Salmon Watershed. The main hydrological feature of the ownership is the Little White Salmon River, which enters the ownership at the northwest corner of the ownership (*see Photo 2 and Map 3*). The total mapped distance of the Little White Salmon River on the ownership is 1.2 miles, though a portion of this is actually Drano Lake. The Little White Salmon River originates in the Gifford Pinchot National Forest west of Monte Cristo Peak and empties into Drano Lake, a backwater to the Columbia River created by impoundment. The Little White Salmon NFH has a concrete dam that spans the entire channel of the Little White Salmon River just above the bridge that accesses hatchery facilities at the north end of the ownership. Below this point the river slows as gradient lessons at the mouth of the Canyon and mixes with Drano Lake (*See Photo 3 and 4*).

Topography above the canyon bottom is typically steep, dissected, and is drained by at least seven small high gradient spring fed creeks that confluence with the Little White Salmon River or at the north inlet of Drano Lake (*see Photo 5*). There is an estimated 2.3 miles of unnamed intermittent and perennial tributaries on the ownership. The creek that flows behind the main hatchery office (Bailey Creek/Hillside Spring) is the only perennial tributary and is classified by the State of Washington as (F1) potentially fish bearing. However, (Peck et al. 2006) document a hatchery water intake as a barrier to fish passage at the base of this creek. Water from this creek is piped underground to hatchery facilities. The remaining reaches are classified as N1 (Modeled non-fish bearing), U1 (un-modeled stream that may or may not exist), or N6 (former untyped stream).

We are aware of no jurisdictional wetland areas on the ownership properties. The NRCS soils survey for Skamania County does not show any hydric soils. However, a complete site survey for wetland determination has not been completed.

Photo 2- LWS River at north ownership boundary. Photo 3- LWS River below main hatchery. Photo 4- Drano Lake (foreground) and Columbia River. Photo 5 - Bailey Creek with evidence of recent debris torrent.



Map 3. Water and Fish Passage Status on the LWS National Fish Hatchery
[N=non-fish habitat, U=un-typed, S= inventoried shoreline, F= fish use]
Water typing from DNR Washington State Watercourse Hydrography layer, Definition of codes found in Appendix C.

Vegetation

The LWS NFH is situated on the western edge of the Oak/Conifer Foothills Ecoregion, bordering the Western Cascades Lowlands Ecoregion. Given the ownership interfaces these two zones, it is not surprising it contains a remarkable diversity of vegetation types arranged over relatively small patch sizes. A number of factors combine on this ownership to create these vegetation patterns. 1- Variation of soil types. 2- High level of topographic variation including slope, aspect and elevation over small spatial scales. 3- Convergence of west and east side climate patterns. 4- Vestigial vegetation conditions resulting from past Native American Burning and natural fire regimes. The resulting patterns of vegetation composition and structure, often typical in this part of the Columbia Gorge, are described below.

Structure/Composition and Vegetation Trends

In this assessment, vegetation has been delineated into polygons of similar vegetation based on dominant overstory conditions or other land cover pattern (e.g. water), and assigned a type name (*see Map 4 and Appendix B and C*) [2]. These unique areas (referred to in this plan as polygons or vegetation polygons) are then grouped into cover types (Forest, Woodland, and Open). Each of these categories is then described and classified using the following approach:

Table 2 Summary of Vegetation Cover Types

Cover Types	Polygons	Acres	% Total
Forest	30	253	61
Woodland	19	80	19
Open-Meadow/Rock	8	22	5
Open-Talus/Scree	3	6	2
Open-Water	5	27	6
Developed	5	29	7
Total	70	417	

[Forest (>80% canopy cover), Woodland (20-80%)]

1- **Overstory Structure and Composition**
The species composition and vertical/horizontal structural conditions of dominant and sub-dominant tree canopy layers are described.

2- **Understory Structure and Composition**
The common species and structural characteristics of the understory are described. For vegetation types lacking tree cover, the dominant plant community is described.

3- **Vegetation Development Stage and Trends.**
In this section, stands are described according to phase of ecological development including past and present trends of succession.

[2] Vegetation typing uses symbols / and - to show levels of overstory cover by dominant species. For example, "Douglas fir - Oak " describes a stand where fir is the dominant overstory tree, while oak is secondary. In the second example, "Oregon white oak/Douglas-fir" describes a stand where oak and fir share main canopy dominance.

Forest Types

Overstory Structure and Composition

Forest is the most prevalent cover type on the ownership, occupying about 253 acres and 61% of the ownership (*see Table 2*)[3]. There are a total of 14 unique vegetation types classified as forest and 30 polygons (*see Appendix C and D*). Douglas-fir is a prevalent overstory tree species in most forested vegetation types. Bigleaf maple is the most commonly occurring hardwood.

There are four general forest conditions that characterize most forest on the ownership. These include:

1- Stands where Douglas-fir is the dominant species and bigleaf maple is a minor associate.

2- Stands where Douglas-fir and bigleaf maple co-dominate. In these areas, Douglas-fir and maple are arranged both in discrete groves and mixed.

3- Stands where maple dominates and Douglas-fir is a minor associate.

4- Stands currently dominated by Douglas-fir and maple that have remnant Oregon white oak and/or ponderosa pine.

Oregon white oak can be found as a minor associate throughout forest types and is often overtopped or growing in small discrete patches, usually on thinner soils. Western redcedar (*Thuja plicata*) is uncommon and found on moist conifer slopes. Ponderosa pine is rare and widely scattered through forest types and indicative, along with oak, of more open conditions prior to white settlement. Black cottonwood (*Populous trichocarpa*), and red alder (*Alnus rubra*) are concentrated mostly in draws and riparian areas and occasionally on moist north slopes and edges of talus.

Photo 6. Low structural diversity forest in Douglas-fir/maple type (Stand 2066). Photo 7. Moderate structural diversity in Douglas-fir/Oak-Maple type (Stand 2034). Photo 8. High structural diversity in Douglas-fir-Maple-Oak type (Stand 2030).

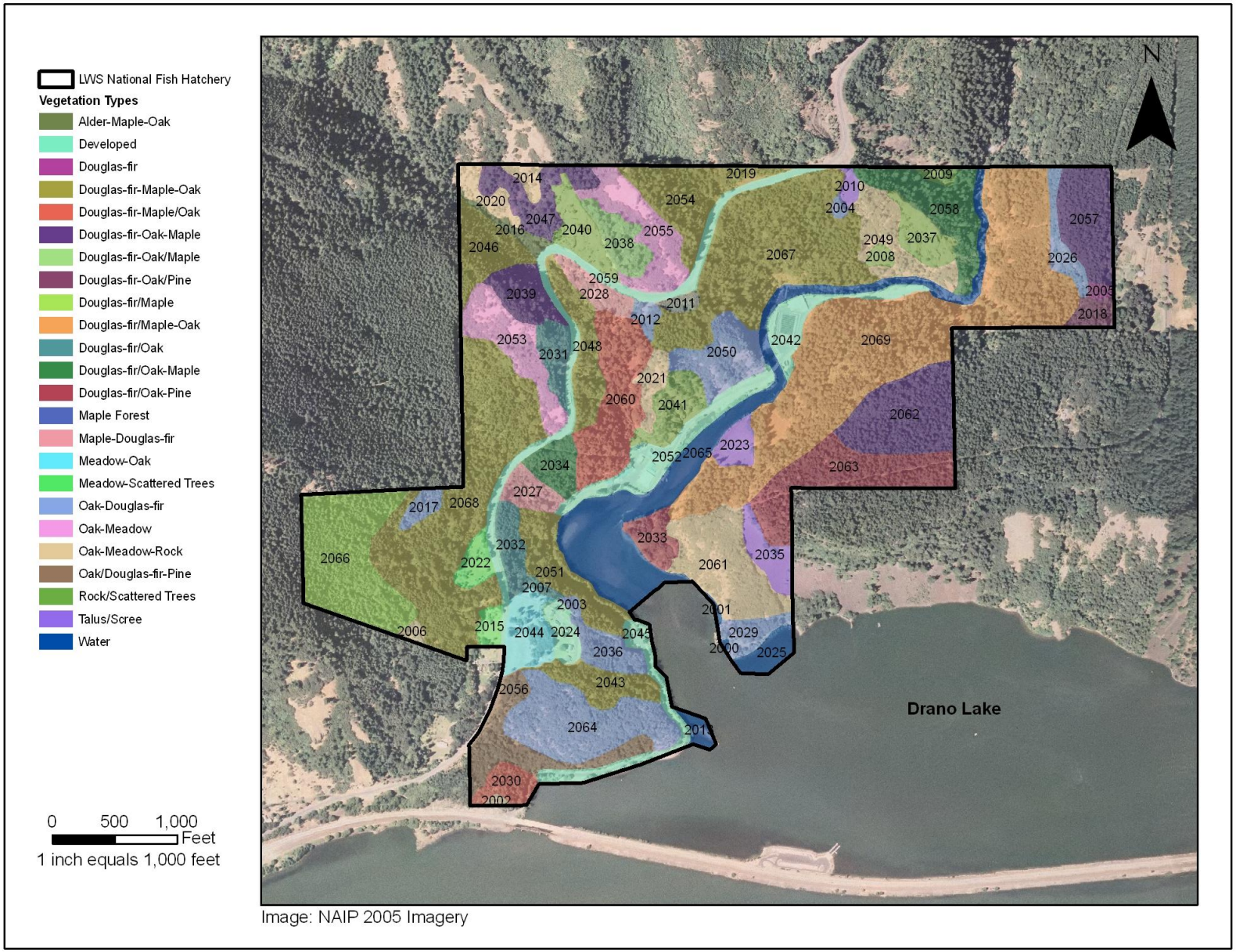
[3] Forest cover includes stands with >80% canopy cover.

Most forested stands are composed of trees at least 50 years of age are older. The Douglas-fir component in these stands is compromised of a mix of 1-3+ age classes, which correspond with regeneration after periodic logging, and ingrowth with cessation of fire. On a few sites, the first age class includes Douglas-fir that have regenerated in the last 50 years as a result of fire suppression, and high grade logging. This young class of fir continues to develop in poorly stocked areas, particularly where oak currently dominates, edges, openings, and other hardwood gaps. Another approximately 100-140 year old class of fir is prominent and scattered or clumped throughout the ownership. At least one older Douglas-fir cohort occurs as scattered individual trees and distinct stands (e.g. Stand 2054). This cohort may represent some trees that regenerated prior to modern fire suppression, possibly as a result of reduction of native burning with population declines starting in the late 1700s (*see Photo 9*). These are the largest trees on the ownership and exhibit characteristics of old growth trees (see Map 6). Hardwoods in these forest types vary in age. The oldest hardwoods are widely scattered remnant oaks in multiple age classes including cohorts that have developed in the last century to trees well over 250 years of age. Maple and alder have mostly regenerated within the last 50 years[4].

Photo 9 - Remnant old growth Douglas-fir in Stand 2067. Note: 6" ruler at DBH on tree.

Assessing vertical and horizontal structure of forest types on the ownership is challenging as patterns of vegetation vary widely both within and between stands (see Stand Development section below). Overall, both vertical and horizontal structure are comparatively high compared to commercial conifer forestland. Structure in these types has been enhanced by a number of factors including: 1- Variation of topography, aspect, and soils. 2- Mixing of fir and hardwood species which tend to occupy distinct canopy layers or single species clumps creating high edge diversity. 3- Areas naturally regenerated after logging causing variable patterns of tree spacing. 4- Old growth Douglas-fir, ponderosa pine, and remnant oaks still occur on some sites. Forest types on the ownership lack extensive canopies of overlapping crown structure common in old growth temperate coniferous forests and associated with multiple tree cohort development. However, canopy overlapping occurs in areas along stand edges, within mixed hardwood-conifer, and where remnant old growth fir persists. Stand size averaging < 9 acres (70% of stands < 8 acres) is one indication of structural diversity at the stand level. The Standard deviation of basal area provides another indication of finer scale patterns of tree structure. Variation of basal area between plots was considerably higher across the ownership, as compared to conifer plantations.

[4] Some bigleaf maple have stump sprouted from older cut trees and are likely well over 150 years old.



Map 4. Vegetation Types on the LWS National Fish Hatchery

Vertical and horizontal live tree structure is most simplified in portions of stands where 50-70 year old single canopy Douglas-fir exist, and those lacking a hardwood layer (*see Photo 6*). In these dense conifer areas, tree foliage is concentrated in the upper canopy and young tree cohort development by shade tolerant conifers is non-existent. Areas of moderate structural diversity include stands and patches within stands with multiple conifer cohorts and single-cohort Douglas-fir dominated stands with a hardwood sub-canopy (*see Photo 7*). Areas of highest structural diversity include multi-cohort conifer patches with several age classes and species of hardwoods (*see Photo 8*). In these patches, maple enhances canopy complexity due to its shade tolerance and ability to maintain live branches in low light.

Snags, down wood and decayed live trees in forest types are described below (see Dead Wood Resources).

Understory Structure and Composition

Understory composition and structure varies widely across forest types resulting from differences in site productivity, plant association, management history, and current forest canopy conditions. Understory conditions can be summarized by three general conditions. 1- Areas with weak understory development often are found in patches with dense conifer canopy (*see photo 10*). 2- Areas with moderate shrub and other plant development are common where canopy is moderate to high in density and where hardwoods and conifer mix. 3- Areas with heavy shrub cover occurs in forest gaps and where hardwoods predominate (*see Photo 11*).

Photo 10 - Heavy conifer canopy cover and resulting poorly developed understory.

In forest types, total understory vegetation cover ranges from 15 % to 96 %, averaging 26% across all types. Shrubs are the most extensive understory cover and range from 20 % to 95 % with an average of 30% across all forest types. The top four dominant shrub cover species in terms of frequency of occurrence include vine maple (*Acer circinatum*), sword fern (*Polystichum munitum*), Western hazel (*Corylus cornuta* var. *Californica*) and oceanspray (*Holodiscus discolor*) each found on over half of the sample plots. On more productive sites, plant cover is dominated by vine maple and sword fern. Moderate productivity sites often contained Western hazel, oceanspray, and dwarf Oregon-grape (*Berberis nervosa*). The lowest productivity sites were dominated by poison oak (*Toxidendron diversiloba*). Pacific dogwood (*Cornus nuttallii*) is common throughout forested types often occupying a mid-canopy position.

Forb cover averaged 3% across all forest types[5]. Common forbs known to occur in these types include Northern starflower (*Trientalis borealis*), Western trillium (*Trillium ovatum*), and vanilla leaf (*Achlys triphylla*). Grass cover averaged 7%. Native understory grasses include blue wild rye (*Elymus glaucus*), Sitka brome (*Bromus Sitchensis*) and Columbia brome (*Bromus vulgaris*). Non-native grasses were uncommon in dense forest areas. In more open areas including roadsides and edges species such as orchard grass (*Dactylis glomerata*), hedgehog dogtail (*Cynosurus echinatus*), ripgut brome (*bromus rigidus*) and bulbous bluegrass (*Poa bulbosa*) occur.

Stand Development and Classification

Photo 11- Heavy shrub cover is common in stand gaps, edges, hardwood groups and more open and/or patchy conifer dominated areas.

Vegetation has changed dramatically over the last 150 years on forest types of the ownership. Due to highly varied soil and topographic conditions, disturbance regimes are difficult to understand fully, without more detailed analysis. However, we surmise there were two dominant stand development patterns in forest types on the ownership in past centuries. 1- Stands accessible to frequent fires both from Native Americans and lightning were maintained in open conditions and dominated by a mix of oak, ponderosa pine and Douglas-fir. These areas were kept below site capacity for tree density by periodic fires. 2- Stands and patches more insulated to fire (some north slopes, rocky areas) had more developed understory (shrubs and smaller trees, and species less tolerant of fire)[6]. Stand development in fire prone areas has been altered most significantly since this element has been removed from the landscape. Substantial ingrowth of trees and shrubs has likely occurred on these sites. Logging of large Douglas-fir throughout most forest types on the ownership have further accelerated changes in forest development by releasing understory vegetation and increasing regeneration of trees and shrubs.

Aside from mature and old growth Douglas-fir remnants, forest types are nearly all in the "competitive exclusion" stage of stand development. Most sites have tree stocking levels that prevent further in-growth. We surmise future stand trajectories in the absence of a major "resetting" type disturbance will favor increased dominance by Douglas-fir across nearly all sites. There is a noteworthy absence of shade tolerant conifers in the understory and Douglas-fir is regenerating in oak patches and lower stocked areas. The above suggests these types are Douglas-fir plant associations, with long-term dominance likely by this species. Other species, notably bigleaf maple (a long-lived, fast growing, and shade tolerant hardwood species) will also increase cover, particularly in small patches still occupied by oak. In some places maple will co-dominate with fir or even develop

[5] Forb cover only reflects those species present during inventory during winter and spring 2008.
[6] Vegetation structure and composition in interface areas where these divergent fire regimes overlapped, contained a mix of both conditions.

into pure stands where disturbance such as wind caused tree fall and breakage reduces conifer cover. Understory plant development will not change appreciably, as the current major species are shade tolerant and competitive, though as canopy gaps form, light-favoring species will increase.

There are six forest types that contain oak as a minor component, comprising 24 stands, and nearly 229 acres, representing 91% of total forest type acres. In these areas, oak density ranges from just a few trees at the stand level, up to 20 trees per acre. Due to the high level of canopy cover in these types, many of the oak in these areas are in poor condition with mortality imminent in the next 10-20 years for many trees, without management. An Oak Succession Classification was applied to each stand to assess oak condition and risk of loss (*see Map 5 and Appendix E*)[7]. In the forest types with oak, 228 acres had at least some oaks classified as level 5, indicating late stage conifer encroachment. See "Summary of Disturbance Regime and Vegetation Change" section below for discussion on oak succession issues.

Woodland Types

Overstory Structure and Composition

Woodland vegetation covers approximately 80 acres (19% of the ownership)[8]. Two general conditions typify these areas including:

1- Oregon white oak woodlands interspersed with grass dominated openings (*see Photo 12 and 13*).

2- Woodlands containing a mix of tree species including Oregon white oak, Douglas-fir, and Ponderosa pine, with grass openings (*see Photo 13*).

There are four vegetation types classified as woodland and 19 vegetation polygons (*see Appendix C and D*). While no age class measurements were made in these stands, work on similar adjacent lands owned by the Columbia Land Trust suggests the dominant oak cohort in these types ranges from approximately150-300 years. These trees range in diameter from 3-20" diameter at breast height (DBH) with heights up to 60'. A distinct older cohort/cohorts of widely spaced oaks is present in several stands (*see Photo 12*). These trees are likely

Photo 12 - Two aged oak woodland (Stand 2064) with grass and forb dominated understory. Photo 13- Single cohort oak woodland (Stand 2061) with mixed shrub/grass and forb understory.

[7] The Oak Succession Condition Classification describes the stage of fir encroachment in areas previously dominated by oak on a scale of 1-5 with class 1 being oak dominance and class 5 being complete replacement of oak by fir (See Appendix E for graphics showing each class).
[8] Woodland cover includes stands with 20-80% canopy cover. Woodland types include some small meadows and rocky slopes too small to type separately.

300+ years old and suggest a savanna structure prior to the cessation of frequent fire regimes. Dead wood in oak woodlands are notably less prevalent compared to forest types. Snags are uncommon in most stands in these types. Snag densities from permanent inventory plots showed well under one snag per acre.

Understory Structure and Composition

Understory floristics in woodland types differ from those in most shadier, moister forest types. Composition varies with site productivity, canopy cover, and disturbance history (including domestic grazing). On dry, thin soils, southerly slopes, and more open woodlands grass cover often dominates, primarily by invasive annual grasses including hedgehog dogtail *(Cynosurus echinatus*), soft brome (*Bromus mollis*), and ripgut brome (*Bromus rigidus*), and perennial grasses comprised mostly of bulbous bluegrass (*Poa bulbosa*). Remnant bunchgrass communities are found throughout woodland types, especially on steep slopes where grazing was limited, stand edges and under more open canopy. Bunchgrass species include Idaho fescue (*Festuca Idahoensis*), prairie junegrass (*Koeleria micrantha*) and bluebunch wheatgrass (*Pseudoroegneria spicata*). Some native forbs found on open woodlands include broadiaea (*Broadiaea spp*.), Mariposa lily (*Calochortus macrophylla*), phlox (*Phlox* spp.) arrowleaf buckwheat (*Eriogonum compositum*), owl clover (*Orthocarpus attenuatus*), larkspur (*Delphinium* sp.) and yarrow (*Achillea millefolium*). Non-native forbs include bachelor's buttons (*Centaurea cyanus*), Saint John's wort (*Hypericum perforatum*), and spreading hedgeparsley (*Torillis arvensis*). Shrub cover on these sites is often dominated by poison oak (*Toxidendron diversiloba*) with cover ranging from 0-100%. See supplemental document for vascular plant list of the ownership.

Photo 14. Mixed woodland containing ponderosa pine, Douglas-fir and Oregon white Oak (Stand 2063).

Oak woodlands on more productive slopes often contain a different understory plant assemblage. On moister sites common native forbs include fern leaf desert parsley (*Lomatium dissectum*), sweet cicely (*Osmorhiza chilensis*), Pacific hound's tongue (*Cynoglossum grande*), largeleaf sandwort (*Moehringia macrophylla*), and rattlesnake plantain (*Goodyera oblongifolia*). Non native forbs are less common in shadier more productive oak sites. Common native grasses in these areas include elk sedge (*Carex geyeri)* and blue wildrye (*Elymus glaucus*) with Columbia brome found on sites often mixed with Douglas-fir and denser canopies. Non-native forbs are uncommon in more productive oak woodlands. Shrub cover of poison oak, oceanspray, snowberry, and wild rose varied from <5% to over 60%. Other common shrub species include tall Oregon-grape (*Mahonia aquifolium*), blue elderberry (*Sambucus cerulea*), mockorange (Philadelphus lewisii), snowberry (*Symphoricarpos*

albus), marah (*Marah oreganos*), Eastern sword fern (*Polystichum munitum* var. *imbricans*) and Oceanspray (*Holodiscus discolor*).

Stand Development and Classification

Current tree structure throughout woodland types suggests a much more open condition occurred prior to the cessation of fires. Much of the area currently typed as woodland was widely spaced oak interspersed with an occasional ponderosa pine or Douglas-fir. The current dominant woodland canopy initiated as fires waned across the landscape. Remnants of the pre-suppression open growth form oak, pine, and fir are found across the ownership surrounded by dense younger cohorts (*see Photo 9, 12, and 14*). Oaks grown under dense conditions have developed more as closed form trees, with less live crown, and often lacking the large lower spreading limbs typical of open grown oaks.

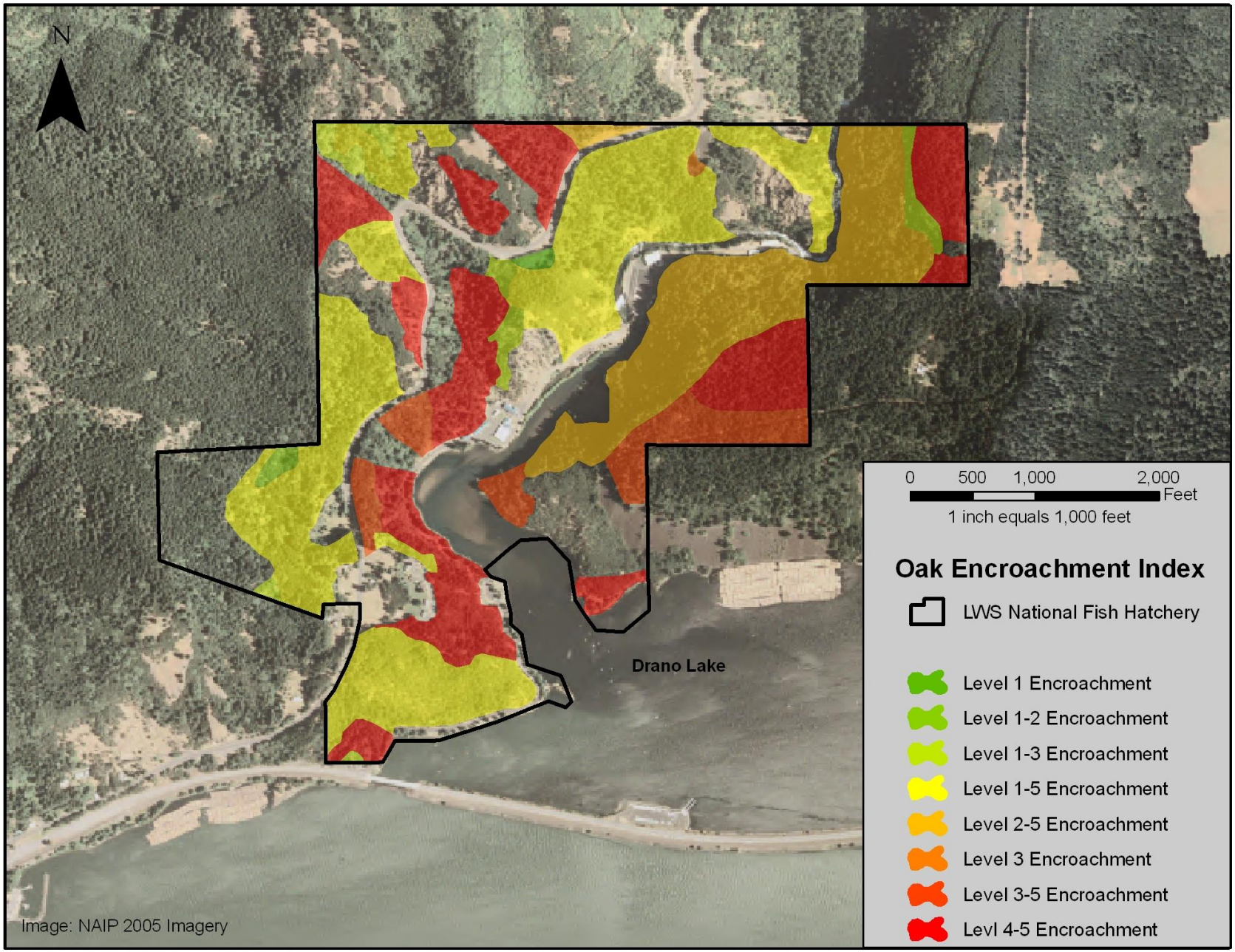
There are two prominent successional pathways in woodlands on the ownership. 1- On the driest sites (typically very thin and rocky soils), conifers cannot survive and oak is the climax species. In woodlands with greater moisture retention, Douglas-fir and bigleaf maple are replacing oaks and pines. This succession is in various stages; most advanced on better sites and slower in drier woodlands. Areas that are intermediate in productivity often have some Douglas-fir encroachment occurring beneath oak. However, on at least some of these sites, fir will probably not be able replace oaks due to moisture limitations[9]. The degree of encroachment and stage of succession for each stand has been assessed using the Oak Succession Classification (*see Appendix E*). The rating for each stand is provided in Appendix D. Overall, the level of fir encroachment on oaks is less advanced than in the forest types. Fourteen stands totaling 45 acres and 57% of woodland acres, had at least a portion of area with class 3 or greater succession (moderate to high levels of fir encroachment). Four woodland stands (33 acres) are considered stable (no noticeable fir encroachment).

Open Types

Structure and Composition

There are five vegetation types associated with open habitats, covering 56 acres[10] (*see Table 2*). Open types are broadly categorized as upland or water. Upland open types include meadows, cliffs and rocky ridges, and talus (*see Photos 15,16, and 17*). Talus is the most limited in extent and occurs on approximately 6 acres and 2% of ownership. While generally free of forest cover, some scattered or clumps of trees occur on upland

[9] Douglas-fir are often able to regenerate on hot, dry sites due to the shade and cooler microclimate afforded by oak canopies. However, these sites often cannot support mature fir, and mortality is high.
[10] Open habitats are areas not dominated by forest canopy, but exclude developed polygons (hatchery facilities).



Map 5. Level of Douglas-fir Encroachment of Oregon White Oak (Oak Succession Index)

[Level 1=None to early stage fir encroachment, 5=Total replacement of oak by fir, See Appendix E for definition of each level]

open areas. Oak and fir are encroaching in places wherever soils are deep enough to support trees. These open habitats were probably much greater in extent prior to the reduction of fire. These remnant habitats are important to a number of plant, invertebrate and wildlife species.

Open grass dominated meadows are the most common upland type and often occur as variably sized openings surrounded by oak woodlands. These areas correspond with very thin soils interspersed with exposed bedrock. A few meadows occur on deeper soils (Veg polygons 2015, 2022, and 2044) west of the hatchery housing and adjacent to Cook-Underwood Road. Plant composition in most upland meadows has been highly altered from its pre-Euro settlement condition. Many open slopes once dominated by bunchgrass and forb communities are now composed primarily of Eurasian weeds. Remnant native bunchgrass/forb communities are still present on some sites, mostly on very steep rocky slopes, typically where inaccessible to domestic grazing.

Altered sites typically feature hedgehog dogtail grass as the dominant cover. Bunchgrass communities are dominated by Idaho fescue, with lesser amounts of bluebunch wheatgrass and prairie junegrass. Invasive forbs in annual grass dominated areas include filaree (*Erodium cicutarium)* and other mostly annual weeds. Some noted native forbs in these areas include various species of lomatium, strawberry (*Fragaria Virginiana*), midget phlox (*Microsteris gracilis*) and plectritis (*Plectritis macrocera*).

In remnant bunchgrass areas, native forb communities are often abundant and include lomatium, strawberry (*Fragario Virginiana*), plectritis, balsam root (*balsamhoriza deltoidea*) and phlox. Species such as arrowleaf buckwheat, rock penstemon (*Penstemon rupicola*), and broadleaf stonecrop (*Sedum spathulifolium*) were common perennial forbs on rocky cliffs.

Photo 15 - Talus slope along Drano Lake. Rock/scattered trees on steep slope in inner gorge of Little White Salmon River (Photo 16). Grassy field near hatchery residence (Photo 17).

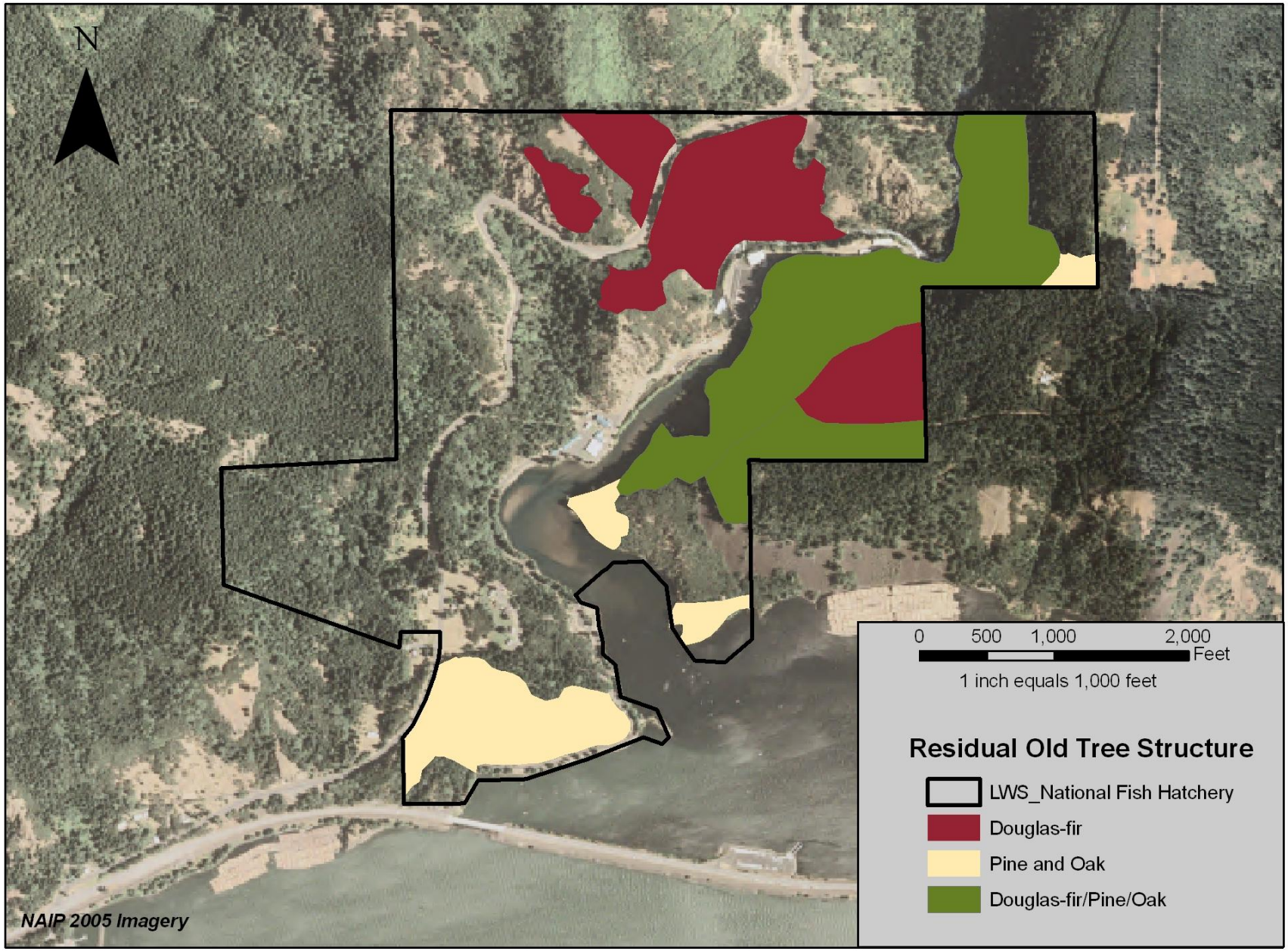
Development and Classification

With the exception of talus slopes, excessively rocky areas, and water most of the open vegetation types on the ownership will succeed to woodland or forest cover in the absence of disturbance.

Other Notable Vegetation Communities

Wet mossy cliffs are present in scattered locations throughout the ownership. The wet communities have likely not been altered much because they are inaccessible. Mosses are often abundant and include species such as *Brachythecium frigidum* and *Scleropodium obtusifolium*. Liverworts include *Chiloscyphus polyanthus* and *Conocephalum conicum.* A list of mosses and liverworts confirmed or likely to occur on the ownership are provided in the supplemental rare plant report (Thie 2009).

Riparian vegetation is generally not distinguished in vegetation typing because these zones are very narrow and limited in extent. The main areas of riparian vegetation occur along the Little White Salmon River. However, developments along the river including the Hatchery Road and hatchery facilities have replaced much of the riparian zone, so previous vegetation communities are unknown. Steep rocky terrain, talus, and natural confinement of the river channel limited riparian vegetation in places prior to development of the river. Current vegetation along the river and Drano Lake is generally confined to a narrow strip between the water line and road bank or canyon wall. Composition includes a mix of native sedges, shrubs and trees including willow (*Salix* spp.), elderberry, thinleaf alder (*Alnus incana*), Oregon ash (*Fraxinus latifolia*), and cottonwood. Invasive shrubs and forbs are common in this zone and include Scot's broom, Armenian blackberry, and many weedy forbs (See Noxious Weed section below).



Map 6. Stands with Remnant Old Growth Trees.
[Old growth conifers are at least 150 years old, oaks are savanna form and > 250 years old.]

Current Disturbance Regimes

Timber Harvests

While actual records of timber harvest are not available, stump and tree age classes indicate logging has occurred across most of the ownership over the last century. Logging prior to this is also probable given the accessibility and proximity of these lands to the Columbia River. It is unclear how much oak was harvested. The majority of the hatchery lands were purchased between 1938 – 1951, and the large Douglas-fir on much of this land was removed prior to this. The most recent logging likely occurred in the 1960-70s on lands acquired in 1989 (see Historic and Current Land Use section). No logging has occurred on hatchery lands since purchased by the Federal Government.

Insects and Disease

Forest insects and disease play pivotal roles in western forest ecosystems. These agents support nutrient cycling, soil productivity, food chains, and influence structure/composition at fine and broad scales. They can also lead to loss of property and timber values, increased fire risk, and visual and recreational impacts. In this assessment, we discuss mainly those species likely to have the most impact on ecological processes and economic values of the ownership. We found no evidence of insect and disease outbreaks or non-native insects or pathogens that would warrant management actions, though one root rot pocket in Stand 2032 should be treated for hazard reduction (*see Photo 18*). Insect and disease populations appear to be within a "normal" range, as defined by reference disturbance regimes. Noteworthy and likely occurring forest insects and diseases are described below.

Bark beetles are important forest insects in the context of management because they cause tree mortality and can affect tree vigor, species composition, and forest fuels. They also influence dead wood levels utilized by many wildlife species. Bark beetles typically respond to drought stress, root rot, insect defoliators, and/or heavy fresh slash/windthrow. The only bark beetle with the major potential to cause group mortality on the Ownership is the Douglas-fir bark beetle (*Dendroctonus pseudotsugae).* Douglas-fir bark beetle populations can erupt after windthrow or stem breakage caused by wind or ice storms, or in response to repeated defoliation by the spruce budworm (*Choristoneura occidentalis*) or tussock moth (*Orgyia pseudotsugata*). In these areas, Douglas-fir beetles can kill nearby trees, creating additional snags and desired canopy gaps, but also causing economic loss. Evidence of this species was noted in at least one laminated root rot (*Phellinus werii*) pocket[11]. This bark beetle likely is found in fir dominated stands on the ownership, at background levels. Since new Douglas-fir snags are relatively uncommon on the ownership yet desired for wildlife, this species serves an important function but is unlikely to cause widespread mortality unless large scale windthrow or fire were to

[11] Douglas-fir bark beetles often kill trees weakened by laminated root rot.

occur. The flatheaded fir borer (*Melanophila drummondi*) will also occasionally kill Douglas-fir, but typically moves into trees already weakened or killed by bark beetles.

Bark beetles that attack ponderosa pine are infrequent on the ownership given the scarcity of this tree on the ownership. Western pine beetle (*Dendroctonus brevicomis*) is the prominent bark beetle species in ponderosa pine in this area. This species occurs at background levels, occasionally killing individual trees, and erupting periodically in drought stricken or fire damaged stands[12]. This species is probably responsible for scattered dead pines seen on the ownership. Other bark beetles including the pine engraver (*Ips pini*), which tend to cause top-kill on older trees, and red turpentine beetle (*Dendroctonus valens)* may occasionally damage or kill ponderosa pine on the ownership.

Conifer stands on the ownership probably have not experienced major infestations by insect defoliators that are more common in eastside mixed-conifer forests. Species such as Western spruce budworm and Douglas-fir tussock moth have periodically defoliated thousands of acres of Douglas-fir on the eastside of Oregon and Washington. These species populations erupt on a cyclical basis, causing serious defoliation of fir trees. One notably defoliation by pine butterfly (*Neophasia menapia*) occurred in 1893-95 in the Klickitat Valley to the northeast, causing fairly extensive mortality in pine. These attacks occurred in nearly pure stands of pine and are unlikely to occur on the ownership.

The most common heart rot agent on the reserve in ponderosa pine and Douglas-fir is red ring rot (*Phellinus pini*). The leathery conks of this species can occasionally be found on Douglas-fir, often where they have grown up through a canopy of oaks. Red belt fungus (*Fomitopsis pinicola*) is an important decay agent of both heartwood and sapwood in pine and fir. The pouch fungus (*Cryptoporus volvatus*) is the most important saprot of fir and pine, and infects trees immediately after death. This wood saprophyte is particularly important to cavity nesting species of ponderosa pine, because this species has very thick sapwood. Root and butt rot agents in hardwoods include white pocket rot (*Inonotus dryophillus*), shoestring root rot (*Armilaria mellea*) in Oregon white oak, and hardwood trunk rot (*Phellinus igniarius*) infecting black cottonwood, and maple. White pocket rot was observed in several older oaks. The other species are known to occur in the area. Several other pathogens have been observed on Oregon white oak on the ownership. *Inonotus Andersonii* and *Inonotus dryophilus* cause a white rot of the heartwood of oak. *Laetiporus gilbertsonii* is a disease that causes a brown cubic rot of the heartwood.

Velvet top fungus (*Phaeolus schweinitzii*) is a both heart rot disease and root parasite that has been observed in older Douglas-fir on the ownership. This disease predisposes trees to windthrow and therefore its presence near major roads and

[12] Evidence of substantial mortality to ponderosa pine can be seen on slopes above the lower Klickitat River.

structures may warrant removal. This species creates hollow cored butts in trees, snags, and down logs, which provide excellent habitat for some wildlife.

Laminated root rot is the most notable disease on hatchery lands and several pockets have been identified. This disease is killing infected Douglas fir trees in these areas. Spread of this disease is typically slow (1-2' diameter increase/year) and is highly beneficial to some wildlife by creating snags, down wood, while increasing understory plant and bryophyte and lichen diversity. However, one pocket is adjacent to the Cook-Underwood road and utility lines. Weakened and dead trees are likely to fall across this road at some point (*see Photo 18*).

Photo 18 - Laminated root rot in Stand 2032 along Cook-Underwood Road. Note: utility line and road adjacent to expanding disease pocket.

Mechanical

Damage and mortality of trees from mechanical forces (lightning, wind, snow, and ice) is apparent but not excessive on the ownership. Wind is a major agent influencing dead wood levels including decay in live trees, snags and down wood. Occasional windthrown trees were found during surveys, however, more common damage to trees results from stem breakage, caused by periodic heavy snow and winds common in the Columbia Gorge in the winter. High winds damage trees in several ways. High winds often cause stem abrasion and injury, which initiates openings for stem rotting agents. Tree stems often break at old heart rot entry points, which often are areas of past branch abrasion from an adjacent tree or lightning damage. Some basal scars from fire and logging were found on older remnant pines, oaks and Douglas-fir. Scattered conifer trees show classic spiral scarring, resulting from lightning injury.

Fire

While historically fire was a major disturbance agent shaping vegetation on the ownership and surrounding landscape, it's influence has been largely absent for at least a century. The most recent fires appear to have occurred after stands west of the Cook-Underwood Road were clearcut logged and broadcast burned.

Fuels and Fire Risk Assessment

Forest fuels, both dead woody material and live vegetation, along with weather and topography, determine fire behavior and strongly influence effects on forest ecosystems. On wetter coniferous forests with low frequency-high intensity/severity fire regimes, forest fuels are generally not as important in managing fire risk as they are in drier eastside forests and some Westside interior valley oak and pine woodlands[13].

Photo 19- Dense encroaching Douglas-fir increase the risk of high severity fire in oak habitats throughout the ownership (Stand 2026).

The complexity of topography, past fire regimes, weather, and vegetation on the ownership, requires different approaches to risk assessment which consider stand type, DFC, and topographic position. The ownership contains elements of both east and westside climate and vegetation types[14]. Moist forest types on the ownership are considered similar to westside stands in the importance of fuels in fire risk analysis. On these moist sites, significant fires are unlikely except under the most extreme weather conditions. The extent of fuel reduction treatments required to reduce fire behavior during these events would not be compatible with desired forest structure. Even so, walk-though exams suggest forest surface fuels in forest types across the ownership are normal for these forest types, and not considered excessive or warranting fuel treatments. Live vegetation, primarily broad leafed shrubs, are the dominant understory fuel component in much of this forest. This component maintains a cool humid forest understory. Therefore removal is unwarranted and would be difficult to maintain given sprouting ability of most shrubs after cutting.

In contrast to moist forest types, woodlands, and open oak and grass dominated sites should be considered more like dry eastside types where fuels more strongly influence fire behavior and effects. Furthermore, dry east winds, and often steep topography combine to increase threats of undesirable fire behavior and effects from fires, while increasing control costs (*see Photo 20*).

Three prominent changes from historic vegetation condition are noteworthy in fire risk assessment in these drier types.

[13] Weather plays a more influential role in determining fire hazard than forest fuels in most westside forests. Westside stands are often very dense and under extreme weather conditions will likely burn with high severity regardless of fuel treatments

[14] The ownership is situated in an interface zone between Oak/Conifer Foothills and Western Cascade Lowlands Ecoregions

1- Annual invasive non-native grasses that now dominate open areas cause more intense fire behavior compared to the scattered native bunchgrass/forb communities they replaced on both oak sites and prairies.

2- Closed canopy oak woodlands that were formerly more open grown are less prone to low intensity fires, but probably more susceptible to hot, higher intensity and moderate to high severity fires under more extreme weather conditions.

3- Oak woodlands and some prairies have been encroached by conifers, which has increased potential for intense fire behavior and high severity effects by: A- Increasing canopy bulk density, B- Increasing flammability of the canopy[15], and C- By providing highly flammable crown ladders to upper stand canopies (*see Photo 19*).

On most oak and meadow types, grass is the primary fuel driving fire behavior. Surface fuel levels from woody materials, estimated during walk-through exams, in all timelag fuel classes (e.g. 1,10, 100, and 1000 hour fuels) are low and would not significantly influence fire behavior on these sites[16]. In oak woodlands with fir encroachment, the live "ladder" fuel component in oak stands will strongly influence fire behavior and make conditions difficult to control, while threatening mature oaks. There are at least 15 stand polygons (47 acres) on the ownership where fir is encroaching in oak stands and increasing the potential for high severity fires.

Photo 20 - Recent stand replacing fire in dense oak woodland in the Columbia Gorge, southwest of the Dalles, Oregon. Oak In contrast, reference era fires more typically were confined to understory fuels and maintained open tree structure.

The ability to control accidental or prescribed fires on the LWS NFH varies widely with terrain factors, road locations and vegetation. The Cook-Underwood Road provides a large fire break and access to stands east down to the Little White Salmon River. Chenowith Road provides a similar firebreak and access to stands to the west down to the river. The most challenging stands to control fire are those west of the Cook-Underwood Road. Topography in these areas is steep and there is no road access in those areas. The closest road access above these areas is over .5 mile to the west on Cook Hill. Most areas on the ownership are within 1000' of a paved road. The longest distances for hose layout are in the northeast part

[15] Douglas-fir are much more flammable than oaks. Most fir growing through oak canopies also have high live crown ratios due to lack of side-shade which enhances fuel ladder effects of these trees.
[16] Dead fuels are categorized into fuel diameter classes named according to the timelag principle. This principal is based on the fact that the proportion of a fuel particle exposed to the atmosphere is related to its size. Smaller diameter fuels tend to dry and combust more quickly due to their high surface area to volume. The smaller timelag classes drive fire behavior.

of the property (Stand 2069) and the extreme west end of the ownership (Stand 2066). Portions of these stands may require up to 1,000 to 2,000 feet of hose. There are numerous access points for filling water tanks from the Little White Salmon River, along the main road to the hatchery.

Dead Wood Resources

Dead wood in the form of snags, down woody debris, stumps, root wads, and heart rot infected portions of live trees serve many useful ecological functions in Pacific Northwest forests. While these structures are widely recognized for their role in providing habitat to many wildlife and invertebrate species, dead wood also contributes to soil building processes, erosion control, nutrient cycling, and refugia of both fungi and small mammals during fire events. Dead wood is particularly important to a number of wildlife species that use these structures for nesting, roosting, feeding and other purposes. The specific function of dead wood varies with the forest type, tree species, and wildlife species. In the frequent fire regimes associated with ponderosa pine and oak habitat types, snags likely represented a larger proportion of dead wood because down wood was quickly consumed in surface fires. Though scarce, scattered down wood are well used by many reptiles and small mammal species. In oak types, decayed wood in live trees is well used by a host of cavity nesting birds including primarily nesters (e.g. Lewis's woodpecker) and secondary nesters such as Western bluebirds and screech owls. The importance of snags and down wood to species potentially using the ownership is well documented. For example, at least 62 wildlife species potentially occurring on hatchery lands are known to use snags (*See Appendix F*).

Snags

Our survey showed snag density averaged over the entire ownership was well under 1 dead tree per acre. Douglas-fir snags were exceedingly rare overall[17]. Only 17 snags were sampled on over 20 acres of belted line transects, across several hundred acres of survey area. A total of 7 Douglas-fir snags were sampled. Fir snags ranged in size from 12-47" DBH per acre (27" DBH average) and ranged in decay from class 1-4 and between 15-90' in height, with tallest snags being in the lowest decay stages. All remaining sampled snags were Oregon white oak. These were mostly small diameter dead trees ranging from 8-19" DBH in decay classes 1-3, and 15-41' tall. No ponderosa pine snags occurred in sampling plots though a few widely scattered dead pines were observed during site visits.

Photo 21 - Though snags are rare across the ownership, high concentration of Douglas-fir snags occur in portions of Stand 2069.

Though our snag inventory indicates scarce snag resources, we noticed a few large diameter (>20" DBH) snags throughout the ownership. Most of these snags are in advanced stages of decay and many show fire scars indicating they predate much of the

[17] Snag estimates would have been higher if sampling had occurred in Stand 2069, but steep conditions prevented access. This stand has fairly abundant snags in concentrations.

current live tree cohorts. A few areas with high Douglas-fir snag counts were noted in laminated root rot pockets in Stands 2069 and 2032. Though snags in root rot areas tend to fall quickly, they provide a source or large diameter conifer snags and down wood for species requiring larger diameter dead wood such as pileated woodpecker and associated secondary cavity nesters.

Snag recruitment for currently standing snags results from several processes. Most of the large heavily decayed Douglas-fir snags are fire scarred and may have originated during early settlement logging. Small Douglas-fir snags in dense forest types are mostly the result of suppression mortality. Pockets of Douglas-fir snags in all sizes result from root rot. Dead oaks, maples and pine were killed by a variety of bark and wood boring beetles, suppression mortality, and wind breakage.

Photo 22 - Most down wood on hatchery lands is widely scattered and in later decay stages.

Down Wood

Like snags, down wood is scarce in most stands on hatchery lands. The average weight of down wood for all forest types is 3.5 tons/acre. Down wood diameters ranged from 0.6" to 35.3". The volume of down wood for the ownership averaged 397 cubic feet/acre and ranged from 77ft3/acre to 1,238 ft3/acre. In several forest type stands, scattered old and second growth stumps represent a significant portion of dead wood volume.

Because down wood persists for many years, the recruitment history and causes varies considerably. The largest Douglas-fir logs are a combination of carryover from the old growth stands (both from snags and pre-existing down wood). In contrast, most down log volume originates from suppression mortality. In woodlands, large downed oak logs make up most down wood volume, and result from mortality due to fir overtopping, encroachment by younger oaks and age related causes.

Decay wood in Live Trees

Trees are damaged by a host of agents including fire, wind, snow, insects, and disease. The death of part of a tree provides softened wood for foraging, roosting, and nesting by wildlife. These structures include softened heartwood, hollowed cores, broken tops, dead and intact tops, and scarred outer boles. These features are most important in large live trees (>20" DBH). Decay wood in Douglas-fir is uncommon in younger stands, and prevalent in old savanna form oaks (*see Photo 23*). The most decayed and structurally unique live trees occur in remnant old growth and older trees. Differences in stem decay in oak with age are striking, with hollow centers

common in old cohort trees, but very rare in younger and closed growth form trees. Wind and snow induced stem breakage has introduced heart rotting fungi in trees throughout the ownership, but is most pronounced on exposed slopes. *Phellinus pini* is probably the most important decay agent in Douglas-fir on the ownership, and is most common where mixed with oak.

Photo 23 - Old savanna form oaks commonly have hollow stems resulting from decades of heart rot development and fire scaring.

Invasive Weeds

The invasion of non-native plants has emerged as one of the greatest threats to biological diversity in Pacific Northwest (PNW) forests. The biology of non-native plants often allows them to out compete natives. Many of these species have no natural biological controls because they have not evolved in these plant communities. They also have adaptations that often allow them to out compete natives, particularly in disturbed environments. Many of these weeds threaten biological diversity as they replace diverse understory plant communities.

In this assessment, we consider both "noxious" and "invasive" weeds. Invasive weeds are a group of non-natives plants that have a high propensity to colonize and replace native vegetation. Noxious weeds are "invasive" <u>and</u> have been designated as, "noxious" by law due to their negative economic and environmental impacts, and ability to rapidly spread. Both noxious and invasive weeds are a management concern.

This assessment uses the State of Washington noxious weed list. This list assigns species to one of the following three classes:

Class A Weeds: Non-native plants which occur in the state in small enough infestations to make eradication possible; or is not known to occur, but its presence in neighboring states make future occurrence in Washington imminent. Eradication is required by law.

Class B Weeds: Non-native plants which are regionally abundant, but which may have limited distribution in some counties. Species are designated for control in regions where they are not yet widespread. Preventing new infestations in these areas is a high priority.

Class C Weeds: Non-native plants that are priority weeds designated by the State Weed Board as a target weed species. Long term programs of suppression and

control are a county option, depending on local threats and the feasibility of control.

During forest and rare plant inventories, other site assessment visits, and consultation with hatchery staff, we compiled a list of state-listed noxious weeds on the ownership (*see Table 3*). These and other weeds may also be listed in the plant list provided as a supplemental report to this plan. Noxious weed problems are concentrated mainly along roadsides and Drano Lake. Twelve state-listed noxious weeds were identified. Most of these species are associated with disturbed areas with partial to full sunlight[18]. Most noxious weed populations on the ownership are comprised of small and scattered populations (typically less than 10 plants), mostly along roadsides. They do not pose a particularly high risk in dense forests. Nevertheless, control should be a high priority because forest restoration treatments will create favorable environments for some of these species. Giant hogweed (*Heracleum mantegazzianum*), yellow iris (*Iris pseudacorus*) and Eurasian watermilfoil *(Myriophyllum spicatum)* pose a major threat to riparian/aquatic habitats if left uncontrolled.

Table 3. State Listed Noxious Weeds

Common Name:	Scientific Name:	Weed Class:	Location:	Status:
Scot's broom	*Cytisus scoparius*	State-B	Stand 2019, Roadside Cook-Underwood (2059)	1
Knapweed	*Centaurea Spp.*	State-B	Roadside Cook-Underwood (2059)	1
Oxeye daisy	*Leucanthemum vulgare*	State-B	Roadside Cook-Underwood (2059), 2045, 2052	1
Bull thistle	*Cirsium vulgare*	State-C	Roadside Cook-Underwood	1
Canada thistle	*Cirsium arvense*	State-C	Roadside Cook-Underwood	1
Herb Robert	*Geranium robertianum*	State-C	Roadside Cook-Underwood	1
Common St. Johnswort	*Hypericum perforatum*	State-C	Along Hatchery Road, 2052	1
Sulfur cinquefoil	*Potentilla recta*	State-B	Along Hatchery Road, 2052	1
Evergreen/Armenian blackberry	*Rubus laciniatus /armeniacus*	State-C	Drano Lakeside	1
Eurasian watermilfoil	*Myriophyllum spicatum*	State-B	Drano Lake	2
Yellow Iris	*Iris pseudacorus*	State-C	Drano Lake	2
Giant Hogweed	Heracleum mantegazzianum	State-A	Drano Lake	1

Status: 1 = Very small and localized population, 2 = Moderate populations and spread rate, 3 = Extensive within located areas and rapidly spreading

Though, not state-listed, there are several other identified invasive plant species on the ownership worth noting because they are likely to increase with tree thinning. Control of these species may be necessary to achieve restoration objectives. Hedgehog dogtail and ripgut brome are annual invasive grasses that are found in open

[18] Herb Robert and Scot's broom may invade forest understories.

habitats and woodland edges. Dogtail is the most prevalent invasive grass on the ownership and often dominates vegetation cover in open oak habitats. Ripgut brome is more common in open areas with deeper soils and roadsides. Wild oats (*avena fatua*) is another invasive annual grass scattered throughout ownership, mostly in the fields along Cook-Underwood Road. The other somewhat common invasive grass in oak and open habitats is bulbous bluegrass, a perennial found in slightly better soils than sites dominated by dogtail. Spreading hedgeparsely (*Torilis arvensis*) is commonly found in disturbed woodlands. Wall lettuce (*Lactuca muralis*) is infrequently found in disturbed forest types but has potential to be quite invasive after thinning. Wild carrot (*Daucus carota*) is found in open grassy areas throughout the ownership.

Though not currently found on the ownership, the following species are described because they are extremely invasive and represent future threats to plant community diversity. Garlic mustard (*Alliaria petiolata*), shining geranium (*Geranium lucidum*), false brome (*Brachypodium sylvaticum*) and knotweed (*Polygonum* spp.) are increasingly found in woodland understories and riparian areas. Their invasion in relatively undisturbed and shady forest understories distinguishes them from many other weeds. Common hound's-tongue *Cynoglossum officinale,* a state B-listed species, is found in open to partially shaded habitats. Several of the above species including garlic mustard, false brome, knotweed, and common hound's-tongue have been found in the Columbia Gorge.

Rare and Listed Plant Species and Habitats

The Washington Natural Heritage Program (WNHP) information system has no records of rare/listed vascular plants within the ownership. The WNHP lists 44 target species for Skamania County and 69 species for Klickitat County. There are 16 endemic species protected by Columbia River Gorge Scenic Area legislation. Based on the habitats and elevations at the LWS NFH, about 35 could possibly occur on the ownership. Plant surveys in 2008-09 did not locate any of these species on the ownership (Thie 2009).

The WNHP information system lists one non-vascular species, Dendriscocaulon lichen (*Dendriscocaulon intricatulum*) occurring on the ownership. It was not found during plant surveys in 2008.

Three high quality terrestrial ecosystem types are listed in the WHNP information system as potentially occurring in the vicinity of the ownership. They include:

1- ***Pseudotsuga menziesii* / *Holodiscus discolor*** (Douglas fir / Oceanspray) forest

2- ***Quercus garryana* / *Symphoricarpos albus*** woodland (Oregon white oak / Snowberry)

3- ***Quercus garryana* / *Festuca idahoensis*** Woodland (Oregon white oak / Idaho fescue)

Summary of Disturbance Regime and Vegetation Change

Timber harvests have supplanted fire, insects and disease as the most impacting disturbance regime across the landscape since the reference period[19]. The reference era fire regime in this area varied from high frequency-low intensity events in oak types to a more mixed frequency/intensity regime in surrounding conifer forests. Given the high frequency of fires in oak/pine areas we surmise these fires occasionally spilled over into adjacent conifer stands, acting to thin out understory vegetation while the severity in these conifer stands was low to moderate due to the fire resistant properties of mature Douglas-fir. Infrequently, conifer stands throughout this region were subject to high intensity fires that corresponded with climatic cycles that brought extremely hot and windy conditions combined with ignition sources[20]. These fires burned with high severity over large spatial scales, although mixed topography in the Cascades often created areas of mixed fire severity (some stands and patches of trees survived these major fires). Whereas historic landscape disturbances (fire, disease, wind, etc) created large areas (500+ acres) of single age-class stands, modern clearcutting has shaped the landscape into smaller, more fragmented habitat patches.

Photo 24- Former bunchgrass and forb prairie now dominated by invasive Eurasian grasses in Stand 2053.

The alteration of fire regimes and resulting vegetation changes on the ownership varies. The fire regime in oak/pine plant communities and prairies has significantly changed. The absence of fire has allowed Douglas-fir to invade and overtop many once open growth oaks and pines, for new oak cohorts and shrubs to encroach on savannas. Bunchgrass communities in these areas have been largely replaced by woodland plant communities or annual grasses (see Photo 24). In the forest types, the degree of departure from reference fire regime has not been as severe, except for the reduction of spillover from periodic low intensity fires from adjacent pine/oak areas.

Changes in other disturbances, such as insects and disease, and abiotic agents including wind/snow and ice, and landslides, are poorly understood. Global warming will alter the patterns of these agents and subsequently lead to changes in forest structure and composition. The most likely result is predicted to be warmer and drier conditions. Such conditions will increase the risk of more moderate to severe fires

[19] The reference period is the time period prior to Euro-settlement.

[20] In 1902, fires burned 480,000 acres on and near the Gifford Pinchot N.F. Many of these early settlement fires resulted from human ignitions. However, research corroborates a low frequency-high severity fire regime in much of the hemlock-fir region.

which if uncontrolled could reduce conifer forest and oak woodland habitats to early seral stages. Though it is still unclear what changes will occur, warmer and drier conditions are predicted. Drought and increased temperatures would likely increase insect-disease mortality leading to increased fuels and risk of hotter, more intense fires. The above scenario would reduce large tree structure and increase shrub cover and young trees and may lead to increased slope failures, and erosion.

Fish and Wildlife

The mix of vegetation types on the ownership provide habitat for many wildlife species. The ownership connects east and westside oak habitats and provides connectivity between the Oregon and Washington Cascades. The site is within the natural movement/migratory corridors along the Columbia River, along the Cascade crest and within the Pacific flyway. Our analysis determined at least 185 species that could potentially occur in habitats on the ownership. Included in this total are 111 bird species, 14 amphibian species, 12 reptiles, and 44 mammal species. (*see Appendix F*). We derived this list by querying the Matrixes for Wildlife-Habitat Relationships Database (O'Neil et al., 2001) for species utilizing east and westside Douglas-fir forests and oak/pine/fir woodlands, and checking these species against Washington GAP analysis species range maps, and known occurrences (observed during site visits, by hatchery staff and other natural resource contractors)[21]. The listing of a species does not imply its life cycle habitat needs are entirely met within the ownership. Several species have home ranges and habitat needs that spatially exceed the ownership size (e.g. pileated woodpecker, elk) though are known to occur on the property. Other species such as neotropical migratory birds, use the ownership only during breeding season or migration.

Mammals

Our analysis suggests potential current use of the ownership by 44 mammal species. Large mammals known or likely to occur on the ownership include elk, black-tailed deer, black bear, and cougar. Gray wolf, wolverine, fisher, lynx, and grizzly bear (all Federally listed species) are not included, because they do not currently use the ownership and future use is unlikely due to lack of good habitat conditions and other landscape recovery issues. Smaller forest predators such as bobcat, coyote, long-tailed weasel, and mink likely occupy habitats on the ownership. River otter and beaver have been spotted by hatchery staff. Small mammals likely present include snowshoe hare, squirrels, Townsend's chipmunk, various shrews and voles. Arboreal mammals are likely to be common and include tree voles, Douglas squirrel, northern flying squirrel, and possibly Western grey squirrels. Bats comprise the largest family of mammal species on LWS NFH. Habitats on the ownership are potentially suitable for at least 9 species of bats. The presence of permanent water, large hollow snags and trees, and a mix of forest and open habits suggest bat diversity may be high. Lack of roost trees may be a limiting factor for some of these species.

Birds

Bird diversity is high at the ownership level due to the mix of coniferous forest with residual old growth trees and hardwoods, oak/pine woodlands, edge habitats, and proximity to the Little White Salmon River and riparian habitats. Our analysis suggests 111 bird species may potentially utilize the ownership. Forest conditions

[21] Amphibian and reptile surveys were recently completed by Rombough (2006)

may be suitable for use by at least 7 woodpecker species. An estimated 14 species of forest predator birds, including 6 owls, 2 eagles, 1 falcon, and 4 hawks, and osprey may use this ownership. Owl species including great horned, pygmy, Northern saw-whet owl, and Western screech owl are likely to use this habitat. The other two species, Northern spotted owl (NSO) and barred owl compete for habitat. Since barred owls are more aggressive, their presence on and around the ownership may preclude nesting by NSO. Though the ownership does not currently have suitable nesting habitat for NSO, use by dispersing owls is possible. Two forest hawks (sharp-shinned and Cooper's hawk) are likely using the property. A third accipiter, Northern goshawk, may use the ownership for dispersal or post fledgling habitat. However, habitat on the ownership may be marginal overall, due to lack of suitable nest habitat, and other landscape limitations.

Neotropical migratory birds (NTMB) are another guild of birds using hatchery lands and an estimated 33 species may occur. These species occupy a range of forest niches including upper tree canopy (Townsend's warbler), mid-canopy conifers (Pacific slope flycatcher), hardwood patches (warbling vireo), edge and broken canopy (Western tanager), shrub-dominated canopy openings (Macgillivray's warbler) and dense oak (Nashville warbler).

Drano Lake and the Little White Salmon River offer good habitat for a variety of waterfowl. River dwelling ducks including common merganser are common. Many other species are found in Drano Lake including cormorants, grebes, mallards and wigeons. Harlequin ducks are present seasonally above the water intake at the north end of the property.

Remaining bird species include other common resident bird species (nuthatches, chickadees, juncos, steller's jay, and grouse). Some of these resident birds are actually short-distance migrators, moving into warmer and snow free parts of the state seasonally. These short-distance migrations are poorly understood for many species.

Amphibians

Our query shows current and/or potential use of the reserve by 14 amphibian species including 5 species of frogs and 9 salamanders. Amphibians includes species which spend their entire life cycle in water (e.g. Cope's giant, Pacific giant, and Cascade torrent salamander), those using a combination of riparian and upland habitats (rough-skinned newt, long-toed, salamander, and Northwestern salamander) and fully-terrestrial species (western red-backed, and Larch Mountain salamander and ensatina.

Reptiles

Our query shows potential use of the reserve by 16 reptile species, including 4 lizards, 10 snakes, and 2 turtles. The California mountain kingsnake have been found on the ownership (Rombough 2006). This snake is very rare in Washington, and the small Columbia Gorge population is disjunct, with the closest population being 200 miles to the Southern Oregon.

Fish
Historical use of the Little White Salmon River by sea-run fish has long been limited by Spirit Falls, about ½ mile upriver of the hatchery. Prior to construction of the fish hatchery and dams on the Columbia River the confluence area of these rivers up to the falls provided spawning habitat for fall and spring chook, chum and coho salmon. All native salmon stocks on the Little White Salmon River are now extinct. Current anadromous fish species include hatchery reared spring and fall Chinook and coho salmon and summer and winter steelhead, which are present in Drano Lake. Resident hatchery raised fish populations include introduced eastern brook and brown trout, and rainbow and cutthroat trout. Other fish species in Drano Lake include largescale and bridgelip suckers, pacific and brook lamprey, threespine stickleback, sculpins, white sturgeon, redside shiners, peamouth, and northern pikeminnow.

The creek that flows behind the main hatchery office (Bailey Creek/Hillside Spring) is the only perennial tributary and is classified by the State of Washington as (F1) potentially fish bearing. However, (Peck et al. 2006) document a hatchery water intake as a barrier to fish passage at the base of this creek. Water from this creek is piped underground to hatchery facilities. The remaining reaches are classified as N1 (Modeled non-fish bearing), U1 (un-modeled stream that may or may not exist), or N6 (former untyped stream).

Listed Fish and Wildlife Species

There are a total 25 listed wildlife species with current ranges that overlap the ownership and may occur (*see Table 4*)[22]. This includes 11 Federal and 16 State listed or candidate species. An additional 5 species are non-listed but are on the Washington State Priority Habitat and Species List (PHS). Wildlife species believed or known to be locally or regionally extirpated are not listed in this table. These species which include grizzly bear, grey wolf, fisher, and wolverine may utilize the ownership in the future with public and private recovery efforts, though use may be unlikely given the level of human development in the landscape surrounding the ownership. Brief descriptions of species needs, habitat conditions, status on the ownership and beneficial stewardship actions are provided below for Federally and Washington State listed species. Non-listed but PHS species are described at the end of this section. Stewardship actions are also described for each species in Appendix I.

> ***Pileated Woodpecker*** is the largest excavating woodpecker in North America, a keystone species and a state candidate for listing. Its large cavities are widely used by many larger secondary cavity nesters that cannot occupy the holes of smaller woodpeckers. This species prefers older forest structure but will occupy younger forests if sufficient snags and down wood are available for nesting and foraging (ants primarily). The large home ranges of this species (1,000 to over 2,000 acres)

[22] While Washington Department of Fish and Wildlife lists the genus *Myotis* on its Priority Habitat 2 list, it does not list individual species of this genus. We determined the ownership may be used by five *Myotis* species, though they are treated as one focal species in this plan.

require suitable habitat on adjacent lands if the ownership is to provide nesting habitat. Pileated woodpecker habitat on the ownership has likely increased in the last century with fire suppression and Douglas-fir encroachment. The ownership offers pockets of good habitat for pileated woodpeckers in forest types that have larger tree structure and an abundance of snags down wood (e.g. mature Douglas-fir stands with root rot pockets and older hardwood groves which often contain dead limbs of live trees). However, many stands lack the large tree structure and dead wood to meet this species needs. Pileated woodpeckers are not shy of edges and will utilize most of the forest types on the ownership including edges of oak/conifer stands if sufficient dead wood occurs. Increasing dead wood in moist forest types where high levels of snags and down wood are desired future conditions would benefit this species.

Lewis's woodpecker is a Federal candidate listing woodpecker species that primarily utilizes oak and pine habitats and cottonwood gallery forest along major riparian areas. Its populations have declined precipitously since Euro-settlement due to habitat destruction, particularly the removal of snags. Reference era habitat on the ownership likely supported Lewis's woodpeckers. This species may still utilize oak woodlands on the ownership, particularly along Drano Lake and the Little White Salmon River. Nest sites are typically in ponderosa pine snags and dead tops which though scarce, occur in the vicinity. Increasing ponderosa pine snags within ¼ mile of the lake and river would benefit this species. However, mature pine are scarce on the property so snag creation is not advised.

Slender-billed white-breasted nuthatch is a Federally listed species of concern, that exclusively utilizes oak and pine habitats. Its populations have declined since Euro-settlement due to habitat loss resulting from conifer encroachment, development, and removal of oaks. Reference era habitat on the ownership likely supported this species. This species is currently utilizing oak woodlands on the ownership. Nest cavities are typically in dead limbs of oaks or snags of the same species. Maintenance of oak woodland and mosaic thinning to increase tree diameter growth of oaks will benefit this species.

Northern Goshawks require large landscapes composed mostly of closed canopy

Table 4. *State, Federal and Priority Habitat Listed Wildlife Species on the LWS National Fish Hatchery*

Species:	Scientific Name:	Federal Listing	State Listing	State Priority	Current Presence	Focal Species
Pileated Woodpecker	*Dryocopus pileatus*	None	Candidate	PH1	Confirmed	Yes
Lewis's Woodpecker	*Melanerpes lewis*	None	Candidate	PH1	Possible	Yes
Slender-billed White-Breasted Nuthatch	*Sitta carolinensis aculeata*	Concern	Candidate	PH1	Confirmed	Yes
Northern Goshawk	*Accipiter gentilis*	Concern	Candidate	PH1	Unlikely	Yes
Bald Eagle	*Haliaeetus leucocephalus*	Concern	Sensitive	PH1	Confirmed	Yes
Peregrine Falcon	*Falco peregrinus*	Concern	Candidate	PH1	Possible (F,N)	Yes
Northern Spotted Owl	*Strix occidentalis caurina*	Threatened	Endangered	PH1	Unlikely	Yes
Barrow's Goldeneye	*Bucephala islandica*	None	None	PH3	Confirmed	Yes
Hooded Merganser	*Lophodytes cucullatus*	None	None	PH3	Confirmed	Yes
Harlequin Duck	*Histrionicus histrionicus*	None	None	PH2,3	Confirmed	Yes
Vaux's Swift	*Chaetura vauxi*	None	Candidate	PH1	Confirmed (F)	Yes
Purple Martin	*Progne subis*	None	Candidate	PH1	Possible (F,N)	No
Olive-Sided Flycatcher	*Contopus borealis*	Concern	None	None	Possible (F,N)	No
Mountain Quail	*Oreortyx pictus*	None	None	PH3	Possible (F,N)	No
Band-tailed Pigeon	*Columba fasciata*	None	None	PH3	Possible (F,N)	No
Myotis Bat (Various)	*Myotis* spp.	None	None	PH2	Possible (F,N)	Yes
Big-Brown Bat	*Eptesicus fuscus*	None	None	PH1,2	Possible (F,N)	Yes
Townsend's Big Eared Bat	*Corynorhinus townsendii*	Concern	Candidate	PH1,2	Possible (F,N)	Yes
Elk	*Cervus elaphus*	None	None	PH3	Likely	No
Western Gray Squirrel	*Sciurus griseus*	Concern	Threatened	PH1	Possible (F,N)	Yes
Cascade Torrent Salamander	*Rhyacotriton cascadae*	None	Candidate	PH1	Confirmed	Yes
Larch Mountain Salamander	*Plethodon larselli*	Concern	Sensitive	PH1	Possible	Yes
Western Pond Turtle	*Clemmys marmorata*	Concern	Endangered	PH1	Possible	Yes
Sharptail Snake	*Contia tenuis*	Concern	Candidate	PH1	Confirmed	Yes
California Mountain Kingsnake	*Lampropeltis zonata*	None	Candidate	PH1	Confirmed	Yes

PH=Washington State Priority Habitat (1=State-listed and Candidate Species, 2=Vulnerable Species, or aggregations, 3=Species of recreational, commercial and/or tribal importance), Current Presence is based on forage, roost, nest and/or dispersal use on the ownership. Possible (F,N,)= possible forage and/or nest). Focal Species are those whose habitat needs are specifically considered in stewardship planning.

mature and late successional coniferous forest. Goshawks are a Federally listed species of concern and State candidate species. Home range size for this species is well over 4,000 acres per pair. This large home-range area requires three components: the nest area (dense mid to late seral forest), the post-fledgling family area (dense to open multi-layered canopy, mid to late seral forest), and the foraging area (semi open to dense mid to late seral forest).

Historical use by goshawks of the ownership is unclear. The more open conditions that prevailed prior to fire suppression were probably poor habitat. However, the landscape may have provided more optimal habitat prior to widespread logging. The ownership and immediate landscape is probably currently marginal goshawk habitat due to both natural and management induced fragmentation of coniferous forest and lack of old forest structure. Quality of habitats is likely to increase with renewed conservation focus of USFS lands to the north and west. These public lands link with the ownership and therefore provide connectivity for this species to access mature conifer forest stands on the ownership. Efforts by private landowners to manage for more complex, mature coniferous forests will enhance potential use by this species. Other forestland in the areas (industrial and state) grown on longer rotations with legacy tree retention during harvest would further aid in goshawk use of the ownership and surrounding lands.

Bald Eagles are found on lakes, rivers, bays, wetlands, and other large water bodies with mature bordering forest and large trees and snags for perching, roosting, and nesting. This Federally listed species of concern and State-listed sensitive species uses Drano Lake for feeding. Bald eagles have been seen perching above the lake in a variety of trees from oaks to Douglas-fir. There are no known nests on the ownership.

Peregrine falcons nest on cliffs over water and other open areas. This Federally listed species of concern and State-listed sensitive species may use Drano Lake for feeding given the abundance of waterfowl, its preferred prey. There have been several peregrine falcon sitings on the ownership. It is not known if nesting occurs on the ownership. Peregrine falcons are known to be nesting in the Columbia Gorge (e.g. Beacon Rock). Though steep rocky terrain can be found on upland habitats, the ownership may lack high-quality nest sites, which often are high on cliff faces where inaccessible to predators. Since this species hunts primarily over open areas, the pre-settlement condition of uplands likely would have been more optimal than the current more densely arranged vegetation. However, the creation of Drano Lake may have improved habitat for its prey base.

Northern spotted owls (NSO) require late-successional and other structurally diverse and mature coniferous forest. This Federally listed threatened species and State endangered is nesting within a few miles on USFS lands within the LWS Watershed, and therefore could potentially use the ownership in the future for nesting, foraging and/or dispersal habitat. However, potential future use will be

heavily influenced by management practices on adjacent lands. Past use of the ownership by this species is unknown. However, this was probably not high quality habitat due to high natural fragmentation with open and oak habitats. This species is unlikely utilizing the ownership for nesting or foraging due to lack of mature forest structure required by this species. However, portions of the ownership and adjacent lands may serve an important strategic role for this species as dispersal habitat linking NSO populations in Oregon and Washington. The Columbia River has been identified as a potential dispersal barrier to this species, and the maintenance of mature forest habitat along the river is strongly supported (CSC 1999).

Potential future use of the ownership by NSO will be heavily influenced by management practices on adjacent lands, disturbances such as high-severity fires, and barred owl population trends. Continuation of short-rotation evenage forestry, expanding barred owl populations, and large high severity fires are negative risk factors for future use of the ownership by NSO.

Vaux's swifts are colonizing neotropical migratory birds that prefer mature coniferous forests throughout the PNW. This species is Federally listed as a species of concern and is a State candidate species. Unlike many other listed species, they don't require large contiguous blocks of older forest, but need certain features these types of forest provide. Their main requirement is a large hollow tree for nest and roosting. Canopy gaps are another important feature. Because these structural components are more typical in old growth stands, they are strongly associated with older forests. Access to a hollow tree and snag is often provided by the cavities excavated by pileated woodpeckers. While these swifts will use younger stands if large, suitable nest trees are present, management for this species hinges on providing long-term habitat needs for pileated woodpeckers, and growing older forests to provide recruitment of large hollow trees and snags.

Past use of the ownership by Vaux's swifts is unknown. We surmise the ownership had more open canopied forest and woodlands, but larger and older Douglas-fir in places including a greater number of large hollow trees and snags which provide ideal habitat for this species. Vaux's swifts have been seen feeding over Drano Lake and the Little White Salmon River. Though no nest or roost trees are known to occur, it is possible that nesting is taking place on the ownership. Though large hollow Douglas-fir appear to be uncommon, only one suitable nest could provide habitat for hundreds of birds. Swifts may be nesting and roosting in adjacent lands and using the ownership for forage habitat[23].

Purple Martin are neotropical migratory colonial nesting swallows that nest in snags near lakes, ponds and rivers. They are rare in the PNW. In Washington populations are centered in the Puget Sound and along the Columbia River. This species is a State candidate species. This species requires large snags in or near

[23] Vaux's swifts typically only forage within ¼ mile of the nest tree during the breeding season.

water. Most known purple martin nests today are in artificial structures constructed over water, due to the rarity of preferred snag conditions. Since this species is an aerial feeder, it prefers large expanses of open or sparsely wooded areas. Historical use of the ownership is unknown but likely given high quality habitat available for this species prior to major land altering actions.

Olive-sided flycatcher is a neotropical migratory bird that inhabits high severity burned forests and other open disturbed forest sites such as harvested areas, large windthrow patches as well as naturally induced edge habitat. It is listed as a Federal species of concern. Current use of the ownership is unknown but limited by lack of the above preferred conditions. Suitable vegetation structure for this species may have occurred after logging during the early to mid 1900s, as open burned forest with scattered large Douglas-fir occurred. This habitat was transitory, lasting 30-40 years. The current trend toward closed forest canopies and low density of snags is a negative habitat trend, though this species may find scattered suitable conditions. Habitat for this species will continue to decline unless treatments are implemented that create edge, snags and uneven conifer canopies with scattered tall snags and Douglas-fir.

Townsend's big eared bat is a Federal species of concern and State candidate species. This forest dwelling species appears to be tolerant of a variety of forest types. Lack of undisturbed buildings, caves, mines and bridges, its required roosting habitat, are major limiting factors for this species. Past use of the ownership by Townsend's big eared bats is unknown. Use may have not occurred because roost sites prior to Euro-settlement, notably caves, are rare in the immediate area. Current use of the ownership by these bats is also unknown. Use by Townsend's big eared bats will depend on availability of undisturbed roost sites. Survey of possible roost sites on the ownership would assist in stewardship of this species.

The ***western gray squirrel (WGS)*** is a State threatened and Federally listed species of concern known to occur in mature mixed oak/pine/fir habitats in Klickitat and Skamania Counties. Habitats in the Columbia Gorge are some of last populations for this species in Washington. There are three remaining populations in Washington, 1) Puget Trough, 2) Klickitat, and 3) Okanagon. The Puget Trough population has been nearly extirpated. Historic use of the ownership is unknown but populations were likely once linked along the Columbia Gorge east though Klickitat County, following the range of oak and pine habitats. There is some uncertainty as to whether this species is using the ownership. Hatchery staff have apparently seen WGS near the hatchery office but no nest trees have been located. This species has been documented by USFS, north of the ownership in the Little White Salmon Drainage but populations are apparently extremely limited in Skamania County with the current documented range only along the southeastern border with Klickitat County, which is at least 4 miles to the east and 6 miles to the northeast (Linders and Stinson 2007). There have been no formal surveys for this species on the ownership. No nests or sitings

were noted during on-site visits and forest inventory. The Columbia Land Trust conducted surveys on their lands directly to the east, but were unsuccessful in documenting any current use. Oak/pine/fir habitats should be surveyed for WGS prior to implementing thinning treatments. Active nests should trigger modified thinning prescriptions to maintain canopy connectivity. Even if no nests are found, edge habitats between oak and Douglas-fir should be feathered with increasing conifer densities to provide long-term habitat for this species.

Cascade torrent salamander is a State candidate amphibian that is restricted to cool wet seeps and cold flowing forest streams. Rombough (2006) notes this to be the most frequently observed amphibian species on the ownership, which suggests this species likely occurred during the reference period since high-gradient riparian habitats probably have not been heavily modified, except where these streams meet the LWS River. However, habitat may have improved over the last century as forest canopies near streams have become more dense, providing increased shade and cooler microclimate in its core use areas. Both larvae and adults were found in nearly all the small streams and seep areas on the ownership.

Larch Mountain salamander, a State sensitive and Federal species of concern, occurs on forested talus, scree and rocky slopes near water, throughout Skamania County. It is also known to occur in some old growth forests, utilizing down logs in lieu of rocky substrates. Though not found on the ownership, Rombough (2006) suggests this species may occur, based on proximity of the ownership to known populations and suitability of habitat.

Western pond turtle is a Federally listed species of concern and State candidate that inhabits marshes, sloughs, and slow-moving portions of creeks and rivers. There are no current or past records of this species using the ownership. Drano Lake is the only potential suitable habitat. Western pond turtles have known populations in Skamania and east into Klickitat County. Lack of suitable nest and overwinter sites may be a limiting factor though due to steep and rocky slopes adjacent to the lake and the Hatchery road. Lack of basking areas may also prevent use. The best sites for nesting and winter habitat on the ownership likely occur on more gradually sloped lands along the south point of the north shore of Drano Lake. This species would benefit from maintenance of open oak vegetation conditions with a brush component in these areas. Placement of down logs and rocks along the edge of the lake would enhance basking habitat.

California mountain kingsnake is a State candidate reptile that occupies open oak habitats, particularly adjacent to streams. This species is only found in Skamania and Klickitat Counties in Washington, and its nearest neighboring populations are in Southern Oregon. Based on known habitat needs, it appears this species occurred on the ownership under reference conditions. Rombough (2006) confirmed the presence on this species through sitings and skins. Documented use throughout the ownership suggests strong use by this very secretive species.

Maintenance and restoration of open oak habitats while providing some down wood cover will benefit California Mountain kingsnakes.

Sharptail snake is a Federally list species of concern and a State candidate reptile that occupies a variety of forest habitats, typically edges with open grass dominated vegetation. Given its association with oak and conifer forest along edges with open habitats, it is assumed this species occurred during reference conditions. This species was not found during herp surveys, but it is known to occur in the near vicinity (Rombough 2006). Like the California mountain kingsnake, this species is secretive and spends more of its time under down logs, rocks, or underground.

Non-listed Priority Habitat Species include Barrow's goldeneye, hooded merganser, harlequin duck, mountain quail, band-tailed pigeon, Myotis bats spp., big brown bat and elk. Suitable habitat for the above species occurs on the ownership. There is confirmed use of the ownership by Barrow's goldeneye, hooded merganser, harlequin duck, band-tailed pigeons and elk. Historic use is unknown but probable for all species. Management for desired future conditions that include a mosaic of oak and mature conifer vegetation types will benefit the above species. Special habitat needs of the above species include a diverse understory with abundance of seed, fruit producing understory shrubs and trees (band-tailed pigeons), large snag and hollow large trees (bats, ducks), and mix of cover types including open habitats and abundant browse and graze plants (elk), and shrubby edge habitat including areas below talus and riparian areas (mountain quail). To maintain Barrow's goldeneye, hooded merganser, harlequin duck nest use, snags and live hollowed trees should be positioned adjacent to the LWS River and Drano Lake.

Summary of Wildlife Species/Habitat Trends

The following is a summary of noted and suspected wildlife/habitat relationship trends and generalizations on the ownership.

- Species associated with late-successional mixed conifer conditions including interior forest (e.g. Northern spotted owl, northern goshawk) have experienced a reduction in habitat due to timber harvests on the ownership early in the 20th century. Harvests have continued on adjacent lands and throughout the landscape in more recent times, which has impacted habitat for mature conifer forest species, especially those with large home ranges and requiring large amounts of dead wood. Some older conifer forest structure has developed since initial logging and these small stands are connected with extensive USFS lands to the west and northwest that are being managed for late-successional forest.

- Species requiring open habitats (e.g. bluebirds, nighthawks) are likely to have reduced habitat since Euro-settlement with conditions continuing to decline as open areas close in with tree cover.

- Species requiring large snags (Douglas-fir/pileated woodpecker, ponderosa pine/Lewis's woodpecker) and hollow live trees (Vaux's swift, various bats) have experienced reduced habitat, though trends are toward improving habitat as trees mature and snags are naturally created.

- Down wood resources in conifer types are currently below optimal levels for species inhabiting wet conifer forest types.

- Species utilizing open oak and pine habitats (slender-billed white-breasted nuthatch, Lewis's woodpecker) have experienced reduced habitat since reference conditions

- Species utilizing more closed younger oak woodlands (Nashville warbler), likely have gained habitat.

- Acorn mast production has likely been reduced in areas where Douglas-fir has replaced oaks, to the detriment of species utilizing mast (band-tailed pigeons, slender-billed white-breasted nuthatch, deer).

- Species adapted to native bunchgrass and forb communities, including many indigenous invertebrates in addition to mammals, birds and reptiles, have reduced habitat.

- Species that prefer oak/conifer ecotones (Western gray squirrel) likely have more suitable habitat with widespread encroachment of Douglas-fir over the last 100+ years, though we suspect some if not many of the large hollow oaks that offer excellent maternity nest habitat this species are more rare. Since much of this habitat is successional, these mixed oak/fir stands are transitional with major reductions predicted as oaks succumb to conifer overtopping.

Infrastructure

Roads and Access

The ownership is well roaded, though steep topography limits vehicle access to many areas. The current road system consists of a network of paved roads and old skid trails (*see Table 5 and Map 7*)[24]. The Cook-Underwood Road, a heavily used paved county line, accesses upper slopes of the ownership west of the Little White Salmon River. Several overgrown skid trails provide limited tracked vehicle access to portions of these uplands. There is no road access for lands in the extreme northwest part of the ownership, most of the slopes between the LWS River and the Cook-Underwood Road, and the parcel of land that forms the extreme west property line (Stand 2066). A paved road provides access at the canyon bottom along the river and to hatchery facilities. Additional paved roads connect the Cook-Underwood and hatchery roads and provide access to staff housing. These roads provide some access for tracked equipment on gradually sloped land on both sides of the road where old skid trails exist. Most of Stand 2064 is accessible to tracked equipment.

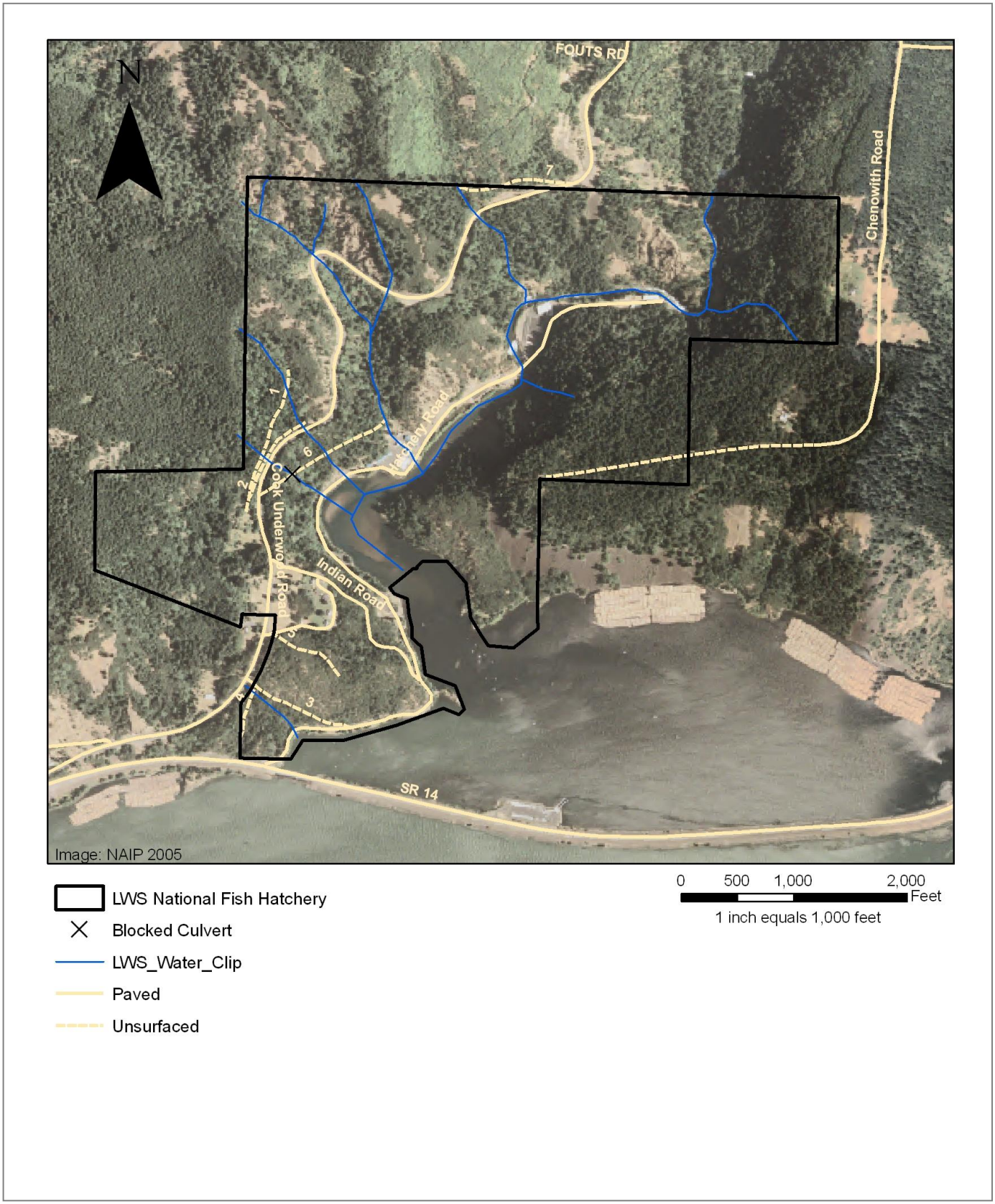
Photo 25 - Old roads and skid trails are common on the ownership like this trail in Stand 2056, and provide access for restoration treatments though will require some maintenance.

Table 5. Roads and Conditions

Type	Surface	Owner	Length (miles)	Active	Issues
Cook-Underwood Road	Paved/Unsurfaced	Skamania	1.20	Yes	2,5
Hatchery Road	Paved	USFW	1.42	Yes	4
Chinook Drive	Paved	USFW	0.21	Yes	
Indian Road	Paved	USFW	0.23	Yes	
Chenowith Road	Unsurfaced	USFW	0.23	Yes	2
Skid Trail 1	Unsurfaced	USFW	0.25	No	3
Skid Trail 2	Unsurfaced	USFW	0.16	No	3
Skid Trail 3	Unsurfaced	USFW	0.20	No	3
Skid Trail 4	Unsurfaced	USFW	0.09	No	3
Skid Trail 5	Unsurfaced	USFW	0.14	No	1
Skid Trail 6	Unsurfaced	USFW	0.25	No	3
Skid Trail 7	Unsurfaced	USFW	0.08	No	1,3
Total			**4.59**		

Issues: 1=Blocked culvert, 2=Access, 3=Trees/rocks blocking road, 4=Unstable slope, 5=Root rot along road

[24] Additional old skid trails may occur throughout the ownership.



Map 7. Roads and Access on the LWS National Fish Hatchery

Though most of the canyon slopes east of the LWS River are inaccessible to vehicles and other wheeled equipment, flat lands on the table east of the canyon can be reached via Chenowith Road. This paved county maintained route runs south just east of the ownership, then turns west and terminates approximately 1,200 feet east of the ownership. The road continues as a rough single track under utility lines owned by Skamania PUD. This road provides access to gentle topography areas north of the Columbia Land Trust's Wind Rim tract but would require agreement with Hank Patton, the owner of land west of the end of Chenowith Road. Access to the flat areas in the northeast part of the ownership, east of the LWS River would also require agreement with Hank Patton, or Broughton Lumber the owner to the north of the northeast ownership corner.

Paved roads throughout the ownership are all passable to vehicles and heavy equipment. The condition of mapped and other existing skid trails varies greatly (*see Photo 25*). Rock slides and tree ingrowth have made portions of these trails inaccessible to equipment without brushing and repair. The culvert along Skid Trail 6 is plugged with rocks and debris[25]. No other culvert or road related issues were identified. Slopes on both sides of the Cook- Underwood appear to be unstable in places and are frequently maintained by the County. Slopes immediately above the Hatchery Road appear to be highly unstable in at least one location, just upriver of the basalt cliff in Stand 2051. Other potential hazards include a Laminated root rot pocket at the intersection of Indian and Cook-Underwood Road.

Structures and Utilities

The ownership has many structures associated with hatchery operations, administration and housing. In addition, Skamania PUD has several utility lines on the ownership. A list of hatchery structures is on file at the hatchery administration building and should be examined prior to treatment implementation. Most of these facilities are located along the LWS River and the staff residences along Chinook Drive. Other less noticeable or un-documented structures will also be identified and protected during treatments.

[25] Skid Trail 6 is the original hatchery road.

Cultural Resources

Prior to Euro exploration and settlement of the Columbia Gorge, the area around the confluence of the Little White Salmon River was heavily used by Native American populations. There is a documented Native American ruin on the gravel bar on the north shore of Drano Lake at the mouth of the Little White Salmon (Parks 2001). This was the location of a fishing village, much of which is now underwater. This location was referred to by Lewis and Clark. Stone artifacts including sinkers, arrowheads and wooden structure remnants have been found there.

Though not physically on the ownership, remnants of the historic Broughton Flume are just east of the hatchery boundary and bears evidence to the extensive logging that occurred in the area.

Habitat Management Synthesis and Recommendations

The upland habitats on the LWS NFH were originally acquired specifically to protect the immediate watershed to avoid any adverse impact to water supply for hatchery operations and drinking water[26]. A secondary goal is to support stewardship of these lands to restore appropriate habitats for the benefit of fish and wildlife, with a focus on rare, declining, and listed species. As described above (see Purpose and Need section) habitats on the ownership have significant conservation value, though are degraded and require active management to achieve these goals.

In this section a framework of goals and objectives, desired future conditions, and management recommendations are analyzed for this ownership.

Management Goals and Objectives

Management objectives are key guiding directives, tiered from goals, upon which specific actions are based. Management goals are more broad standards, which guide objectives. The following goals (in bold) and supporting objectives (lettered) were developed in consultation with the LWS National Fish Hatchery staff to guide future management of this property.

1. Protect water resources.

A. Manage upland habitats to provide clean, cold water for hatchery operations and maintain current water quality in terms of temperature, dissolved oxygen and turbidity.

2. Restore and maintain a mosaic of site appropriate vegetation conditions. These desired future conditions (DFC) should balance habitat needs of focal and other rare, declining, and listed wildlife species, and use pre-European settlement conditions as a template with modifications that reflect other values.

A. Enhance and maintain a range of oak habitat types including open to more closed woodlands and edge where Douglas-fir and oak interface, using DFC as guidelines.
B. Restore and maintain mature Douglas-fir and mixed hardwood-Douglas fir forest types, using DFC as guidelines.
C. Identify and implement stewardship actions to protect old tree structure in all types.
D. Restore prairies where operationally feasible, using DFC as guidelines.
E. Control noxious weeds, and prevent new invasions.

[26] For example, the Chenowith area properties were acquired for watershed protection of springs, which provide a clean and cold water supply for hatchery rearing and incubation. The north boundary and western properties were purchased to protect the springs for drinking water supply.

3. Maintain/Enhance fragile and rare habitat types.

A. Protect talus, riparian areas, remnant bunchgrass and moss/lichen communities on rock outcrops and springs and design stewardship activities to enhance as necessary.

4. Collaborate with neighboring landowners to enhance landscape level habitat function.

A. Seek partnerships with the Columbia Land Trust, and other neighboring private and public landowners to conserve, restore, and monitor lands in the vicinity.
B. Coordinate stewardship actions to better achieve habitat management goals and objectives.

5. Manage roads to reduce adverse impacts to fish and wildlife populations and protect safety.

A. Identify and repair/replace damaged or inadequate culverts.
B. Identify and repair roads and uplands as needed to minimize surface erosion and risk of slope failure.
C. Control roadside noxious weeds.

6. Use the ownership as a model to demonstrate cutting edge restoration strategies, and techniques, and as a research site for public and private agencies to evaluate active, passive, and minimal stewardship approaches.

A. Use permanently located inventory plots to monitor ecosystem change.
B. Encourage research and monitoring to assess a range of innovative habitat restoration strategies.
C. Facilitate tours and other outreach to natural resource professionals working in similar habitat types, to demonstrate a range of stewardship options and promote landscape-conservation of oak and associated communities.

Desired Future Conditions

Future desired conditions (DFC) serve as targets upon which a stewardship strategy will be based and success of management judged. The use of reference conditions as a general template for DFC is generally consistent with the core management goals of restoring habitats for focal species[27]. The DFC for this ownership includes a set of descriptors of structural characteristics (e.g. multi-layered canopy) and quantitative targets (snags/acre). This description of future desired conditions serves as targets upon which future stewardship actions can be based and success of goals judged. Though these are stated as the DFC, these are not hard-and-fast targets or endpoints, rather a flexible collection of possible configurations of forest conditions to provide a directional guide for development of this plan's goals and objectives. One of the key components of the mature forest is variation of structure over space and time; so to define it too tightly denies this integral feature. Forest ecosystems are dynamic and parameters change at various spatial and temporal scales in both predictable and irregular/unpredictable patterns. A decision support flow chart was created to guide the design of DFC for each vegetation polygon (*see Figure 1*). Map 8 shows the DFC for each vegetation polygon on the ownership.

Interim DFC are targets that help managers reach milestones during the restoration process toward long term DFC." For practical purposes, these are set at a 10-20 year window. Interim and Long-term DFC should be revised as necessary to reflect updates to forest inventories and new research findings. For example, future research may allow refinement of standards for dead wood based changes in site productivity.

Fir/Hardwood Forest

Long-Term Desired Future Conditions

The DFC for stands in these types will be mature to old growth forest structure. Stand development is occurring from a wide range of initial conditions, aspects and soils, and resulting DFC will vary in terms of canopy structure, composition and understory plant community. Maple dominated areas will slowly succeed to Douglas-fir. Douglas-fir will be widely spaced and a maple canopy will remain a significant component between these trees. Where fir is dominant, structure will continue to be

[27] Reference Conditions classify stands based on their presumed structure and composition prior to Euro-settlement. Reference conditions provide a baseline to assess the degree of departure from this period, and a framework to determine a range of desired future conditions. Use of reference forest conditions as a foundation and template for future stand structure and composition is widely used by restoration practitioners. The reference condition target is an interpretation of the vegetation community that evolved under past disturbance regimes, and is well adapted to the current soils and climatic conditions of the area. This reference condition also provides a broad description of the necessary habitat conditions for focal wildlife management species. We can assume the reference period provides adequate habitat for these guilds, as they evolved under these conditions over the last several thousand years.

dominated by this species though hardwoods such as bigleaf maple, cottonwood, and red alder are highly desirable tree components and should be present in canopy gaps, draws and scattered throughout.

In the forest setting, maple is a highly desirable species. While red alder is a short lived species, bigleaf maple can live for centuries. Mature maple support a high diversity of epiphytes (mosses, lichens) and are heavily used by birds, especially resident populations during winter months due to the abundance of insects in them. Maple is widely known as a soil conditioner; increasing base cation exchange and nutrient cycling. Maple gaps allow more light into understory after leaf fall, which can increase understory plant diversity.

In Douglas-fir dominated stands, the following structures and conditions are highly desirable in these stand types:

- *Multiple species forest in patches, but long-term dominance of upper canopy layer by Douglas-fir. Though these sites are generally too dry for hemlock and cedar, these trees may develop in scattered pockets where moisture is sufficient.*

- *Variable canopy layering, with some areas of multi-cohort structure that are arranged closely over small spatial scales so layering occurs and others with fir overstory and maple mid to lower canopy.*

- *Large diameter trees with character features (broken tops, large diameter and witches broom branches, forked tops, heart rot and butt rot decay)*

- *Variable spatial patterns of tree distribution (clumps, individuals, patches, gaps)*

- *Substantial volumes of large diameter standing dead trees & large woody debris (lower levels in hardwood areas)*

- *Uproots (root wads and holes)*

- *Diverse ground community development composed of a both native sun and shade type species*

- *Hardwoods such as cottonwood and red alder may be present in canopy gaps, draws and scattered throughout ownership*

- *Organic upper soil profiles*

-*Variably sized canopy gaps (hardwood, shrub and conifer filled)*

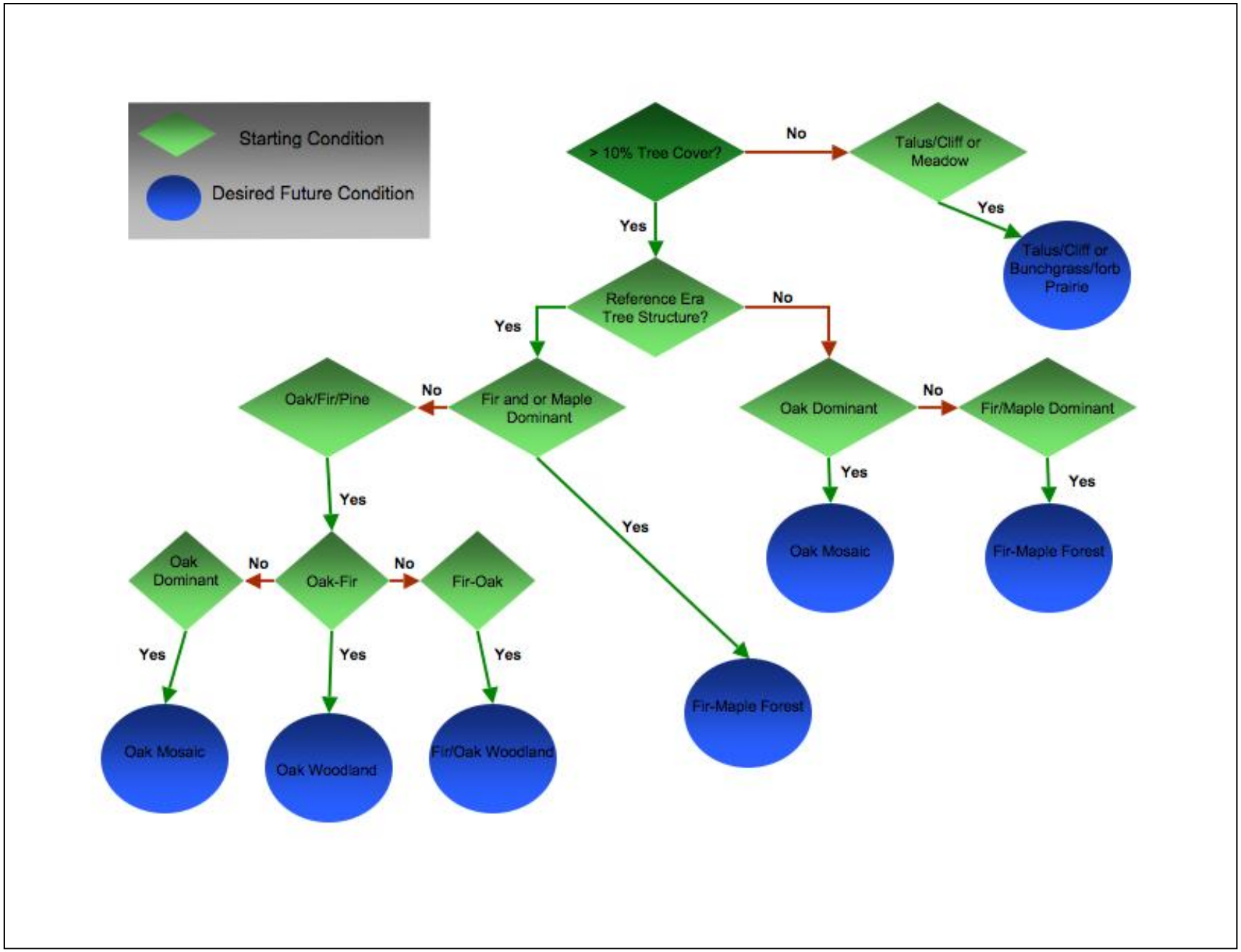


Figure 1. Desired Future Conditions Decision Flow Chart

Patch size of the forest conditions described above also varies widely due to extreme topographic variation on the ownership. The few age classes currently present are arranged mostly in distinct groups and small stands. Age class structure will diversify with stand development as individual and small group mortality occurs due to wind, snow damage, root rot, and other disease. These patterns including root rot pockets and wind damage are already present on this site. The unique weather and topography on these sites make forecasting stand development difficult. Though it appears disturbance will continue to enhance structural development on timelines faster than on more protected conifer sites.

DFC for dead wood, should be sufficient to support maximum levels of snag and down wood utilizing wildlife species for these forest types. In designing DFC for fir/maple types we considered reference conditions, and research that has quantified specific dead wood needs for specific species. We also considered disturbance history and other constraints on maintaining large accumulations of dead wood volume. For example, in westside old growth coniferous forests, down wood and snag levels recommended by some models are usually unattainable as goals in younger forests given concern for insect outbreaks, fire, and loss of wood volume[28]. For example, data from unharvested westside forest plots shows total snag levels as high as 47 snags/acre >10" dbh, with 14-20 snags/acre >20". Reference levels, as determined from the DecAID wood advisory model are regional summaries for dead wood. More site specific snag and down wood quantifications are not available. However, we surmise that actual reference levels on the ownership are somewhere between west and eastside coniferous forest estimates. Furthermore, the apparent broadcast burning of slash after initial logging and lack of legacy snags on much of this type, has resulted in very low volumes of dead wood. As a result, it will take centuries to attain the levels more consistent in Westside old growth. Dead wood conditions vary widely both temporally and spatially with disturbance events and stand age.
DFC assume this variance and are intended only as approximate targets.

The DecAID dead wood advisory model was used to determine density, size, and decay class targets of snags and down wood[29]. Currently available research indicates providing at least 36 snags/acre total, with 14 snags/acre > 20" dbh to meet a full range of wildlife needs for species associated with Westside coniferous stands. Recommendations for Eastside mixed conifer stands are 25 snags/acre $\geq$ 10" dbh, of which 9 snags/acre $\geq$ 20" dbh. We advise a long-term DFC of 10-30 snags/acre $\geq$ 10" dbh, of which 4-12 snags/acre > 20" dbh. Desired conditions also include a few very large snags (40" DBH+) per acre, to meet highly specialized habitat functions associated with species such as roost sites (pileated woodpecker, various forest bats). Maple dominated sites, with low Douglas-fir densities will have fewer snags than the

[28] For example, dead wood in Westside old growth stands have been estimated to be higher than the entire live tree biomass in some mature eastern hardwood forests.
[29] DECAID is a management model developed by the USFS which recommends dead wood levels to manage for based on wildlife habitat needs and general forest type.

range above and smaller sizes[30]. Snags should be both clumped and scattered and distributed across a range of topographic positions to provide for the range of cavity nesting needs[31].

Recommended down wood levels for maximizing wildlife species habitat for Washington Westside Cascades coniferous forests are based on percent cover with some specifications on size and distribution. DECAID recommends maintaining a total of 17% cover in a range of sizes (>4" DBH) and decay stages, spread among all decay classes. Distribution should be patchy and scattered with some high concentrations of down wood. Actual reference conditions were likely much lower in these types on the ownership given a reference era mixed fire regime. For contrast, DECAID advises maintaining 5% down wood cover for mixed conifer eastside stands. The recommended long-term DFC is 5-10% cover with roughly half the cover in logs greater >10" mid-point diameter and with levels at the upper range occurring on sits with highest site productivity and dominance by Douglas-fir.

In addition to snags and down wood, dead portions of live trees and hollow live trees are other important dead wood habitat components of DFC. Specific targets to guide DFCs for these structural features are not available. Fine-scale disturbance and tree senescence in older forest created low to high levels of defect in trees[32]. These features including hollowed, scarred and topped trees and are all highly desirable. DFC include increasing amounts of these structural features as stands mature.

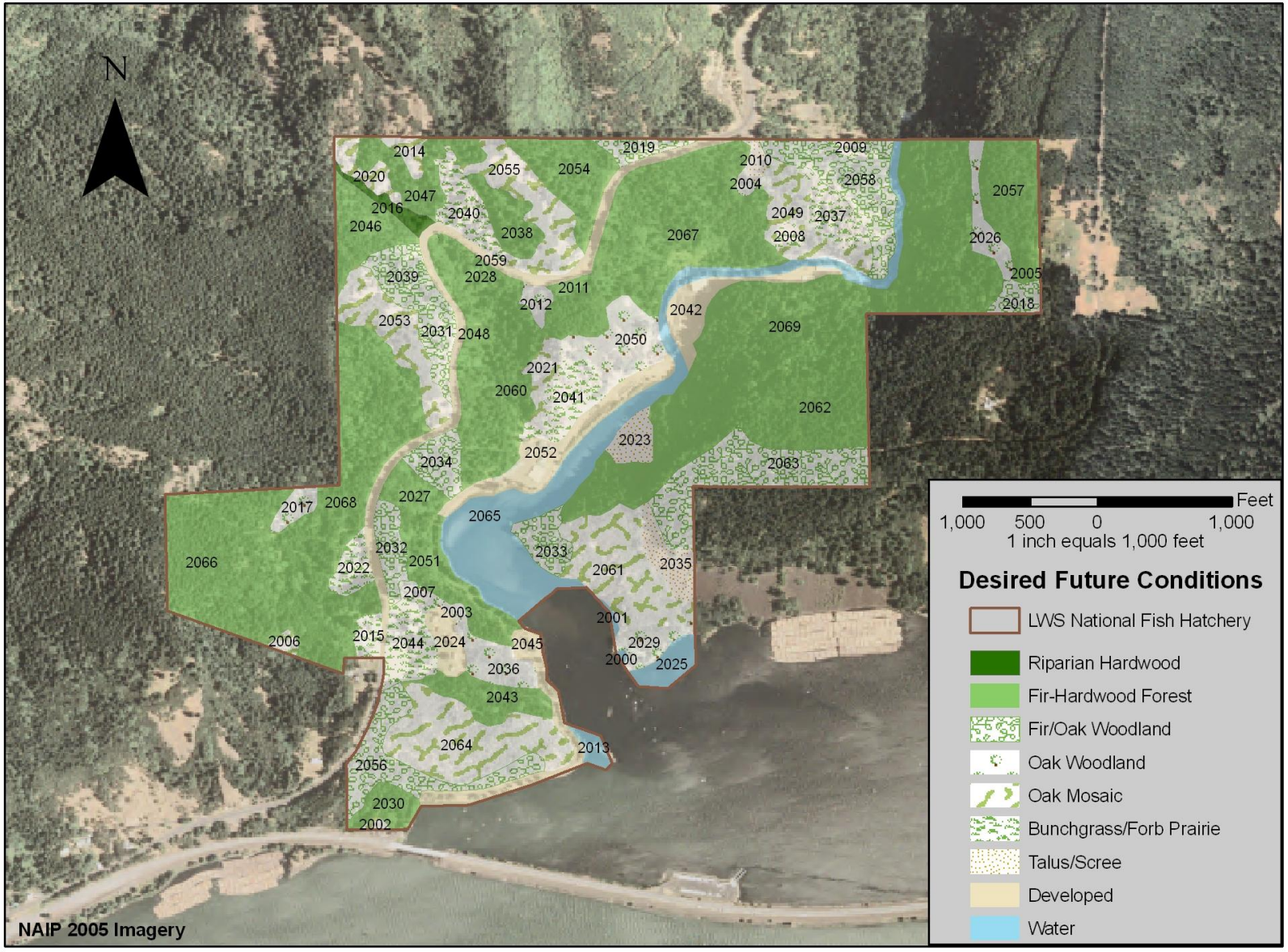
The above dead wood targets are well above those found in younger forests and represent more than the current live tree volume in some parts of the ownership. These dead wood DFC are long-term targets and represent levels that will be achieved over many decades to centuries.

Understory DFC includes a forest floor dominated by native plants appropriate for the plant community of each stand. Noxious and invasive weeds should not be present. Non-native plants that are not highly invasive plants should not occur on more than 5% of inventory plots and should not exceed 1% of overall percent cover.

Interim Desired Future Conditions

Conditions in the interim in these areas should continue to develop along normal stand development trajectories for young conifer stands. These stands will remain in a stem exclusion stage until natural disturbance processes provides canopy gaps, thus initiating a host of structural/compositional changes discussed above. Interim DFC

[30] Maple snags decay and fall much faster than Douglas-fir, don't have thick separating back and usually lack hollow cores and therefore provide fewer nesting and roosting opportunities.
[31] Pileated woodpeckers and bats often use a range of snags and hollow trees during the day to maintain ideal roost site temperatures.
[32] Live volume defect, provides info on decayed live trees in older forests. Defect in timber cruises in Westside old growth range from 10-50% or more.



Map 8. Desired Future Conditions

for down wood is 5-30 tons/acre, with low end of range in maple patches and along stand edges with oak habitats, where fire would naturally keep down wood levels low. Snag targets should be phased in over many decades. Post-treatment targets for structure and composition (described below) serve as interim DFC.

Desired Processes

The development of DFC in this type requires a range of mostly fine-scale disturbance processes. The main disturbance agents include laminated root rot, individual and small group blowdown, snow load and wind-induced stem breakage. There are a few disturbance agents that are undesirable including landslides and fire. Landslides may not be controllable, but actions that might accelerate such processes should be avoided. Fire is also unwanted in these forests, because fire behavior would be contrary to desired stand development, except in ecotones between woodlands and forest.

Fir/Oak Woodland

Long-Term Desired Future Conditions

Fir/Oak DFC Type is composed of a mix of Douglas-fir and Oregon white oak with canopy cover ranging from 50-80%. Ponderosa pine is infrequent but a dominant tree where occurring. Relative tree composition will vary with existing conditions. Where oak or ponderosa pine is currently dominant or below a 40' average spacing threshold (clumps are treated as individual trees), oak will comprise 75-100% of basal area. Where oak is widely scattered, Douglas-fir will remain dominant and oak will persist in partial to full-light. The patterns resulting from the above criteria is a mosaic of distinct patches of oak, fir, and ecotonal areas where the two species overlap. In these mixing zones, enough light will be provided to maintain oak in a persistent to dominant condition. Stand structure will feature both single and multiple age classes arranged as single trees and small groups generally smaller than 1/4 acre. Single canopy dominance is prevalent except around edges and scattered regenerating tree cohorts. Oak and fir regeneration will mostly be limited to more open woodland areas within this type, and

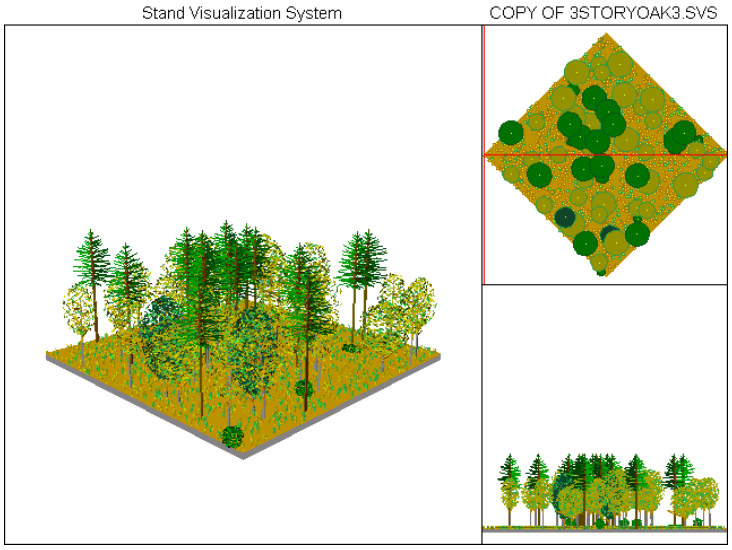


Figure 2 - Desired Future Conditions for fir/oak woodlands demonstrating numerous canopy openings, diverse age class distribution of trees, clumpy to scattered tree spacing, open grass dominated understory, and scattered shrub cover.

will occur as clumps and individual trees. Large tree structure will dominate and include deformed, and highly defective trees.

Understory plant community DFC will consist of a mosaic of native grass/forbs and shrub cover suitable to the site and disturbance regime. Understory light levels will be highly variable in this type, resulting in a mix of open woodland to closed forest species compositions and cover. Shrub cover will vary with frequency of fire, with open canopied areas burned more often, resulting in reduced shrubs in these areas. Shrubs including hazel, serviceberry, poison oak, snowberry and creeping Oregon grape are most common species. Grasses include Idaho fescue, blue wildrye and Columbia brome. A wide range of native forbs are appropriate for this type including strawberry, yarrow, sweet cicely, iris, lovage, fawn lily and brodiaea, blue eyed grass, lomatium, Noxious weeds should not be present while non State-listed invasive and other non native plants should not exceed 10 % understory cover.

DFC for standing dead wood is similar to Oak Woodland Type with some modifications in Douglas-fir dominated patches. For example, Snag levels should be 2-5/acre >16" DBH. Up to 10 tons of down wood (logs > 10" diameter) can occur, comprised primarily of large dimension logs in a range of decay stages with dispersed to concentration distribution. Finally, large deformed/decayed Douglas-fir are more common in these areas.

Oak Woodland

Long-Term Desired Future Conditions

The Oak Woodland DFC Type maintains tree density to achieve a 40-80% range of canopy cover. Oregon white oak is dominant with < 5% cover by ponderosa pine and Douglas-fir. Where oak woodlands interface with Douglas-fir and maple dominated stands, tree cover is at the high end of cover range. Douglas-fir and pine are also more concentrated in these areas. Multiple age classes of oaks are present and arranged in an individual to group-wise distribution. Large diameter oaks (>20" DBH) are a dominant feature throughout this type with smaller sizes present in regenerating oaks and younger age classes. At the more dense end of canopy cover mature oaks will exhibit a more closed form crown ranging from 20-30%. Open woodlands will contain dominant sized oaks with live crown ratios of 30-50%.

Understory plant cover varies from native grass/forb to shrub dominated cover. A mosaic of grass/forb and shrub coverage is desirable with variation determined by light levels, site tendencies and disturbance regimes. Dry, more open sites may feature Idaho fescue/forbs and shrubs such as tall Oregon grape, and poison oak. On sites with deeper soils and more shade and moisture, Elk sedge, western fescue, Columbia brome become more prevalent along with shrubs including serviceberry, snowberry, hazel, sword fern, and other species. Shrub cover may range from 10-50%

or more at the stand level. Noxious weeds should not be present while non State-listed invasive and other non-native plants should not exceed 10 % understory cover

DFC for dead wood in the Oak Woodland type were developed using a similar approach as the Oak Mosaic Type. A snag density of 0-10/acre is a reasonable target with 1-3 snags/acre >16" DBH. Pine and fir snags will likely be the most common snag species where conifers are present. Down wood (logs > 10" diameter) should range from 1-5 tons per acre, and be comprised primarily of large dimension logs (>20" midpoint diameter) in a range of decay stages and concentrations

Oak Mosaic

Long-Term Desired Future Conditions

Desired future conditions in Oak Mosaic designated areas is a network of variably spaced patches of open to semi-closed oak dominated vegetation communities (*see Photo 26*). Tree composition dominated by Oregon white oak, with ponderosa pine a minor associate with co-dominance only in small scattered patches. Douglas-fir is absent or widely scattered and < 1% canopy cover. Tree canopy cover ranges from 10-70% in patches from ½ to 5 acres. Open areas free of trees or with savanna density occur throughout with some patch sizes 5 acres or larger. At the more dense end of canopy cover, mature oaks will exhibit a more closed form crown ranging from 30-50%. Open woodlands will contain dominant sized oaks with live crown ratios of 50-90%. Tree structure should feature a multi-cohort age class distribution, comprised primarily by evenage groups of trees up to several acres in size. Both open and woodland form oaks are desirable in this DFC type. Large diameter oak trees (>20" DBH) are a key feature and are prominent feature across this landscape. Widely scattered conifers with heartrot and/or deformed bole and crown structure are highly desirable.

Photo 26- DFC for Oak Mosaic. Note scattered to clumpy tree spacing and grass dominated understory.

The understory plant community in the Oak Mosaic DFC type will be a mosaic of open to semi-shade adapted native species. Species composition and structure will approximate the Prairie Type (i.e. bunchgrass/forbs) in areas with sparse tree cover. Upper canopy cover range areas will be similar to the plan communities described for the more open cover range in the Oak Woodland Type described below. Areas with intermediate levels of tree canopy cover will contain examples of both plant communities. Noxious weeds should not be present while non State-listed invasive and other non native plants should not exceed 10 % understory cover.

Given the high frequency/low intensity and severity fire regime common in this type under reference conditions, dead wood was much less prevalent compared with more

moist conifer dominated stands. Fires in oak stands would have consumed down wood and fine fuels and kept the understory quite open. These events would have also created new snags occasionally, though oak is fairly fire resistant so snag recruitment rates would still be low compared with similar fire regimes in ponderosa pine stands. There is little research guiding optimal dead wood levels for oak woodlands for this Ecoregion. Recommendations for down wood are intuitive targets based on observation, reasonable assumptions about dead wood recruitment and consumption given disturbance regimes and tree species, and comparison with other forest types with a similar disturbance regime (e.g. ponderosa pine climax type). Because snags are not as prevalent in oak vs. conifer stands, many cavities for wildlife are in dead portions of live trees, often where dead branches enter the bole. A key habitat structure is old hollow oaks. These trees can persist for many years in this condition and should be the focus of release efforts even if these trees will not develop full healthy crowns.

We conclude a reasonable DFC for standing dead trees should be 1-10 snags/acre with 1-2 snags > 16" DBH per acre. Pine and fir snags will likely be the most common species where conifers occur. Down wood (logs > 10" diameter) should be < 1 ton per acre, and comprised primarily of large dimension logs (>20" midpoint diameter) in a range of decay stages. Distribution should be patchy. Large oak trees with hollow boles create excellent down wood after death and falling, and are a highly desirable feature.

Interim Desired Future Conditions

Interim DFC for snags and down wood is the same as long term DFC. Other interim targets are detailed in the Management Pathways section of this plan.

Desired Processes

Prescribed fire, where it can be implemented safely and efficiently, is a key desired process to maintain long-term DFC. Manual removal of trees by cutting will be used as surrogate to fire on some areas (see Implementation Plan).

Bunchgrass Prairie

Bunchgrass prairies are DFC throughout nearly all open grass dominated sites on the ownership (*see Photo 27*). Vegetation on these prairies will consist of up to 95% native grass and forb cover. Relative cover by grasses vs. forbs varies[33]. Native perennial bunchgrasses including Idaho fescue, prairie junegrass, and blue wild rye are dominant. Bluebunch wheatgrass is a dominant on the hottest driest slopes. In contrast to grasses, a much larger range of mostly perennial forbs typically occupy

[33] Bunchgrass is an important carrier of fire, which is a key disturbance agent in maintaining open structure in prairies. Therefore grass cover should generally be dominant over forbs.

healthy bunchgrass communities. Lomatium, buckwheat, and balsamroot are among forb species that may be common. . Shrub cover is very low throughout these areas, though can be more extensive where talus and surface bedrock occurs. Poison oak is a common shrub species on these slopes, though hazel, serviceberry, rose, and tall Oregon-grape may also persist. Tree cover is typically <5%. A range of tree species may occur including all the species currently present on the ownership with the exception of cedar. Oak and pine are most common species, being most fire resistant.

Because tree cover is very sparse, snags and down wood are typically uncommon on prairies. Dead wood should be maintained at the lowest levels of all types on the ownership (< 1 snag per acre and <.25 tons per acre down wood).

Photo 27- DFC for Bunchgrass Prairie.

Interim Desired Future Conditions

Re-establishing bunchgrass communities is likely to be a long and expensive process. Interim DFC may include plant communities with a wide range of native/non-native cover. Tree cover targets should be achievable in 1-2 treatments and therefore interim and long-term DFC are similar.

Desired Processes

While conditions such as thin soils, and steep exposed hot, dry slopes help limit tree establishment, perpetuating these open vegetation habitats on the ownership will require periodic disturbance. Fire has historically acted as this agent, and provides other benefits to the prairie plant community, and is therefore a highly desired and key disturbance process. Manual removal of trees by cutting will be used as surrogate to fire on some areas.

Other Habitats

The DFC for riparian habitats along the Little White Salmon River is maximum tree cover by native species, with a native plant understory using existing remnant functional areas as a template for species composition and structure[34]. Large diameter decayed trees and snags near water are highly desirable as habitat for bats, and cavity nesting ducks. Talus slopes provide habitat for specialized wildlife (Larch Mountain salamander) and should remain undisturbed from management activities that would adversely alter current conditions. Rocky cliff habitat and moist mossy rocky areas should remain in current condition.

[34] Riparian DFC refer to areas where vegetation does not hamper hatchery operations.

Management Pathways to Achieve and Maintain Desired Future Conditions

Three different approaches were considered to guide long-term habitat management of this ownership.

1-**Minimal Management Strategy**- Stewardship activities would be limited to those which maintain safety, clean water for hatchery operations, and protect hatchery facilities.

2- **Biodiversity Level 1 Management Strategy**- Stewardship actions would include those in the Minimal Management Strategy, but also address loss of oak habitat by conifer encroachment. Treatments would be limited to removal or snag creation of Douglas-fir which threaten viable oaks.

3- **Biodiversity Level 2 Management Strategy**- Stewardship actions include those in the Minimal Management Strategy and include comprehensive restoration actions that address the full range of habitat degradation described in the resource assessment.

Given the rarity of habitats on the ownership, their importance in a landscape context, and the unique opportunity of these lands to be managed for wildlife, the Biodiversity Level 2 Management Strategy is recommended to guide long-term management of the LWS National Fish Hatchery.

This strategy includes use of both "passive" and "active" restoration strategies to achieve DFC on this ownership[35]. A high level of active restoration is required in plant communities that require disturbance to maintain optimal composition and structure such as oak and bunchgrass DFC. Treatments also are recommended to restore native plants where dominated by invasive species. In contrast, passive restoration is likely to achieve objectives in more fire-insulated forest types. On these sites, more limited manipulation is recommended in order to accelerate desired structural components (snags, down wood, canopy gaps).

Management pathways and recommended plans and prescriptions to achieve DFC are arranged below with divisions based on fire frequency (*Frequent* vs. *Infrequent Fire*) with prescriptions detailed for specific vegetation communities.

[35] "Active" management employs treatments such as thinning, gap creation, prescribed fire, snag and down wood creation, herbicides, and native plant seeding to manipulate vegetation structure and process toward a desired condition. In contrast, "passive" restoration relies on natural processes without human intervention. Appropriate strategies are adopted after synthesizing objectives, with acceptable time-frames for achieving DFC, self-correcting capacity of the ecosystem, cost, commitment, effective technologies/methodologies and likelihood of success of each option.

Frequent Fire Vegetation Community DFC for *Bunchgrass Prairie, Oak Mosaic, and Woodland Types* were historically shaped and maintained under the influence of frequent low to moderate intensity fires. Such events favored oak and pine dominance and bunchgrass/forb communities. Future stewardship of these lands will require fire and other treatments to achieve these conditions. This plan advocates a high degree of active management in these areas to push vegetation structure toward more open conditions and native plant dominance. Such strategies employ thinning, prescribed burning, herbicides and native plant seeding.

Within these types on the ownership, tree densities far exceed desired levels and must be reduced by approximately 20-90%. Across these types, various prescriptions including mechanical and hand cutting of excess trees, pile burning, and machine removal of tree biomass, and a regular schedule of prescribed burning are needed to maintain conditions. Burning alone is not a viable option to reduce tree stocking given smoke management issues, and risk associated with the intensity of fire required to kill and consume this quantity of trees on steep slopes. Thinning provides more control of tree selection and patterns of spacing than fire. Burning alone under prescription windows likely allowed would not result in the levels of mortality to achieve desired tree density. A passive strategy alone will not achieve the desired mosaic of tree structure and will result in higher tree cover, loss of additional remnant open habitat understory species, and increase the risk of out of prescription fires and associated undesirable effects.

To achieve DFC for plant composition, repeat herbicide application, prescribed fire native seeding are recommended actions. There is little evidence that native bunchgrasses can re-establish dominance on invasive grass sites without the above restoration treatments. Because many of the invasive plant species have competitive advantages in disturbed environments and due to restrictions around modern fire use, burning alone is likely to be an ineffective strategy to revert degraded open type plant communities back to desired native composition. For example, fire to control annual grasses must be hot enough to consume seed bed, which limits burn windows to periods where risk of escape is higher. Fire will be used for the following applications: 1- To prepare seed beds in areas to be seeded. 2- To reduce slash from thinning operations, 3- As long-term maintenance tool primarily to control tree stocking.

After primary restoration treatments have been completed, these areas will enter an indefinite maintenance phase, featuring periodic prescribed burning, on a 10-20 year interval to control tree ingrowth and favor bunchgrass communities. Spot herbicide treatments and manual tree cutting may also be employed on an as needed basis, with these treatments used where fire is unfeasible and to deal with noxious weed issues.

Proposed management strategies for each DFC type are described below:

Bunchgrass Prairie- Bunchgrass prairie restoration and enhancement will be completed using a range of treatments which may include manual or mechanical cutting/piling and burning and snagging of excess trees, repeat herbicide application, prescribed burning and seeding treatments. Plant community restoration techniques will vary with initial conditions, slope and accessibility being determining factors. Treatments and timeframes for Bunchgrass Prairie are described in Appendix L. Appendix H details specific treatments planned for each vegetation polygon. Bunchgrass prairie DFCs on the ownership vary widely in terms of tree cover and degree of remnant bunchgrass cover and quality.

Treatments to reduce tree cover will vary with accessibility and slope. In accessible areas, harvester/forwarder will be used to remove whole trees (*see Photo 28 and 29*). On steep slopes trees will be cut, piled and burned. Slash piles are excellent site prepped areas for native plant re-establishment and should be seeded within a few weeks after burning. On excessively steep slopes, treatments may be limited to girdling and lop and scattering or areas will remain untreated. Girdling at least one Douglas-fir >12" DBH/acre is recommended to provide snags for kestrels, bluebirds and other open habitat cavity nesting birds.

Photo 28 - Use of a harvester is an efficient, safe and sensitive approach to tree felling and processing.

Areas dominated by invasive annual grasses will be treated primarily with repeat herbicide application followed by native grass seeding. Broadcast burning, though a desirable treatment, will not occur on most of these sites due to steeps slopes and lack of access for control. These highly degraded prairies will require the greatest effort and expense to restore. Some of these annual grass dominated sites on excessively steep slopes may not be treated because of excessive cost and concern for erosion during vegetation control phase. Various combinations of such treatments are highly recommended to test different methods on the range of sites, while limiting potential unintended consequences over large project areas. At least three consecutive herbicide applications will be required before seeding to exhaust the weed seed bank. Failure to complete weed control treatments is a major cause of many failed prairie projects. Following the above treatments, broadcast seeding of a mix of

Photo 29 – Use of a forwarder reduces the need for extensive logging roads, allows for removal of slash and greater use of pre-existing impacted areas (e.g. old fields) for landings.

native mostly perennial grasses will occur. Some native forbs can be seeded with grasses, particularly those slow to establish such as arrowleaf balsamroot, lomatium and buckwheat. In areas where forb weeds are likely to need additional control with herbicides after seeding, grasses should be established first to allow use of broad leaf specific herbicide.

Areas still containing strong native bunchgrass and forb cover will not need herbicide treatments. Stewardship in these areas may include tree density reduction and periodic burning (5-20 years) if possible. In many areas, remnant native bunchgrass and forbs are interspersed with invasive grasses. These are difficult sites to fully restore because natives reduce herbicide options. Various methods can be employed based on specific conditions. Burning can be used if timed correctly, to reduce annual grasses around established bunchgrasses, or a very low rate of glyphosate may be applied in the spring to target young germinants. Certain grass specific herbicides can be applied over established bunchgrasses to control invasive annual grass. In most cases, weeds will persist along with natives even under optimal restoration conditions and treatments. Native bunchgrass communities, under most circumstances, are effective at maintaining dominance once well established. The goal of treatments is not to eliminate invasive grasses, but to re-establish native plant community dominance.

Different restoration treatments methods can be utilized in the non-native perennial grass fields along the Cook-Underwood Road due to easy and accessible terrain. Herbicides will be applied these fields. However prescribed burning should follow this treatment to reduce the thick thatch that will result. Following burning, 1-2 additional years of spray treatments are needed to exhaust weed seed banks. Herbicides such as milestone, that are effective against tough well-established biennial and perennial weedy forbs can be used. Native seeds can be no-till drilled on these fields, resulting in higher germination.

The above management pathway will likely result in a mixed success and a varied timeframe in meeting DFC in Bunchgrass Prairie Types. On most sites, tree cover objectives can be met and maintained with the above treatments within a year. Desired understory composition and cover will require major planning and financial effort if pursued at meaningful scales. Eurasian weeds now dominant much of this these area, are well-entrenched and respond positively to some of the disturbance that also favors natives. At least 10 years are likely required to re-establish bunchgrass/forb dominance on heavily invaded sites. Weeds are likely to always persist on these sites but with maintenance can be kept at background cover levels.

Oak Mosaic- The DFC in this type include creating patchy landscape of open to partially closed oak habitats with tree cover ranging from 10-60%. Both passive and fire only type treatments are not likely to achieve these targets due to the same reasons described above. We recommend these areas be restored using

thinning and prescribed burning of piles to control tree density and the techniques outlined for Bunchgrass Prairies above for understory work. Use of prescribed fire beyond winter pile burning will likely be limited to areas where there is good road access for control and natural boundaries to contain fire. These areas may include the slopes just north of Drano Lake, stands along the utility road off Chenowith Road and those areas between the Cook-Underwood Road, Main Hatchery Road and Indian Road.

Appendix H details specific treatments planned for each vegetation polygon. The following guidelines for will be used to guide tree selection and layout during thinning:

1- Thinning to very low density (down to 10% canopy cover) will occur in areas with scattered remnant savanna oaks surrounded by dense younger oak cohorts. Old remnant savanna form oaks will the favored. Where highly decadent oaks occur, retain scattered clumps of younger trees as replacement cohorts.

2- Canopy cover will diffuse from upper limit to lower limits along Oak Mosaic type edge with Fir-Hardwood Hardwood Forest and Fir/Oak Woodland type.

3- Retain all old growth trees.

4- Favor oaks over Douglas-fir and ponderosa pine over oak and fir.

5- Oaks will be thinned to retain both clumps and individual trees. Prioritize retention of large full-crowned individual oaks as scattered trees and dense more sparse crown crowned trees in clumps.

Pre and post treatment of oak woodland near Mosier, Oregon.

The following operational considerations will guide implementation of thinning and understory restoration:

1- Where accessible and on slopes up to 30% thinning will be performed with a harvester-forwarder.

2- Designated trees on steeper slopes will be cut/piled and burned.

3- 1-2 Douglas-fir snags/acre will be created where available by girdling or topping.

4- Minimize equipment traffic and burn piles in areas with remnant bunchgrass/forb populations.

5- Retain all snags and down wood. An additional 1-2 wood piles per acre will be retained where down wood falls below DFC.

6- Extensive understory restoration similar to that described for degraded bunchgrass prairie areas is planned in portions of vegetation polygons that are currently sparsely treed. In more dense wooded areas, suppressed understories are often more open and weed free. Prescribed fire (where feasible) is high recommended followed by seeding immediately after thinning, to rapidly establish native dominance of more open habitat species.

7- In areas where wooded understories contain well-established poison, herbicide treatment followed by native grass seeding should be considered. This species is likely to quickly dominate the understory and while preferable to invasive species, the over expansion of this species might reduce plant diversity. Poison oak can be controlled using glyphosate or successive prescribed burns, but invasion of invasive weeds might preclude such action.

8- Cut oaks will stump aggressively resprout and this regrowth should be controlled using glyphosate during subsequent understory restoration work. Approximately 5-10% of these sprouting oaks will be retained in both a scattered to clumpy distribution to enhance new cohort development.

Oak Woodland- Appendix H details specific treatments planned for each vegetation polygon. These areas will be restored using thinning to control tree density and prescribed burning on some sites to achieve understory plant community objectives. The guidelines described for Oak Mosaic types apply to Oak Woodlands with several modifications. For example, tree cover will be maintained at higher overall levels (40-80%). In addition, understory plant community DFC allow for higher shrub cover and more woodland type species composition.

Fir/Oak Woodland- Appendix H details specific treatments planned for each vegetation polygon. Desired future conditions in this type will be achieved with thinning, prescribed fire, herbicide application and native grass and forb seeding. Thinning treatments should reduce tree canopy to within a range of 50-80%. The following guidelines for tree selection will be used:

1- Prescriptions focus on thinning most or all fir in areas where viable oak or pines maintain a 40’ or less spacing. Viable oak and pine are defined as those with a minimum of 20% and 30% live canopy, respectively. Less live crown

is acceptable if on hollow remnant savanna form oak. In these areas retain only the largest Douglas-fir, particularly those with high levels of defect. Basal area of retained fir should not exceed 10% of post thinning total stocking in these oak dominated areas.

2- Outside these oak and pine concentrations, thinning should focus on removal of Douglas-fir within the drip line and those shading the live portion of the crown of viable oaks and pines. This distance will vary with fir and tree height ratio of live crown on the oak with a range of 20-60'. Partial shading by fir is acceptable if these trees are desired for retention to meet grey squirrel requirements, or if fir is desirable (>20"DBH and deformed structure) for retention. Where possible, such fir should be concentrated on the north side of oaks to minimize shading.

3- Large trees and "character trees"; those with heartrot and/or deformed bole and crown structure, of all species are highly desirable and should be maintained.

4- Patches of oaks with touching or overlapping crowns should be thinned to 60-80% canopy cover, leaving a clumpy structure and largest, fullest crowned oaks and those with hollow boles.

5- In stands with identified Western grey squirrel nests, canopy connectivity should be maintained between nest trees and large hollow oaks. At least two lines, extending 100-200 feet from nest tree, of trees with crowns touching or overlapping should be maintained (two crown widths wide) to provide escape pathways for squirrels.

6- Canopy cover will diffuse from upper limit to lower limits along edge with more dense Fir-Hardwood.

The following operational considerations will guide implementation:

1- Where accessible and on slopes up to 30% thinning will be performed with a harvester-forwarder.

2- Designated trees on steeper slopes will be cut/piled and burned.

3- Equipment traffic and burn piles will be minimized in areas with remnant bunchgrass/forb and other sensitive and desirable plant populations, and large snags and down wood.

4- Douglas-fir snags should be increased where below DFC. A range of 1-5 snags should be created by combination of limbing, and topping and girdling.

5- Down wood and small diameter wood piles should be retained where this structural feature falls below 2 tons per acre.

Fire Insulated Vegetation Community on the ownership including *Fir/Hardwood Forest* will likely continue to develop without the strong influence of fire. In contrast to prairie and oak types, DFC for these areas can be achieved and maintained with limited management intervention and a more passive approach.

Fir/Hardwood Forest- A variety of DFC and custom management approaches are suitable for this type given the range of initial conditions.

Stand structure dominated by young Douglas-fir dominant forest in the Biomass Accumulation/Competitive Exclusion stage are on a protracted processes toward development of DFC. These stands will progress toward more structurally diverse and mature conditions without management. However, silvicultural treatments can accelerate some of the key desirable features and processes by increasing snags, down wood and large tree development, gaps, stimulating crown complexity, and understory plant diversity. Such activities will benefit at least 16 of the species in Table 4 and other wildlife.

The recommended treatments described below for these young stands address specific limiting habitat factors. Most of the acreage in this condition are inaccessible to machines. Treatments on these slopes in Stands 2030, 2047, 2066, 2067 and parts of 2068 include the following:

1- Creation of small canopy gaps (variable size and up to 1/5 acre, 1-2 gaps / 5 acres) where dense homogenous Douglas-fir prevails. Trees in gaps will be felled, snag topped, and girdled and 1-5 deformed dominant/codominant fir left per gap.

2- Thinning by snag topping, girdling and drop/leaving of individual trees within dense homogenous fir areas in groups up to 1/5 acre (5 groups / 10 acre) in size leaving largest trees at 60-100 ft2/acre retention level.

3- Release viable oaks according to fir/oak woodland prescription for widely scattered trees.

4- Follow guidelines in Appendix N for creating snags and down wood.

Machine accessible areas young conifer stands of this DFC type are limited to Stands 2005, 2043, 2057, and 2068 and should include the following:

1- Variable density thinning to create areas of varied tree density with reductions of basal area from 10-30% in treatment groups up to 1/5 acre in size. Thinning

is primarily from below with retention of small fuller crowned trees to retain vertical structure.

2- Creation of small canopy gaps (variable size and up to 1/5 acre, 1-2 gaps/5 acres) where dense homogenous Douglas-fir prevails. Several dominant sized fir will be retained for snag creation. In some gaps 1-2 deformed dominant/codominant fir can be left per gap.

3- Release of viable oaks by removing encroaching fir according to fir/oak woodland prescription for widely scattered trees.

4- Create snags and down wood creation to meet DFC.

Maple dominated areas in this DFC type include Stands 2011, 2027 and 2028. Passive management is recommended in these areas with the exception of release of viable oak by snagging encroaching fir and maple.

Stands containing moderate to older aged Douglas-fir dominant forest in the Maturation Stage have begun to develop some of features associated with late-successional forest. These include Stands 2038, 2054, 2060, 2062, and 2069. Mostly passive restoration of these stands is appropriate. However, a prominent limiting structural feature in most of these stands is the lack of snags and down wood (see Dead Wood Resources section above)[36]. While creation of these features will occur over time with root rot, wind and other disturbance, creation of snags and down wood will benefit at least 17 of the species in Table 4 and many other unlisted dead wood dependent wildlife.

The following recommended treatments in Maturation Stage stands address specific limiting habitat factors outlined in Table XX.

1- Follow guidelines in Appendix N for creating snags and down wood

In all fire insulated vegetation polygons maintenance treatments will be limited to spot herbicide use or hand pulling or cutting to control noxious weeds, and periodic snag creation to move dead wood conditions toward DFC. Monitoring will indicate progress toward these long-term goals.

[36] An exception is in Stand 2029 where Phellinus root rot pockets have created many snags and will continue to provide new recruitment.

Implementation Plan

Addressing the management issues identified in the resource assessment of this plan will require a substantial commitment in time and financial resources. The implementation plan schedules stewardship actions, based on the prioritization ranking given to each issue.

Tier 1 actions address issues that involve safety, protection of hatchery operations and structures. These include treating the laminated root rot area along the Cook-Underwood Road, replacing the culvert on the Old Hatchery Access Road, and evaluating stabilization options to reduce potential slope failure along the Hatchery Road.

Tier 2 actions are habitat restoration treatments. Since these prescriptions are extensive, a prioritization was developed to guide hatchery managers so financial and time outlays are most effectively used. These treatments are grouped into three phases (Phase 1= highest priority). Highest priority activities should occur in oak DFC types and noxious weed control. Within these stands, oaks with Douglas-fir encroachment were given highest precedence. Stands accessible to machines, more moderately sloped areas for hand treatments, and those sites conducive to prescribed burning were also given preference. Such areas are also in close proximity to roads to demonstrate practices and results to the public and natural resource managers. These phases do not include maintenance treatments[37]. These activities are described at the end of this section. Recommended treatments for all vegetation polygons and phases is provided in Appendix H.

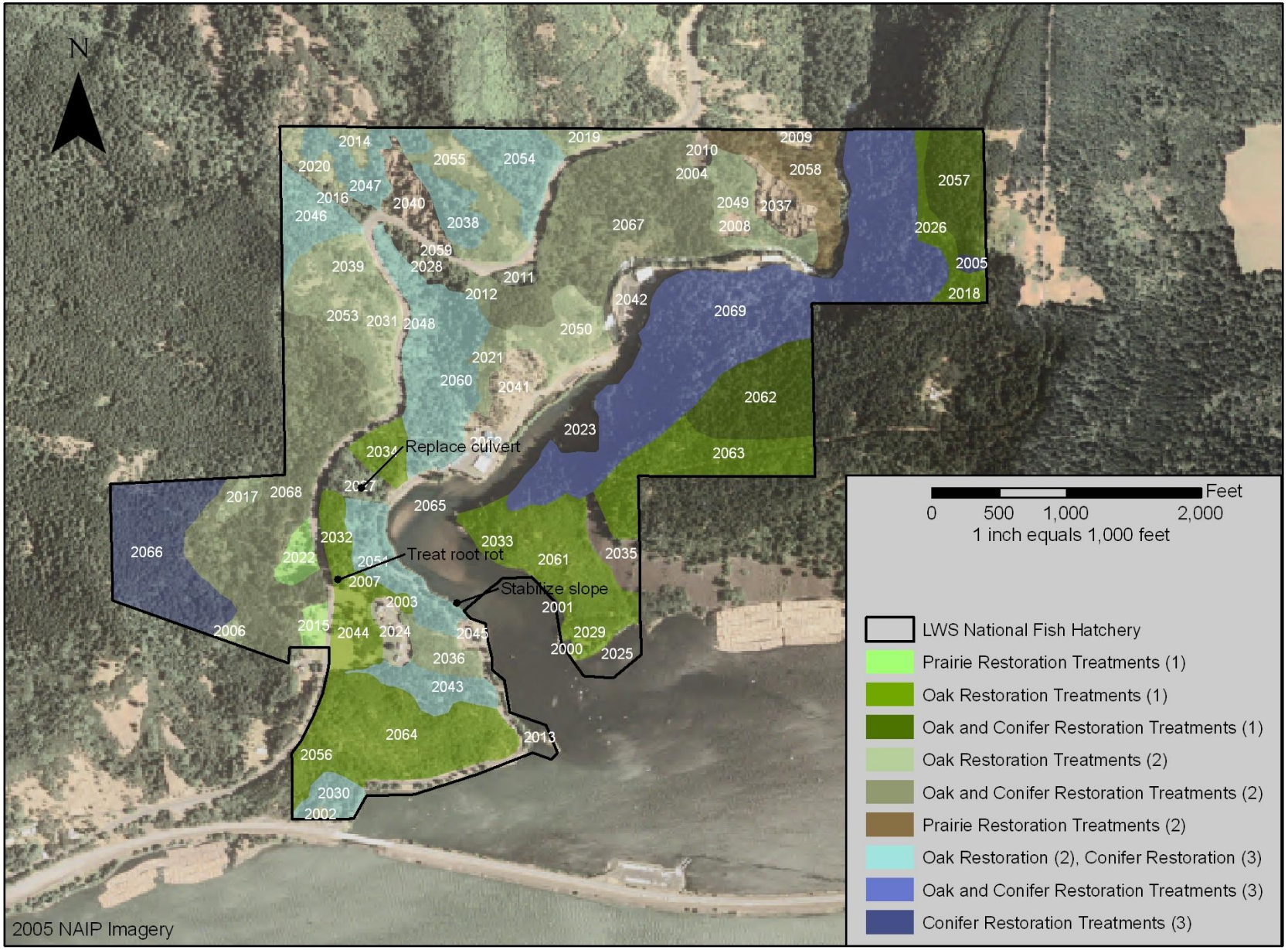
Recommended Treatments (Phase 1)

Table 6 and Map 9 show all Phase 1 recommended stewardship activities for the ownership. Phase 1 treatments include all Tier 1 activities and highest priority Tier 2 actions. Since there currently is no funding secured to complete management recommendations, specific timelines are not provided. However, we assume the treatments described in Table 6 can reasonably be completed in a 5-10 year window. Activity narratives are provided below for this group of treatments.

Project 1- Treat Root Rot Along Cook-Underwood Road

Issue: Expanding root rot pocket adjacent to Cook-Underwood Road
Vegetation Polygons: 2032
Treatment Description: Cut and remove all Douglas-fir and slash within 50 feet of the outer perimeter of infected conifers and remove stumps. Seed the area with a native

[37] Maintenance activities are treatments completed on an ongoing and indefinite basis to maintain the structure/composition and other desired conditions created through initial restorative actions.



Map 9. Treatment Phases
[(1)=Phase 1]

woodland understory species mix. Snags should be felled if within tree length of road. Down logs, snags, cut trees can be placed in the adjacent forest to enhance dead wood. Stumps and slash should be piled and burned, or removed to biomass pile in Veg Polygon 2044 for processing during Phase 1 thinning operations.

Project 2- Replace/remove culvert along old Hatchery Access Road

Issue: Plugged and undersized culvert could cause road failure.
Vegetation Polygons: 2027
Treatment Description: Several options are available. The first involves replacement of the culvert. The second involves pulling the culvert and road fill. This decision should be made by hatchery staff after examining the site. If the culvert is to be pulled, it should be delayed until restoration activities are completed in Stand 2034.

Project 3- Analyze unstable slope above Hatchery Road between entrance and main office.

Issue: Potential slope failure onto Hatchery Road and Drano Lake.
Vegetation Polygons: 2051
Treatment Description: Consult with Geotechnical specialist to determine risk of slope failure and actions if possible to reduce risk.

Project 4- Noxious weed control

Issue: Expanding noxious weeds along Main Hatchery Roads and Cook-Underwood Road.
Vegetation Polygons: 2040, 2042,2052, 2059
Treatment Description: Continue and expand current treatments to control noxious weeds. Priority should be given to Class A and B weeds (*see Table 3*). Treatments for the identified weeds can be controlled with a range of available herbicides. Treatments along waterways are limited to hand cutting and pulling and biocontrol agents where available. Of the weeds on the ownership, Eurasian watermilfoil represents the most serious threat to aquatic habitats on the ownership. Given this threat, hatchery staff should seek expertise in controlling this weed (e.g. Aquatic Bioinvasions Research and Policy Institute at Portland State University, Washington Department of Ecology). Use of aquatic herbicides such as Sonar®, 2,4-D and triclopyr are being used with some success on other sites to control milfoil infestations. Other control methods include harvesting, rotovation (underwater rototilling), installation of bottom barriers, diver hand pulling, diver dredging, and in some very limited situations the use of triploid (sterile) grass carp have been used. Biological controls such as the milfoil weevil are being experimented with but are currently not available.

Project 5- Oak Restoration Treatments (Phase 1-West Block)

Issue: Conifer encroachment of oaks, lack of large oak tree structure and open tree distribution.

Vegetation Polygons: 2003, 2007, 2032, 2034, 2064, 2056,

Treatment Description: Treatments in block consist of removal of fir to release viable oaks, thinning of dense oak groups, herbicide use to control invasive grasses, seeding of native species and prescribed burning. Specific treatments for each Vegetation Polygon are listed in Appendix H.

Initial tasks include at least two herbicide spot applications to control invasive grasses (preferably in the spring prior to seed formation but after grass has risen above leaf later). Herbicides will be applied with an ATV and backpacks using herbicides allowed for use on USFW lands.

Table 6. Phase 1 Recommended Treatments (Year 1-10)

Tier	Phase	Issue:	Veg Polygon	Action:
1	1	Slope instability	2051	Consult geotechnical specialist
1	1	Roadside root rot pocket	2032	Remove infected trees and stumps
1	1	Plugged Culvert	2034	Replace or remove culvert
2	1	Noxious Weeds	2052, 2044, 2059, 2040	Control weeds
2	1	Loss of Oak Habitat	2026	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2063	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2018	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2056	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2044	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2064	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2029	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2061	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2033	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2032	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2007	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2062	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2057	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2034	Treatments (see Appendix H)
2	1	Loss of Oak Habitat	2003	Treatments (see Appendix H)
2	1	Loss of Prairie Habitat	2015, 2022	Treatments (see Appendix H)

Layout and tree marking should follow the prescriptions described in the "Management Pathways" section above for the appropriate DFC for each Vegetation Polygon. Douglas fir should be "cut-tree" marked with blue paint for trees > 6"DBH. Any fir < 6" DBH to retain will be marked with orange paint. Trees designated for snag creation will be marked with "ST" if topping is planned, or "SG" if tree will be girdled. Topping will occur prior to harvester-forwarder activity so top can be removed. All oaks designated for removal should be blue paint marked. Unit

boundaries should be clearly marked with double orange/blue flagging. Surveys for western grey squirrels should be completed to identify nest sites in areas where fir and oak overlap. If nest are found, tree should be Marked “WGS” and at least two lines flagged out from tree for at least 100’ and two crown widths of overlapping trees retained along these lines to provide escape pathways for squirrels.

Harvester/forwarder machines will be used to cut all trees where accessible. This includes most areas within units in this block. Thinning should occur between the months of June and September, once soils have dried. All cut material will be removed with a forwarder to the landing in Veg Polygon 2044. Logs and slash will be separated at the landing into three sorts which includes sawlogs, chiplogs and biomass. Logs will be removed to area mills, and biomass will be chipped on site using a horizontal grinder and material sent to SDS in Bingen, WA, or Bear Mountain, in Cascade Locks, OR.

In areas inaccessible to the harvester-forwarder, designated trees will be hand felled and piled in openings and burned during the winter. Burned pile circles will be seeded immediately once cooled.

After logging, an additional application of herbicide may be necessary to control invasive grasses, before seeding. Seeding of native grasses and forbs will be completed using a bag seed spreader at the rate of 15-20 pounds/acre (Seed list to be developed after consultation with producers). Forbs will be determined based on availability at time of operation. To augment down wood levels to reach DFC, a few wood piles or rough large cut logs should be left on site. In areas of hand cutting, piles should be approximately 4’x 4’x 8’in length. Monitoring for weeds should be completed during annually. Follow up treatments to deal with weeds including herbicides may be needed. Periodic prescribed burning every 10-20 years will commence once native bunch grasses are mature enough to withstand fire.

Special Considerations: Note utility lines within several units. Seeding operations should occur after landing has been de-commissioned. Springs, seeps and streams should be protected (i.e. no machine traffic or slash piling over wet areas, and follow state forest practice rules). Understory riparian vegetation should be protected.

Project 6- Prairie Restoration Treatments (Phase 1-West Block)

Issue: Invasive species dominance
Vegetation Polygons: 2015, 2022, portions of 2044
Treatment Description: These meadows will be sprayed in the late spring with a broad-spectrum herbicide. Dead plant material will be prescribe burned in the early fall. At least two additional herbicide applications will be completed the following spring and summer. Herbicide applications the following year may be needed if field is not adequately site prepped within a year after burning. Seeding of grasses and some slow to establish perennial forbs using a no-till drill will occur in the fall 1-2 years after burning. Native forbs will be seeded the year following grass seeding

(Seed list to be developed after consultation with producers). Monitoring of the site will dictate needed follow-up treatments which may include additional spot herbicide treatments and seeding. Periodic prescribed burning every 10-20 years will commence once native bunch grasses and forbs are mature enough to withstand fire

Special Considerations: Seeding operations should occur after landing has been de-commissioned.

Project 7- Oak and Douglas-fir Restoration Treatments (Phase 1-East Block)

Issue: Conifer encroachment of oaks, lack of large oak tree structure and open tree distribution.
Vegetation Polygons: 2018, 2026, 2029, 2033, 2057, 2061, 2062, 2063
Treatment Description: Restoration treatments in oak DFC types should follow the description in Project 6 (West Block area). Oak release treatments in the fir-hardwood forest DFC (Veg polygon 2062 and 2057) should follow prescription guidelines outlined for that DFC type.

There are several potential log and biomass landing sites for the East Block treatment area. The preferable landing location for Material from stands 2062 and 2063 would be the old home site on the Morby property just west of the end of Chenowith Road. An alternate site would be across from Hank Patton's house in the field owned by the Columbia Land Trust. The landing location for Veg polygon's 2018, 2026, and 2057 would be the field at the north end of Hank Patton's property. A secondary landing option would be the field adjacent to the farm house owned by the Columbia Land Trust one half mile north of Veg Polygon 2057 along Chenowith Road.

Special Considerations: Utility lines run through 2063. Skamania PUD should be contacted prior to thinning to allow their fallers to remove marked trees along the power line. Veg polygon 2029 has a known archeological ruin. Proper consultations and permits should be secured prior to work in this area. Springs, seeps and streams should be protected (i.e. no machine traffic or slash piling over wet areas, and follow state forest practice rules). Understory riparian vegetation should be protected.

Recommended Treatments (Phase 2 and 3)

Project 8- Prairie, Oak and Douglas-fir Restoration Treatments (Phase 2 and 3- West and East Blocks)

Issue: Conifer encroachment of oaks, lack of large oak tree structure and open tree distribution, degraded prairies, lack of dead wood and old growth conifer structure.
Vegetation Polygons: 2018, 2026, 2029, 2033, 2057, 2061, 2062, 2063
Treatment Description: Phase 2 and 3 treatments occur in areas that are difficult to access, expensive to treat and where prescribed fire would be difficult to implement compared to Phase 1 units. These areas are shown in Map 9. A complete list of treatments associated with each vegetation polygon in these phases is provided in Appendix H.

Tree removal in these phases will be manual with slash piled and burned, though some down wood piles will be created and retained where augmentation is needed.

Special Considerations: Utility lines are located within several of these Vegetation polygons. Safety issues should be carefully considered when tree falling, piling and burning near Cook-Underwood Road. These activities on slopes above the road could trigger rockfall, trees or burning logs falling on the road. Treatments should be modified, excluded in these areas or flaggers used to minimize risk to road traffic.

Maintenance Treatments (All Phases)

Treatments to maintain all restoration work in phases 1-3 involve use of prescribed broadcast burning, manual cutting and snag creation, and spot herbicide application as described in “Management Pathways” section of this plan. There is no set schedule for maintenance activities. Timelines will be guided by a recognized need as indicated by monitoring. For example, prescribed burning will be pursued in areas where tree stocking encroaches prairies or open oak habitats. Additional snag creation may be completed if monitoring indicates a lack of large diameter snags or early decay class dead trees. Plugged culverts will be cleaned and slope stability issues addressed when identified.

Monitoring

A monitoring plan is essential to gauge progress toward meeting management objectives. It provides the feedback necessary for adaptive management so restorative treatments and techniques can be modified in response to undesirable or unintended treatment effects or new resource issues. The Monitoring plan for this ownership has been designed to provide baseline documentation of plant community and other resources to compare with future conditions as a basis for evaluating progress towards stewardship plan goals and objectives. Monitoring will provide periodic data to:

1- *Compare current stand conditions (structure and composition) in relation to a historic/reference condition.*

2- *Assess viability of existing habitat for focal species.*

3- *Provide rapid assessment and detection of invasive and noxious weeds and road related issues.*

4- *Assess the effectiveness of restorative treatments.*

An effective monitoring plan is simple to implement and provides the necessary data to assess well-defined indices of resource change. We have found that most of the key management questions can be answered with a relatively simple monitoring design. This plan includes two components: 1) Treatment Effectiveness Monitoring, and 2) Long-Term DFC Monitoring. Monitoring techniques range from walk-through site visits using ocular estimates and quick-plots to re-measurement of permanent inventory plots and photo points (*see Appendix M*).

Treatment Effectiveness Monitoring

This component of the monitoring program seeks to insure that restorative treatments are implemented according to prescriptions, and that management practices are followed. Treatment monitoring is generally done during operations, and at set intervals after completion by project coordinator. Initial and ongoing assessment of activities is crucial so changes can be made early in treatment implementation.

DFC Monitoring

The purpose of DFC Monitoring is to gauge whether the designated vegetation prescriptions are moving plant communities towards desired future conditions? This ongoing assessment will compare initial and follow-up estimates of relative vegetation composition and structure using repeat photography, silvicultural walk-throughs and forest inventory data. This monitoring is structured around repeat measurement of permanently installed forest inventory plots, annual or period

walkthroughs, and repeat photography using established additional established photopoints.

Because early detection of noxious weeds is crucial to control, the following four-pronged monitoring strategy is recommended:

1- Noxious weeds will be reported by hatchery staff during normal operations to the weed manager.

2- Noxious weeds will be documented and reported if discovered during Treatment Effectiveness Monitoring and during repeat measurement of inventory plots.

3- Bi-annual weed surveys should be scheduled. Priority search areas include roadsides and forest adjacent to roads and hatchery facilities and riparian areas.

Appendices

A. Literature Cited

Cold Spring Conservancy (CSC). September 1999. Cold Spring Conservancy: A Request for Funding to the Paul G. Allen Forest Protection Foundation.

DeWater, L.L. 1985. Swiss Roots in Willard Soil - A Genealogical and Historical Account of the Willard Family at Willard, Washington. Wilderness Valley Publishing Co., Ketchikan, AK 99901. 120 pp.

Larsen, E. M., and J. T. Morgan. 1998. Management Recommendations for Washington's Priority Habitats: Oregon White Oak Woodlands. Wash. Dept. Fish and Wildl., Olympia. 37pp.

Linders, M.J. and D.W. Stinson. 2007 Western Gray Squirrel Recovery Plan. Washington Department of Fish and Wildlife Wildlife Program. PP. 128

Marcot, B.G., K. Mellen, S.A. Livingston, and C. Odgen. 2002. The DecAID Advisory Model: Wildlife Component. pp 561-590. In: Laudenslayer, William F., Jr.; Valentine, Brad; Weatherspoon, C. Philip; Lisle, Thomas E., technical coordinators. Proceedings of the symposium on the ecology and management of dead wood in western forests. 1999 November 2-4; Reno, NV. Gen. Tech. Rep. PSW-GTR-181. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Marcot 1991. Snag Recruitment Simulator.

O'Neil, T.A. and D.H. Johnson. Wildlife-Habitat Relationships in Oregon and Washington. OSU Press.

Rombough, C. 2006. The amphibians and reptiles of the Little White Salmon National Fish Hatchery. Report to he USFWS. 32 pp.

Parks V. 2001. Archaeological and Historical Resources Identification Report. Report on file at LWS National Fish Hatchery Admin office.

Peck, B.J., H.J Tschaekofske, and L Moore 2006. Fish Passage Inventory and Barrier Assessment on U.S. Fish and Wildlife Service Lands: Watershed Resource Inventory Areas 24-29. U.S. Fish and Wildlife Service, Western Washington Fish and Wildlife Office Division of Fisheries and Division of Environmental Assessment and Restoration. Lacey, Washington.

Thie, K. 2009 Rare Plant Survey: Little White Salmon National Fish Hatchery.

Washington Forest Practices Board, 2004, Washington Forest Practices Board manual--Standard methodology for conducting watershed analysis under Chapter 222-22 WAC, version 3.0: Washington Forest Practices Board, 1 v. (Section 16 – Guidelines for Evaluating Potentially Unstable Slopes and Landforms, updated Nov. 2004)

B. Fish Passage Codes

Code	Description
U1	U1 Un-modeled stream that was formerly untyped/unknown and has not been field verified (former water type code 9). Stream may or may not exist on the ground.
F1	F1 Modeled as fish habitat, occurring downstream of a modeled end of fish habitat point.
N1	N1 Modeled as non-fish habitat, occurring upstream of a modeled end of fish habitat point.
S1	S1 Shoreline Management Act (SMA): Shorelines of the State (Chapter 90.58 RCW)
N6	N6 Former untyped/unknown hydrographic stream feature (type 9) occurring upstream of a modeled end point. May or may not have a matching DEM-modeled stream.
S2	S2 Shoreline Management Act (SMA): Shorelines of Statewide Significance (Chapter 90.58 RCW) "S+" Waters.
S3	S3 Artificial line segment (interior arc) that maintains stream network connectivity through type "S" lake or reservoir.

C. Vegetation Polygon Types and Acreage

Vegetation Type	# Polygons	Acres	Cover Type
Alder-Maple-Oak	1	1.5	Forest
Douglas-fir	1	0.6	Forest
Douglas-fir-Maple-Oak	8	93.1	Forest
Douglas-fir-Maple/Oak	2	14.4	Forest
Douglas-fir-Oak-Maple	4	29.8	Forest
Douglas-fir-Oak/Maple	1	3.8	Forest
Douglas-fir-Oak/Pine	1	1.8	Forest
Douglas-fir/Maple	1	16.6	Forest
Douglas-fir/Maple-Oak	1	51.5	Forest
Douglas-fir/Oak	3	6.6	Forest
Douglas-fir/Oak-Maple	2	11.8	Forest
Douglas-fir/Oak-Pine	2	15.5	Forest
Maple	1	0.9	Forest
Maple-Douglas-fir	2	5.4	Forest
Oak/Douglas-fir-Pine	1	7.8	Woodland
Oak-Douglas-fir	9	32.4	Woodland
Oak-Meadow-Rock	7	24.1	Woodland
Oak-Meadow	2	15.1	Woodland
Meadow-Scattered Trees	2	3.5	Open
Meadow-Oak	1	4.9	Open
Rock/Scattered Trees	5	14.0	Open
Talus/Scree	3	6.4	Open
Water	5	26.9	Open
Developed	5	28.5	Open
Total	**70**	**417**	

D. Vegetation Polygons and Current Attributes

				DFC		Old Growth			Stewardship Issues			
#	Acres	Type	Structural Stage	DFC Type	Meets	DF	PP/WO	Limiting Factors	OSC	Fuels	I/D	Nox Weeds
2000	0.1	Water	N.A.	Water	No			N.I		N.I	N.I	HEMA,IRPS,MYSP,LEVU
2001	0.3	Water	N.A.	Water	No			N.I		N.I	N.I	HEMA,IRPS,MYSP,LEVU
2002	0.3	Oak-Meadow-Rock	N.A.	Oak Mosaic	No			↑TD	1-3	N.I	N.I	N.I
2003	0.4	Oak-Douglas-fir	N.A.	Oak Woodland	No			↑TD,↑DF,↑W	1-5	N.I	N.I	N.I
2004	0.4	Oak-Douglas-fir	N.A.	Oak Woodland	No			↑TD,↑DF,↑W	3	N.I	N.I	N.I
2005	0.6	Douglas-fir	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No			↓S,DW,LTS,CC		N.I	N.I	N.I
2006	0.6	Oak-Meadow-Rock	N.A.	Oak Mosaic	No			↑TD,↑DF,↑W	1-3	N.I	N.I	N.I
2007	0.8	Douglas-fir/Oak	N.A.	Oak Woodland	No			↑TD,↑DF,↑W	1-5	N.I	N.I	N.I
2008	0.8	Rock/Scattered Trees	N.A.	Bunchgrass/Forb Prairie	No			↑TD,↑DF,↑W		N.I	N.I	N.I
2009	0.8	Rock/Scattered Trees	N.A.	Bunchgrass/Forb Prairie	No			↑TD,↑DF,↑W		N.I	N.I	N.I
2010	0.9	Talus/Scree	N.A.	Talus/Scree	No			N.I		N.I	N.I	N.I

				DFC		Old Growth			Stewardship Issues			
#	Acres	Type	Structural Stage	DFC Type	Meets	DF	PP/WO	Limiting Factors	OSC	Fuels	I/D	Nox Weeds
2011	0.9	Maple	N.A.	Fir-Hardwood Forest	No			N.I		N.I	N.I	CYSC
2012	1.1	Oak-Douglas-fir	N.A.	Oak Woodland	No			N.I	1-3	N.I	N.I	N.I
2013	1.1	Water	N.A.	Water	No			N.I		N.I	N.I	HEMA,IRPS,MYSP,LEVU
2014	1.2	Oak-Meadow-Rock	N.A.	Oak Mosaic	No			↑TD,↑DF,↑W	1-3	N.I	N.I	N.I
2015	1.3	Meadow-Scattered Trees	N.A.	Bunchgrass/Forb Prairie	No			↑TD,↑DF,↑W		N.I	N.I	N.I
2016	1.5	Alder-Maple-Oak	N.A.	Riparian Hardwood	Yes			N.I		N.I	N.I	N.I
2017	1.5	Oak-Douglas-fir	N.A.	Oak Woodland	No			↑TD,↑DF,↑W	1-2	N.I	N.I	N.I
2018	1.8	Douglas-fir-Oak/Pine	N.A.	Fir/Oak Woodland	No		Yes	↓S,↑TD,↑DF	4-5	N.I	N.I	N.I
2019	1.9	Douglas-fir-Maple-Oak	N.A.	Fir/Oak Woodland	No			↓S,↑TD,↑DF,↑W	2-5	N.I	N.I	N.I
2020	2.1	Oak-Meadow-Rock	N.A.	Oak Mosaic	No			↑TD,↑DF,↑W	1-3	N.I	N.I	N.I
2021	2.1	Oak-Meadow-Rock	N.A.	Oak Mosaic	No			↑TD,↑DF,↑W	1-3	N.I	N.I	N.I
2022	2.2	Meadow-Scatt. Trees	N.A.	Bunchgrass/Forb Prairie	No			↑TD,↑DF,↑W		N.I	N.I	N.I

				DFC		Old Growth		Stewardship Issues				
#	Acres	Type	Structural Stage	DFC Type	Meets	DF	PP/WO	Limiting Factors	OSC	Fuels	I/D	Nox Weeds
2023	2.3	Talus/Scree	N.A.	Talus/Scree	No			N.I		N.I	N.I	N.I
2024	2.3	Developed	N.A.	Developed	No			N.I		N.I	N.I	N.I
2025	2.5	Water	N.A.	Water	No			N.I		N.I	N.I	HEMA,IRPS,MYSP,LEVU
2026	2.6	Oak-Douglas-fir	N.A.	Oak Woodland	No			↑TD,↑DF,↑W	1-3	N.I	N.I	N.I
2027	2.7	Maple-Douglas-fir	N.A.	Fir-Hardwood Forest	No			↓S,DW,LTS,CC		N.I	N.I	CYSC
2028	2.7	Maple-Douglas-fir	N.A.	Fir-Hardwood Forest	No			↓S,DW,LTS,CC		N.I	N.I	N.I
2029	2.7	Oak-Douglas-fir	N.A.	Oak Woodland	No		Yes		4-5	N.I	N.I	N.I
2030	2.8	Douglas-fir-Maple/Oak	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No			↓S,DW,LTS,CC	4-5	N.I	N.I	N.I
2031	2.9	Douglas-fir/Oak	N.A.	Fir/Oak Woodland	No			↓S,↑TD,↑DF,↑W	4-5	N.I	N.I	N.I
2032	3.0	Douglas-fir/Oak	N.A.	Fir/Oak Woodland	No			↓S,↑TD,↑DF	3-5	N.I	LRR	N.I
2033	3.0	Douglas-fir/Oak-Pine	N.A.	Fir/Oak Woodland	No		Yes	↓S,↑TD,↑DF	3-5	N.I	N.I	N.I
2034	3.2	Douglas-fir/Oak-Maple	N.A.	Fir/Oak Woodland	No			↑TD,↑DF	3-5	N.I	N.I	N.I

				DFC		Old Growth			Stewardship Issues			
#	Acres	Type	Structural Stage	DFC Type	Meets	DF	PP/WO	Limiting Factors	OSC	Fuels	I/D	Nox Weeds
2035	3.2	Talus/Scree	N.A.	Talus/Scree	No			N.I		N.I	N.I	N.I
2036	3.5	Oak-Douglas-fir	N.A.	Oak Woodland	No			↑TD,↑DF	4-5	N.I	N.I	N.I
2037	3.6	Rock/Scattered Trees	N.A.	Bunchgrass/Forb Prairie	No			↑TD,↑DF,↑W		N.I	N.I	N.I
2038	3.8	Douglas-fir-Oak/Maple	Maturation	Fir-Hardwood Forest	No	Yes		↓S,DW	4-5	N.I	N.I	N.I
2039	4.3	Douglas-fir-Oak-Maple	N.A.	Fir/Oak Woodland	No			↓S,↑TD,↑DF,↑W	1-5	N.I	N.I	N.I
2040	4.3	Rock/Scattered Trees	N.A.	Bunchgrass/Forb Prairie	No			↑TD,↑DF,↑W		N.I	N.I	N.I
2041	4.5	Rock/Scattered Trees	N.A.	Bunchgrass/Forb Prairie	No			↑TD,↑DF,↑W		N.I	N.I	N.I
2042	4.6	Developed	N.A.	Developed	No			N.I		N.I	N.I	N.I
2043	4.8	Douglas-fir-Maple-Oak	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No			↓S,DW,LTS,CC	4-5	N.I	N.I	N.I
2044	4.9	Meadow-Oak	N.A.	Bunchgrass/Forb Prairie	No			↑TD,↑W		N.I	N.I	N.I
2045	4.9	Developed	N.A.	Developed	No			N.I		N.I	N.I	HEMA,IRPS,MYSP,LEVU

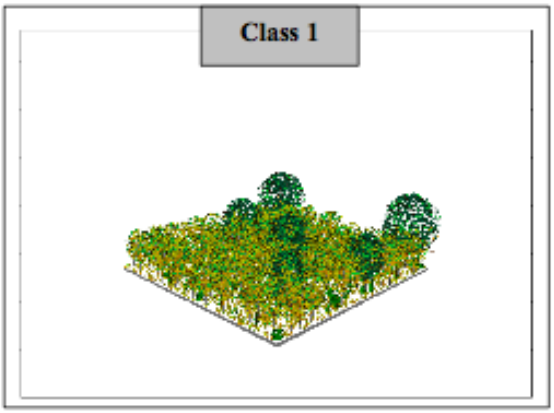
				DFC		Old Growth			Stewardship Issues			
#	Acres	Type	Structural Stage	DFC Type	Meets	DF	PP/WO	Limiting Factors	OSC	Fuels	I/D	Nox Weeds
2046	5.7	Douglas-fir-Maple-Oak	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No			↓S,DW,LTS,CC	4-5	N.I	N.I	N.I
2047	5.8	Douglas-fir-Oak-Maple	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No			↓S,DW,LTS,CC	1-5	N.I	N.I	N.I
2048	5.9	Douglas-fir-Maple-Oak	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No			↓S,DW,LTS,CC	4-5	N.I	N.I	N.I
2049	6.0	Oak-Meadow-Rock	N.A.	Oak Mosaic	No			↑TD,↑DF,↑W		N.I	N.I	N.I
2050	6.6	Oak-Douglas-fir	N.A.	Oak Woodland	No			↑TD,↑DF,↑W	1-5	N.I	N.I	N.I
2051	7.1	Douglas-fir-Maple-Oak	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No			↓S,DW,LTS,CC	4-5	N.I	N.I	N.I
2052	7.3	Developed	N.A.	Developed	No			N.I		N.I	N.I	LEVU
2053	7.4	Oak-Meadow	N.A.	Oak Mosaic	No			↑TD,↑DF,↑W		N.I	N.I	N.I
2054	7.4	Douglas-fir-Maple-Oak	Maturation	Fir-Hardwood Forest	No	Yes		↓S,DW	4-5	N.I	N.I	N.I
2055	7.8	Oak-Meadow	N.A.	Oak Mosaic	No			↑TD,↑DF,↑W		N.I	N.I	N.I
2056	7.8	Oak/Douglas-fir-Pine	N.A.	Fir/Oak Woodland	No		Yes	↑TD,↑DF,↑W	1,5	N.I	N.I	N.I

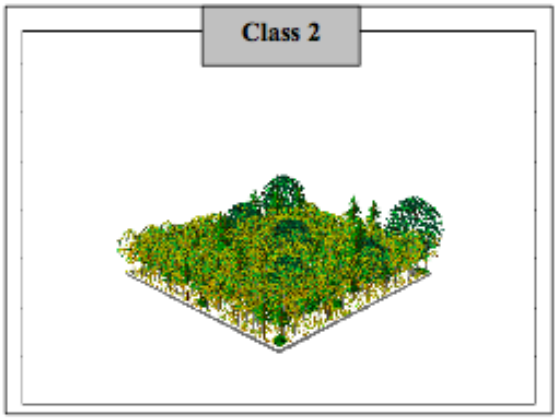
				DFC		Old Growth			Stewardship Issues			
#	Acres	Type	Structural Stage	DFC Type	Meets	DF	PP/WO	Limiting Factors	OSC	Fuels	I/D	Nox Weeds
2057	8.1	Douglas-fir-Oak-Maple	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No			↓S,DW,LTS,CC	4-5	N.I	N.I	N.I
2058	8.6	Douglas-fir/Oak-Maple	N.A.	Fir/Oak Woodland	No			↓S,↑TD,↑DF	1-5	N.I	N.I	N.I
2059	9.5	Developed	N.A.	Developed	No			N.I		N.I	N.I	CYSC,LEVU,CIVU, CIAR,GERO,CEDI
2060	11.6	Douglas-fir-Maple/Oak	Maturation	Fir-Hardwood Forest	No			↓S,DW,LTS,CC	4-5	N.I	N.I	N.I
2061	11.7	Oak-Meadow-Rock	N.A.	Oak Mosaic	No			↑TD,↑DF,↑W		N.I	N.I	HEMA,IRPS,MYSP
2062	11.7	Douglas-fir-Oak-Maple	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No	Yes		↓S,DW,LTS,CC	4-5	N.I	N.I	N.I
2063	12.5	Douglas-fir/Oak-Pine	N.A.	Fir/Oak Woodland	No	Yes	Yes	↓S,↑TD,↑DF	1-5	N.I	N.I	N.I
2064	13.7	Oak-Douglas-fir	N.A.	Oak Mosaic	No		Yes	↑TD,↑DF	1-5	N.I	N.I	N.I
2065	22.9	Water	N.A.	Water	No			N.I		N.I	N.I	HEMA,IRPS,MYSP

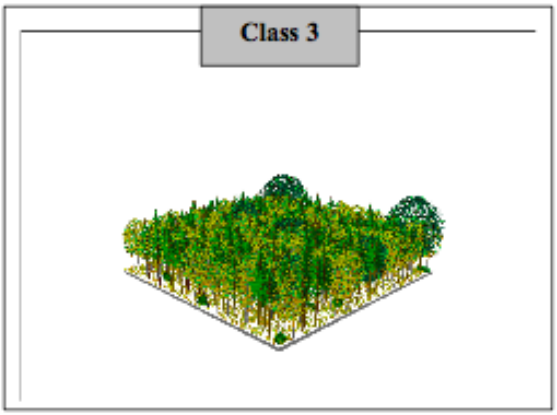
				DFC		Old Growth			Stewardship Issues			
#	Acres	Type	Structural Stage	DFC Type	Meets	DF	PP/WO	Limiting Factors	OSC	Fuels	I/D	Nox Weeds
2066	16.6	Douglas-fir/Maple	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No			↓S,DW,LTS,CC		N.I	N.I	N.I
2067	28.4	Douglas-fir-Maple-Oak	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No	Yes		↓S,DW,LTS,CC	1-5	N.I	N.I	N.I
2068	31.8	Douglas-fir-Maple-Oak	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No			↓S,DW,LTS,CC	1-5	N.I	N.I	N.I
2069	51.5	Douglas-fir/Maple-Oak	Bio Acc/Comp Exclude	Fir-Hardwood Forest	No	Yes	Yes	↓S,DW,LTS,CC	1-5	N.I	LRR	N.I
Total	**417.0**											

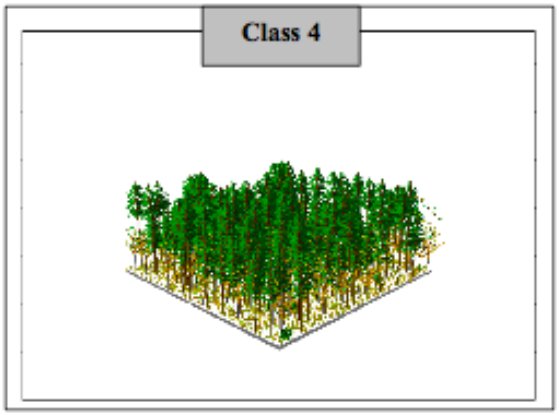
[N.A.=Not applicable, (Limiting Factors: ↓=does not meet resource targets, S=Snags, DW=Down Wood, LTS= Large Tree Structure, CC=Canopy Cover, TD=Tree Density, W=Weeds, DF=Douglas-fir, PP=Ponderosa Pine, WO=Oak), OSC=Oak Succession Class, I/D=Insects and Disease Problems, N.I.=None Identified, LRR=Laminated Root Rot]

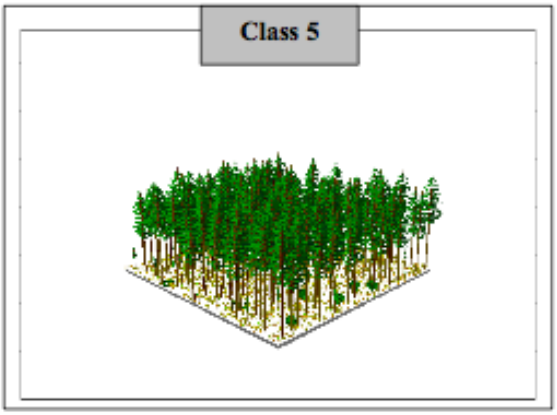
E. Oak Succession Classification











Class 1= 1-2 cohorts of oak form dominant canopy, seedling to sapling sized conifers are present under oaks, **Class 2**= Conifers are beginning to compete with oak crowns, **Class 3**= Conifers have emerged above oak canopy, oak crowns are receding, **Class 4**= Canopy has shifted to conifer dominance, many oaks are dying from suppression effects, most remaining oaks have very poor crowns, **Class 5**= Succession to conifer stand is complete, all oaks have died, oak snags and down

F. Wildlife Species Known or Associated with Ownership Habitats

Species	Occurrence	Activity	Dead Wood	Comments
Birds			Snag or DWD	
Turkey Vulture	Confirmed	Feeds and Breeds	Snag/CWD	Requires rocky outcrops, small caves, boulder piles, ledges on high cliffs, or large hollow logs for nesting.
Osprey	Confirmed	Reproduces	Snag	Could breed in this habitat where near open water habitats.
Bald Eagle	Confirmed	Reproduces	Snag	Could breed in this habitat where near open water habitats.
Great Blue Heron	Confirmed	Feeds and Breeds		none noted
Common Merganser	Confirmed	NA		none noted
Wood Duck	Confirmed	NA	Snag	none noted
Mallard	Confirmed	NA		none noted
Greater Scaup	Confirmed	NA		none noted
Redhead	Confirmed	NA		none noted
Harlequin Duck	Confirmed	Feeds/Breeds?	Snag/DWD	none noted
American Coot	Confirmed	NA		none noted
American Wigeon	Confirmed	NA		none noted
Hooded Merganser	Confirmed	NA	Snag	none noted
Barrow's goldeneye	Confirmed	NA	Snag	none noted
Western Grebe	Confirmed	NA		none noted
Cormorant	Confirmed	NA		none noted
Arctic Loon	Confirmed	NA		none noted
Belted Kingfisher	Possible	Feeds and Breeds		none noted
Sharp-shinned Hawk	Likely	Feeds and Breeds		none noted
Cooper's Hawk	Likely	Feeds and Breeds		none noted
Northern Goshawk	Possible	Feeds and Breeds	Snag/DWD	none noted
Red-tailed Hawk	Likely	Feeds and Breeds		none noted
Golden Eagle	Possible	Feeds and Breeds	Snag	Needs cliffs for nesting.
Peregrine Falcon	Possible	Feeds and Breeds	Snag	Requires suitable cliffs for nesting.
Ring-necked Pheasant	Possible	Feeds		Likely uses edges of this habitat more for cover than feeding where is adjacent to habitats used for reproduction.
Ruffed Grouse	Likely	Feeds and Breeds	Snag/DWD	none noted
Blue Grouse	Likely	Feeds and Breeds	Snag/DWD	none noted

Species	Occurrence	Activity	Dead Wood	Comments
Wild Turkey	Likely	Feeds and Breeds	DWD	none noted
Mountain Quail	Likely	Feeds and Breeds		none noted
California Quail	Confirmed	Feeds and Breeds		
Band-tailed Pigeon	Likely	Feeds and Breeds		none noted
Mourning Dove	Likely	Feeds and Breeds		none noted
Western Screech-owl	Likely	Feeds and Breeds	Snag	none noted
Great Horned Owl	Likely	Feeds and Breeds	Snag	none noted
Northern Pygmy-owl	Likely	Feeds and Breeds	Snag	none noted
Spotted Owl	Unlikely/Possible	Dispersal	Snag	none noted
Barred Owl	Possible	Feeds and Breeds	Snag	none noted
Northern Saw-whet Owl	Likely	Feeds and Breeds	Snag	none noted
Common Nighthawk	Possible	Feeds and Breeds		none noted
Vaux's Swift	Possible	Feeds and Breeds	Snag	none noted
Rufous Hummingbird	Likely	Feeds and Breeds		none noted
Red-napped Sapsucker	Likely	Feeds and Breeds	Snag	none noted
Red-breasted Sapsucker	Likely	Feeds and Breeds	Snag	none noted
Downy Woodpecker	Likely	Feeds and Breeds	Snag	Requires the presence of hardwoods.
Hairy Woodpecker	Likely	Feeds and Breeds	Snag	none noted
Lewis's Woodpecker	Possible	Feeds and Breeds	Snag	
Northern Flicker	Likely	Feeds and Breeds	Snag	none noted
Pileated Woodpecker	Likely	Feeds and Breeds	Snag/DWD	none noted
Olive-sided Flycatcher	Likely	Feeds and Breeds	Snag	none noted
Western Wood-pewee	Likely	Feeds and Breeds		none noted
Willow Flycatcher	Likely	Feeds and Breeds		none noted
Hammond's Flycatcher	Likely	Feeds and Breeds		none noted
Pacific-slope Flycatcher	Likely	Feeds and Breeds	Snag	none noted
Cassin's Vireo	Likely	Feeds and Breeds		none noted
Hutton's Vireo	Likely	Feeds and Breeds		none noted

Species	Occurrence	Activity	Dead Wood	Comments
Warbling Vireo	Likely	Feeds and Breeds		none noted
Gray Jay	Possible	Feeds and Breeds		none noted
Steller's Jay	Likely	Feeds and Breeds		none noted
American Crow	Likely	Feeds and Breeds		none noted
Common Raven	Likely	Feeds and Breeds		none noted
Tree Swallow	Likely	Feeds and Breeds	Snag	Requires snags not far from open water for nesting.
Violet-green Swallow	Likely	Feeds and Breeds	Snag	none noted
Barn Swallow	Possible	Feeds and Breeds		Can nest anywhere buildings, bridges, or overhanging cliffs occur in close proximity to water.
Black-capped Chickadee	Likely	Feeds and Breeds	Snag/DWD	none noted
Chestnut-backed Chickadee	Likely	Feeds and Breeds	Snag	none noted
Bushtit	Likely	Feeds and Breeds		none noted
Slender-billed White-breasted Nuthatch	Likely	Feeds and Breeds		none noted
Red-breasted Nuthatch	Likely	Feeds and Breeds	Snag	none noted
Brown Creeper	Likely	Feeds and Breeds	Snag	none noted
Bewick's Wren	Likely	Feeds and Breeds	Snag/DWD	none noted
House Wren	Likely	Feeds and Breeds	Snag	none noted
Winter Wren	Likely	Feeds and Breeds	DWD	none noted
Golden-crowned Kinglet	Likely	Feeds and Breeds		none noted
Ruby-crowned Kinglet	Likely	Feeds		Winter only.
Western Bluebird	Possible	Feeds and Breeds	Snag	none noted
Townsend's Solitaire	Possible	Feeds and Breeds	DWD	none noted
Swainson's Thrush	Likely	Feeds and Breeds		none noted
Hermit Thrush	Likely	Feeds and Breeds		none noted
American Robin	Likely	Feeds and Breeds		none noted
Varied Thrush	Likely	Feeds and Breeds		none noted
European Starling	Likely	Feeds and Breeds	Snag	none noted

Species	Occurrence	Activity	Dead Wood	Comments
Cedar Waxwing	Likely	Feeds and Breeds		none noted
Orange-crowned Warbler	Likely	Feeds and Breeds		none noted
Nashville Warbler	Likely	Feeds and Breeds		none noted
Yellow-rumped Warbler	Likely	Feeds and Breeds		Mostly breeds at higher elevations, but does breed in this habitat near the coast. More common in winter migration.
Black-throated Gray Warbler	Likely	Feeds and Breeds		none noted
Townsend's Warbler	Possible	Feeds and Breeds		Species breeds in this habitat in Washington, but not in Oregon.
Hermit Warbler	Likely	Feeds and Breeds		none noted
Macgillivray's Warbler	Likely	Feeds and Breeds		none noted
Common Yellowthroat	Possible	Feeds and Breeds		none noted
Wilson's Warbler	Likely	Feeds and Breeds		none noted
Western Tanager	Likely	Feeds and Breeds		none noted
Spotted Towhee	Likely	Feeds and Breeds		none noted
Chipping Sparrow	Likely	Feeds and Breeds		none noted
Fox Sparrow	Likely	Feeds		Winter only.
Song Sparrow	Likely	Feeds and Breeds		none noted
Lincoln's Sparrow	Likely	Feeds		Winter only.
White-crowned Sparrow	Likely	Feeds and Breeds		none noted
Golden-crowned Sparrow	Likely	Feeds		none noted
Dark-eyed Junco	Likely	Feeds and Breeds	DWD	none noted
Black-headed Grosbeak	Likely	Feeds and Breeds		none noted
Lazuli Bunting	Likely	Feeds and Breeds		none noted
Purple Martin	Possible	Feeds and Breeds	Snag	none noted
Brown-headed Cowbird	Likely	Reproduces		Primary activity is reproduction; feeds only occasionally in this habitat.
Purple Finch	Likely	Feeds and Breeds		none noted
House Finch	Likely	Feeds and Breeds		Uses this habitat where it is not too far from urban or agricultural areas.

Species	Occurrence	Activity	Dead Wood	Comments
Red Crossbill	Possible	Feeds and Breeds		none noted
Pine Siskin	Likely	Feeds and Breeds		none noted
Lesser Goldfinch	Possible	Feeds and Breeds		none noted
American Goldfinch	Likely	Feeds and Breeds		none noted
Evening Grosbeak	Likely	Feeds and Breeds		Not known whether breeding occurs regularly in lowland forests.
Mammals				
Montane Shrew	Likely			
Vagrant Shrew	Likely	Feeds and Breeds		none noted
Bendire's Shrew	Likely	Feeds and Breeds	DWD	Closely tied to water.
Trowbridge's Shrew	Likely	Feeds and Breeds	DWD	none noted
Shrew-mole	Likely	Feeds and Breeds	DWD	none noted
Broad-footed Mole	Likely	Feeds and Breeds		none noted
California Myotis	Possible	Feeds and Breeds	Snag	Uses rock crevices, hollow trees, mines or caves for breeding.
Yuma Myotis	Possible	Feeds and Breeds	Snag	More closely associated with water than other bat species. Uses caves, mines, loose bark and bark crevices typically close to water.
Little Brown Myotis	Possible	Feeds and Breeds	Snag	Uses caves, mines, or hollow trees, often near water.
Long-legged Myotis	Possible	Feeds and Breeds	Snag	Uses caves or mines as hibernacula. Uses hollow trees, loose bark or rock crevices for maternity colonies.
Townsend's Big-eared Bat	Possible	Feeds/Breeds	Snag	
Long-eared Myotis	Possible	Feeds and Breeds	Snag/DWD	Uses caves, mines, hollow trees, loose bark or rock crevices.
Silver-haired Bat	Possible	Feeds and Breeds	Snag	Uses trees, bark crevices, and snags for summer roosts; if present in winter, may use caves, mines, or rock crevices for hibernacula.
Big Brown Bat	Possible	Feeds and Breeds	Snag	Requires snags, caves, mines, rock crevices, or bridges for breeding and roosting.

Species	Occurrence	Activity	Dead Wood	Comments
Hoary Bat	Possible	Feeds	Snag	Requires trees for roosting, but forages in openings and at edges of forests.
Snowshoe Hare	Possible	Feeds and Breeds		none noted
Eastern Cottontail	Confirmed	Feeds and Breeds		none noted
Townsend's Chipmunk	Likely	Feeds and Breeds	DWD	none noted
California Ground Squirrel	likely	Feeds and Breeds		none noted
Western Gray Squirrel	Possible	Feeds and Breeds		none noted
Douglas' Squirrel	Possible	Feeds and Breeds	DWD	none noted
Northern Flying Squirrel	Possible	Feeds and Breeds	Snag/DWD	none noted
Deer Mouse	Possible	Feeds and Breeds	DWD	none noted
Forest Deer Mouse	Likely	Feeds and Breeds	DWD	none noted
Bushy-tailed Woodrat	Likely	Feeds and Breeds	DWD	none noted
Gapper's Red-backed Vole	Possible	Feeds and Breeds	DWD	none noted
Creeping Vole	Possible	Feeds and Breeds	DWD	none noted
Long-tailed Vole	Possible			
Common Porcupine	Likely	Feeds and Breeds	DWD	none noted
Coyote	Likely	Feeds and Breeds		none noted
Black Bear	Likely	Feeds and Breeds	Snag/DWD	none noted
Raccoon	Likely	Feeds and Breeds	Snag/DWD	none noted
Ermine	Possible	Feeds and Breeds		none noted
Beaver	Confirmed	Feeds and Breeds		none noted
River Otter	Confirmed	Unknown		none noted
Long-tailed Weasel	Likely	Feeds and Breeds	Snag/DWD	none noted
Mink	Possible	Feeds and Breeds	Snag/DWD	none noted
Muskrat	Possible	Feeds and Breeds	Snag/DWD	
Western Spotted Skunk	Likely	Feeds and Breeds	Snag/DWD	none noted
Spotted Skunk	Likely	Feeds and Breeds	Snag/DWD	none noted
Mountain Lion	Likely	Feeds and Breeds	DWD	none noted
Bobcat	Likely	Feeds and Breeds		none noted

Species	Occurrence	Activity	Dead Wood	Comments
Roosevelt Elk	Possible	Feeds and Breeds	DWD	none noted
Black-tailed Deer	Likely	Feeds and Breeds	DWD	none noted
Amphibians				
Northwestern Salamander	Possible	Feeds and Breeds	DWD	Requires ponds or stream backwaters for breeding.
Western red-back Salamander	Likely	Feeds and Breeds	DWD	
Cascade Torent Salamander	Confirmed	Feeds and Breeds	DWD	
Long-toed Salamander	Possible	Feeds and Breeds	DWD	Requires ponds, shallow lake edges, seasonal pools (like elk wallows) or slow streams for breeding.
Pacific Giant Salamander	Confirmed	Feeds and Breeds	Snag/DWD	Requires small to mid-sized streams with a streambed of gravel, boulders and large logs for breeding.
Cope's Giant Salamander	Possible	Feeds and Breeds		
Rough-skinned Newt	Confirmed	Feeds and Breeds		Requires ponds or stream backwaters with abundant aquatic vegetation for breeding.
Ensatina	Likely	Feeds and Breeds	Snag/DWD	Requires logs, woody debris, or moist talus with woody debris.
Larch Mountain Salamander	Possible	Feeds and Breeds	Snag/DWD	Requires mossy talus, logs, or woody debris.
Tailed Frog	Unlikely	Feeds and Breeds		Requires clear, cold steep-gradient streams for breeding.
Western Toad	Possible	Feeds and Breeds	DWD	Requires ponds or shallow lake edges for breeding.
Pacific Chorus (Tree) Frog	Confirmed	Feeds and Breeds		Requires ponds, seasonal pools, temporary rain-filled depressions or slow streams for breeding.
Red-legged Frog	Possible	Feeds and Breeds		Requires cool-water ponds, lake edges or slow streams for breeding.
Bullfrog	Possible	Feeds and Breeds		
Reptiles				
Northern Alligator Lizard	Yes	Feeds and Breeds		none noted
Southern Alligator Lizard	Yes	Feeds and Breeds		Prefers oak habitat
Western Fence Lizard	Yes	Feeds and Breeds	DWD	This is the primary habitat west of the Cascades.
Western Skink	Yes	Feeds and Breeds	DWD	Oregon only; uses drier areas such as grassy openings or talus as well as downed logs.

Species	Occurrence	Activity	Dead Wood	Comments
Northwestern Garter Snake	**Yes**	**Feeds and Breeds**		**none noted**
Common Garter Snake		**Feeds and Breeds**		**none noted**
Rubber Boa	**Yes**	**Feeds and Breeds**	**DWD**	**Usually does not occur far from water.**
Racer	**Yes**	**Feeds and Breeds**		**none noted**
Western Rattlesnake	**Yes**	**Feeds and Breeds**		**none noted**
Sharptail Snake	**Possible**	**Feeds and Breeds**	**DWD**	**none noted**
Gopher Snake	**Possible**	**Feeds and Breeds**		**none noted**
Night Snake	**Possible**	**Feeds and Breeds**		**none noted**
Ringneck Snake	**Yes**	**Feeds and Breeds**	**DWD**	**none noted**
Western Terrestrial Garter Snake	**Yes**	**Feeds and Breeds**		**none noted**
Painted Turtle	**Possible**	**Feeds and Breeds**	**Logs**	**none noted**
Western Pond Turtle	**Possible**	**Feeds and Breeds**	**Logs**	**none noted**

** This list represents species known to occur on the ownership or those generally associated with similar habitats and geography. The table was compiled from notes of sitings by hatchery staff and hired contractors and by querying the Wildlife-Habitat Relationships in Oregon and Washington Matrix (Northwest Habitat Institute 2001) and comparing against probable range maps for individual species in the Washington GAP analysis.*

G. Desired Future Conditions for Vegetation Types

		Dead Wood				
DFC:	**Description:**	**Snags >16" DBH:**	**Down Wood (12" m.p. dia):**	**Tree Cover:**	**Spatial and Structural Considerations**	**Understory Plant Community**
Bunchgrass Prairie	Native dominance of perenial bunchgrass and forbs.	Widely scattered snags (< 1/acre)	(<.25 ton/acre)	<5%	This DFC type occurs as distinct polygons and small patches within the Oak Mosaic DFC.	95% grass/forb dominanace. Dryest sites feature Idaho Fescue, bluebunch wheatgrass and prairie junegrass. Deeper soils and moister sites have same species but less bluebunch. Blue wildrye and elk sedge on woodland edge. Forb species various species of lomatium, buckwheat brodeia, balsam root. Invasive grasses and forbs are less 20% cover.
Oak Mosaic	Savanna to open oak woodland	(1-2/acre)	(<1 ton/acre)	10-60%	Mix of widly scattered savanna form trees, and variably spaced groups of oaks up to 5 acres in size. Clumping (up to 20 trees) in oak groups is desireable.	90% grass/forb cover-Dry, open sites (Idaho fescue/bluebunch wheatgrass/praire junegrass. Deeper soils, scattered shade (Idaho fescue/blue wildrye with elk sedge under densest oaks). Up to 10% shrub cover average at stand level. Invasive grasses and forbs are less 10% cover. No invasive shrubs tolerated.
Oak Woodland	Open to semi-closed oak dominated woodland. <5% pine and fir.	(1-3/acre)	(1-5 ton/acre)	40-80%	Clumps (up to 20 trees) and single oaks variably spaced in groups up to 5 acres. Lowest canopy cover % in areas of remnant savanna trees.	60-80% grass/forb cover-Dry, open sites (Idaho fescue/bluebunch wheatgrass/praire junegrass. Deeper soils, scattered shade (Idaho fescue/blue wildrye). 10-50% native shrub cover average at stand level. Elk sedge, western fescue, columbia brome under dense oaks on better soils. Invasive grasses and forbs are less 10% cover. No invasive shrubs tolerated.

		Dead Wood				
DFC:	**Description:**	**Snags >16" DBH:**	**Down Wood (12" m.p. dia):**	**Tree Cover:**	**Spatial and Structural Considerations**	**Understory Plant Community**
Fir/Oak Woodland	Woodland dominated by Douglas fir with scattered and groups of oaks and pine in partial to full sunlight.	(1-5/acre)	(< 10 ton/acre)	50-80%	Variably spaced fir, with partial to full light on canopy of targeted oak pine release trees. Clumping of fir (up to 10 trees) desireable. Single conifer canopy structure is prominent.	Widely variable composition of shrubs, grass and forbs with none exceeding 50% at the stand level. Duff/litter cover and deep shade from firs maintain areas of no vegetation cover. Invasive grasses and forbs are less 10% cover. No invasive shrubs tolerated.
Fir/Hardwood Forest	Single to multiple canopy forest dominated by Douglas-fir with bigleaf maple mid and under canopy. Oak is present in some stands	(5-20/acre)	Up to 5-10% cover at old growth stage	70-95%	Varible spaced trees, canopy overlapping of fir and maple, and gaps up to 1 acre	Widely variable composition of shrubs, grass and forbs with none exceeding 50% at the stand level. Duff/litter cover and deep shade from firs maintain areas of no vegetation cover. Noxious/invasive species should be absent or strictly controlled.

H. Vegetation Polygons (DFC and Prescriptions)

			DFC			Prescriptions									
#	Acres	Type	DFC Type	Meets	Treat	Prior	T1	T2	T3	T4	T5	T6	T7	T8	H Type
2000	0.1	Water	Water	No	9	1	9	0	0	0	0	0	0	0	0
2001	0.3	Water	Water	No	9	1	9	0	0	0	0	0	0	0	0
2002	0.3	Oak-Meadow-Rock	Oak Mosaic	No	1,7	3	1	7	0	0	0	0	0	0	2
2003	0.4	Oak-Douglas-fir	Oak Woodland	No	1,3,4,6,7	2	1	3	4	6	7	0	0	0	3
2004	0.4	Oak-Douglas-fir	Oak Woodland	No	1,4	1	1	4	0	0	0	0	0	0	2
2005	0.6	Douglas-fir	Fir-Hardwood Forest	No	7	3	7	0	0	0	0	0	0	0	2
2006	0.6	Oak-Meadow-Rock	Oak Mosaic	No	1,7	3	1	7	0	0	0	0	0	0	2
2007	0.8	Douglas-fir/Oak	Oak Woodland	No	1,3,4,6,7	2	1	3	4	6	7	0	0	0	3
2008	0.8	Rock/Scattered Trees	Bunchgrass/Forb Prairie	No	NT		0	0	0	0	0	0	0	0	0
2009	0.8	Rock/Scattered Trees	Bunchgrass/Forb Prairie	No	NT		0	0	0	0	0	0	0	0	0
2010	0.9	Talus/Scree	Talus/Scree	No	NT		0	0	0	0	0	0	0	0	0
2011	0.9	Maple	Fir-Hardwood Forest	No	9	1	9	0	0	0	0	0	0	0	0
2012	1.1	Oak-Douglas-fir	Oak Woodland	No	1,4,10,7	1	1	4	10	7	0	0	0	0	2
2013	1.1	Water	Water	No	9	1	9	0	0	0	0	0	0	0	0
2014	1.2	Oak-Meadow-Rock	Oak Mosaic	No	1,7,9,10	3	1	7	9	10	0	0	0	0	2

			DFC			Prescriptions									
#	Acres	Type	DFC Type	Meets	Treat	Prior	T1	T2	T3	T4	T5	T6	T7	T8	H Type
2015	1.3	Meadow-Scattered Trees	Bunchgrass/Forb Prairie	No	9,10,11	3	9	11	10	0	0	0	0	0	0
2016	1.5	Alder-Maple-Oak	Riparian Hardwood	Yes	NT		0	0	0	0	0	0	0	0	0
2017	1.5	Oak-Douglas-fir	Oak Woodland	No	1,4,9,10	3	1	4	9	10	0	0	0	0	2
2018	1.8	Douglas-fir-Oak/Pine	Fir/Oak Woodland	No	3,7,9,10	1	3	7	9	10	0	0	0	0	1
2019	1.9	Douglas-fir-Maple-Oak	Fir/Oak Woodland	No	1,3,4,6,8	1	1	3	4	6	8	0	0	0	3
2020	2.1	Oak-Meadow-Rock	Oak Mosaic	No	1,7,10	3	1	7	10	0	0	0	0	0	2
2021	2.1	Oak-Meadow-Rock	Oak Mosaic	No	1,7	3	1	7	0	0	0	0	0	0	2
2022	2.2	Meadow-Scattered Trees	Bunchgrass/Forb Prairie	No	9,10,11	3	9	11	10	0	0	0	0	0	0
2023	2.3	Talus/Scree	Talus/Scree	No	NT		0	0	0	0	0	0	0	0	0
2024	2.3	Developed	Developed	No	NT		0	0	0	0	0	0	0	0	0
2025	2.5	Water	Water	No	9	1	9	0	0	0	0	0	0	0	0
2026	2.6	Oak-Douglas-fir	Oak Woodland	No	1,3,4,6,10	1	1	3	4	6	10	0	0	0	3
2027	2.7	Maple-Douglas-fir	Fir-Hardwood Forest	No	NT		0	0	0	0	0	0	0	0	0
2028	2.7	Maple-Douglas-fir	Fir-Hardwood Forest	No	NT		0	0	0	0	0	0	0	0	0
2029	2.7	Oak-Douglas-fir	Oak Woodland	No	1,4,10,7,11	3	1	4	10	7	11	0	0	0	2

			DFC			Prescriptions									
#	Acres	Type	DFC Type	Meets	Treat	Prior	T1	T2	T3	T4	T5	T6	T7	T8	H Type
2030	2.8	Douglas-fir-Maple/Oak	Fir-Hardwood Forest	No	1,3,7	3	1	3	7	0	0	0	0	0	3
2031	2.9	Douglas-fir/Oak	Fir/Oak Woodland	No	1,2,4,7,9,10	1	1	2	7	9	10	0	0	0	2
2032	3.0	Douglas-fir/Oak	Fir/Oak Woodland	No	1,3,7,10	1	1	3	7	10	0	0	0	0	3
2033	3.0	Douglas-fir/Oak-Pine	Fir/Oak Woodland	No	1,4,7,11	2	1	4	7	11	0	0	0	0	2
2034	3.2	Douglas-fir/Oak-Maple	Fir/Oak Woodland	No	1,3,7	1	1	3	7	0	0	0	0	0	3
2035	3.2	Talus/Scree	Talus/Scree	No	NT		0	0	0	0	0	0	0	0	0
2036	3.5	Oak-Douglas-fir	Oak Woodland	No	1,3,4,6,7,10	2	1	3	4	6	7	10	0	0	3
2037	3.6	Rock/Scattered Trees	Bunchgrass/Forb Prairie	No	NT		0	0	0	0	0	0	0	0	0
2038	3.8	Douglas-fir-Oak/Maple	Fir-Hardwood Forest	No	1,2,4,7	1	1	2	4	7	0	0	0	0	2
2039	4.3	Douglas-fir-Oak-Maple	Fir/Oak Woodland	No	1,2,4,7,9,10	1	1	2	4	7	9	10	0	0	2
2040	4.3	Rock/Scattered Trees	Bunchgrass/Forb Prairie	No	NT		0	0	0	0	0	0	0	0	0
2041	4.5	Rock/Scattered Trees	Bunchgrass/Forb Prairie	No	NT		0	0	0	0	0	0	0	0	0
2042	4.6	Developed	Developed	No	NT		0	0	0	0	0	0	0	0	0
2043	4.8	Douglas-fir-Maple-Oak	Fir-Hardwood Forest	No	1,3,7	2	1	3	7	0	0	0	0	0	3

			DFC			Prescriptions									
#	Acres	Type	DFC Type	Meets	Treat	Prior	T1	T2	T3	T4	T5	T6	T7	T8	H Type
2044	4.9	Meadow-Oak	Bunchgrass/Forb Prairie	No	6,9,10,11	3	6	9	11	10	0	0	0	0	1
2045	4.9	Developed	Developed	No	9	1	9	0	0	0	0	0	0	0	0
2046	5.7	Douglas-fir-Maple-Oak	Fir-Hardwood Forest	No	1,2,7	2	1	2	7	0	0	0	0	0	2
2047	5.8	Douglas-fir-Oak-Maple	Fir-Hardwood Forest	No	1,2,4,7	1	1	2	4	7	0	0	0	0	2
2048	5.9	Douglas-fir-Maple-Oak	Fir-Hardwood Forest	No	1,2,7	2	1	2	7	0	0	0	0	0	2
2049	6.0	Oak-Meadow-Rock	Oak Mosaic	No	4	2	4	0	0	0	0	0	0	0	2
2050	6.6	Oak-Douglas-fir	Oak Woodland	No	1,4,7	3	1	4	7	0	0	0	0	0	2
2051	7.1	Douglas-fir-Maple-Oak	Fir-Hardwood Forest	No	1,2,7	2	1	2	7	0	0	0	0	0	2
2052	7.3	Developed	Developed	No	9		0	0	0	0	0	0	0	0	0
2053	7.4	Oak-Meadow	Oak Mosaic	No	4,9,10	2	4	9	10	7	0	0	0	0	2
2054	7.4	Douglas-fir-Maple-Oak	Fir-Hardwood Forest	No	1,2,7	2	1	2	7	0	0	0	0	0	2
2055	7.8	Oak-Meadow	Oak Mosaic	No	4,9,10	2	4	9	10	0	0	0	0	0	2
2056	7.8	Oak/Douglas-fir-Pine	Fir/Oak Woodland	No	1,3,4,6,9,10,7,11	1	1	3	4	6	9	10	7	11	3
2057	8.1	Douglas-fir-Oak-Maple	Fir-Hardwood Forest	No	3,7	1	3	7	0	0	0	0	0	0	1
2058	8.6	Douglas-fir/Oak-Maple	Fir/Oak Woodland	No	1,2,7	2	1	2	7	0	0	0	0	0	2

			DFC			Prescriptions									
#	Acres	Type	DFC Type	Meets	Treat	Prior	T1	T2	T3	T4	T5	T6	T7	T8	H Type
2059	9.5	Developed	Developed	No	8,9	1	8	9	0	0	0	0	0	0	0
2060	11.6	Douglas-fir-Maple/Oak	Fir-Hardwood Forest	No	1,2,7	3	1	2	7	0	0	0	0	0	2
2061	11.7	Oak-Meadow-Rock	Oak Mosaic	No	4,9,10,11	2	4	9	10	11	0	0	0	0	2
2062	11.7	Douglas-fir-Oak-Maple	Fir-Hardwood Forest	No	3,7	1	3	7	0	0	0	0	0	0	1
2063	12.5	Douglas-fir/Oak-Pine	Fir/Oak Woodland	No	1,3,7,9,10,11	1	1	3	7	9	10	11	0	0	3
2064	13.7	Oak-Douglas-fir	Oak Mosaic	No	1,3,4,6,7,9,10,11	2	1	3	4	6	7	9	10	11	3
2065	22.9	Water	Water	No	9	1	9	0	0	0	0	0	0	0	0
2066	16.6	Douglas-fir/Maple	Fir-Hardwood Forest	No	7	2	7	0	0	0	0	0	0	0	2
2067	28.4	Douglas-fir-Maple-Oak	Fir-Hardwood Forest	No	1,2,8,7	2	1	2	8	7	0	0	0	0	2
2068	31.8	Douglas-fir-Maple-Oak	Fir-Hardwood Forest	No	1,2,3,7	2	1	3	3	7	0	0	0	0	3
2069	51.5	Douglas-fir/Maple-Oak	Fir-Hardwood Forest	No	1,2,7	3	1	2	7	0	0	0	0	0	2

[DFC Type=Desired Future Condition Type, Meets=Meets DFC, Treat=Recommended Treatments, NT=No treatment, H Type= Method of tree cutting (1=Mechanized, 2=Hand Thinning, 3=Combination of 1 and 2)]

Treatment descriptions are in table on following page.

Treatment Descriptions from Appendix H

Treat #	Treatment Method
1	Oak/Pine Release- Pile & Burn
2	Oak/Pine Release- Lop/Scatter
3	Oak/Pine Release- Harvester-Forwarder
4	Thin Oaks-Pile & Burn
5	Thin Oaks-Lop & Scatter
6	Thin Oaks-Harvester-Forwarder
7	Create Snags
8	Cut Scot's broom
9	Herbicide Control of Invasive Weeds
10	Seed Native Plants
11	Broadcast Burn
NT	No Treatment

I. Stewardship Actions for Focal Wildlife Species

Species:	Habitat Type	Recommended Stewardship Actions
Pileated Woodpecker	Mature Coniferous Forest	Snag/down wood creation, thin to accelerate large tree structure.
Lewis's Woodpecker	Mature Oak/Pine Woodland	Release oak/pine woodlands adjacent to LWS.
Slender-billed White-Breasted Nuthatch	Mature Oak/Pine Woodland	Reduce fir encroachment and thin oaks to accelerate large diameter oaks in open woodlands.
Northern Goshawk	Mature Coniferous Forest	Snag/down wood creation, thin to accelerate large tree structure.
Bald Eagle	Mature Coniferous Forest/Water	No action recommended
Peregrine Falcon	Cliffs	No action recommended
Northern Spotted Owl	Mature Coniferous Forest	Snag/down wood creation, thin to accelerate large tree structure.
Barrow's Goldeneye	Riparian Mature Forest	Snag creation along LWS, thin to accelerate large tree structure.
Hooded Merganser	Riparian Mature Forest	Snag creation along LWS, thin to accelerate large tree structure.
Harlequin Duck	Riparian Mature Forest	No action recommended
Vaux's Swift	Mature Coniferous Forest	Top trees above live lower limbs in large Douglas-fir in canopy gaps
Purple Martin	Riparian Mature Forest	No action recommended
Olive-Sided Flycatcher	Early Seral with Old Tree Structure	No action recommended
Mountain Quail	Shrubby Riparian/Woodland	No action recommended
Band-tailed Pigeon	Mature Coniferous Forest/Oak/Pine Woodland	Reduce fir encroachment and thin oaks to accelerate large diameter oaks in woodlands.
Myotis Bat (Various)	Mature Coniferous Forest	Snag creation, thin to accelerate large tree structure, create gaps.
Big-Brown Bat	Mature Coniferous Forest	Snag creation, thin to accelerate large tree structure, create gaps.
Townsend's Big Eared Bat	Mature Coniferous Forest	No action recommended

Species:	Habitat Type	Recommended Stewardship Actions
Elk	Wide Range of Habitats	No action recommended
Western Gray Squirrel	Mature Oak/Pine Woodland	Maintain conifer/oak interface areas
Cascade Torrent Salamander	Riparian Forest	No action recommended
Larch Mountain Salamander	Mature Coniferous Forest/Talus	Minimize disturbance to existing down wood, and increase levels to meet DFC.
Western Pond Turtle	Water/Oak Habitats	Maintain open oaks and shrub cover along portions of Drano Lake. Create basking structure.
Sharptail Snake	Mature Oak/Pine Woodland	Reduce fir encroachment and thin oaks to accelerate large diameter oaks in woodlands. Minimize disturbance to existing down wood, and increase levels to meet DFC.
California Mountain Kingsnake	Mature Oak/Pine Woodland	Reduce fir encroachment and thin oaks to accelerate large diameter oaks in woodlands. Minimize disturbance to existing down wood, and increase levels to meet DFC.

J. Douglas-fir/Hardwood DFC Management Pathways

Starting Condition	Slope (L,M,H)	Treatment Description	Maintenance Treatments	Timeframe to Achieve DFC	Stands
Biomass Accumulation/Competitive Exclusion Stage Douglas-fir Dominated and Fir/Hardwood Mixed Stands	L	Variable density thinning and small gap creation with harvester-forwarder, removal of slash for biomass, seeding of native grass and forbs along forwarder trails. Release of viable oaks by removing or snagging encroaching fir. Additional treatments include snag and down wood creation to meet DFC.	Noxious/invasive weed patrol and treatment, additional snag and down wood creation every 20 years if monitoring indicates inadequate dead wood levels.	Diversification of structural heterogeniety acheived immediately after thinning and gap creation. Late successional forest conditions will develop after 50-70 years.	2005, 2043, 2057,2068,
Biomass Accumulation/Competitive Exclusion Stage Douglas-fir Dominated and Fir/Hardwood Mixed Stands	M,H	Small gap creation by group snag creation, additional individual tree snag creation and down wood creation thoughout areas where dead wood is scarse and Douglas-fir canopy struture is simple. Release of viable oaks by snagging encroaching fir.	Noxious/invasive weed patrol and treatment, additional snag and down wood creation every 20 years if monitoring indicates inadequate dead wood levels.	Diversification of structural heterogeniety acheived immediately after thinning and gap creation. Late successional forest conditions will develop after 50-70 years.	2030, 2047, 2066, 2067, 2068

Starting Condition	Slope (L,M,H)	Treatment Description	Maintenance Treatments	Timeframe to Achieve DFC	Stands
Biomass Accumulation/Competitive Exclusion Stage Maple Dominated Stands	All	Release of viable oaks by snagging encroaching fir and maple.	Noxious/invasive weed patrol and treatment.	DFC are currently met, or will be met with release of viable oaks where these occur. DFC will be maintained with minimal or no managment action as these stands succeed to Douglas-fir dominance (Oaks may not persist in long-term)	2011, 2027, 2028
Maturation Phase Douglas-fir Dominated Stands	All	Small gap creation by group snag creation, additional individual tree snag creation and down wood creation thoughout areas where dead wood is scarse and Douglas-fir canopy struture is simple. Release of viable oaks by snagging encroaching fir, if fir are not greater than 24" DBH.	Noxious/invasive weed patrol and treatment, additional snag and down wood creation every 20 years if monitoring indicates inadequate dead wood levels.	These stands are entering the maturation phase of development and old growth features are beginning to emerge. Dead wood DFC will be partially met with creation, but will require decades to fully meet.	2038, 2054,2060, 2062, 2069

Slopes [L (Low-0-30% and accessible to machines), M,H (>30%)]

K. Oak Mosaic, Oak Woodland and Fir/Oak Woodland DFC Management Pathways

Starting Condition	Slope (L,M,H)	Treatment Description	Maintenance Treatments	Timeframe to Achieve DFC
Oak Mosaic	L	Initial treatments include mechanized cutting and removal of designated trees or cut/pile/burn or girdling of trees to reach target tree cover. Piles will be seeded quickly after burning. Follow snag creation guidelines in Appendix N. Follow Bunchgrass Prairie Guidelines for understory plant treatments for open understories. Burn and/or seed in shaded woods where feasible. Control sprouting oaks with glyphosate, leaving 5-10% for new oak cohort development.	Fall burn on a 5-20 year interval if possible, spot spray noxious weeds.New oak tree cohort groups, created through natural processes and induced gap cuts at the rate of 5% every 25-50 years.	1-2 years for tree cover, 10+ years for understory targets, centuries for age class and size structure.
	M,H	Initial treatments include cut/pile/burn or girdling of trees to reach target tree cover if not too steep. Follow above guidelines of understory restoration. Extreme slopes are too steep for native plant restoration treatments.	Same as above, but burning only where operationally feasible.	1-2 years for tree cover, 10+ years for understory targets, centuries for age class and size structure, some targets unattenable due to extreme slopes.
Oak Woodland	L	Initial treatments include mechanized cutting and removal of designated trees or cut/pile/burn or girdling of trees to reach target tree cover. Piles will be seeded quickly after burning. Follow snag creation guidelines in Appendix N. Follow Bunchgrass Prairie Guidelines for understory plant treatments for open understories. Burn and/or seed in shaded woods where feasible. Control sprouting oaks with glyphosate, leaving 5-10% for new oak cohort development.	Fall burn on a 5-20 year interval if possible, spot spray noxious weeds. New oak tree cohort groups, created through natural processes and induced gap cuts at the rate of 5% every 25-50 years.	1-2 years for tree cover, 10+ years for understory targets, centuries for age class and size structure.

Starting Condition	Slope (L,M,H)	Treatment Description	Maintenance Treatments	Timeframe to Achieve DFC
	M,H	Initial treatments include cut/pile/burn or girdling of trees to reach target tree cover if not too steep. Follow above guidelines of understory restoration. Extreme slopes are too steep for native plant restoration treatments.	Fall burn on a 10-20 though burning unlikely on most slopes, spot spray noxious weeds. New oak tree cohort groups, created through natural processes and induced gap cuts at the rate of 5% every 25-50 years.	1-2 years for tree cover, 10+ years for understory targets, centuries for age class and size structure.
Fir/Oak Woodland	L	Initial treatments include mechanized cutting and removal of designated trees or cut/pile/burn or girdling of trees to reach target tree cover. Piles will be seeded quickly after burning. Follow snag creation guidelines in Appendix N. Follow Bunchgrass Prairie Guidelines for understory plant treatments. Densely wooded sites may be burned and/or seeded without herbicide treatments.	Fall burn on a 5-20 year interval if possible, spot spray noxious weeds. New oak tree cohort groups, created through natural processes and induced gap cuts at the rate of 5% every 25-50 years.	1-2 years for tree cover, 10+ years for understory targets, centuries for age class and size structure.
	M,H	Initial treatments include cut/pile/burn or girdling of trees to reach target tree cover if not too steep. Piles will be seeded quickly after burning. Follow snag creation guidelines in Appendix N. Follow Bunchgrass Prairie Guidelines for understory plant treatments. Some high % slopes are too steep for native plant restoration treatments.	Fall burn on a 10-20 though burning unlikely on most slopes, spot spray noxious weeds. New oak tree cohort groups, created through natural processes and induced gap cuts at the rate of 5% every 25-50 years.	1-2 years for tree cover, 10+ years for understory targets, centuries for age class and size structure, some targets unattenable due to extreme slopes.

Slopes [L(Low-0-30%), M,H (>30%)]

L. Bunchgrass Prairie DFC Management Pathways

Starting Condition	Slope (L,M,H)	Treatment Description	Maintenance Treatments	Timeframe to Achieve DFC
Invasive annual grass dominated	L,M	Initial treatments include cut/pile/burn or girdling of trees to reach target tree cover. Various combinations of herbicide application and burning should be used including spring application of plateau followed by following year spring burn and glyphosate treatment with fall and/or spring seeding. Heavily infested annual grass areas may require three consecutive years of spray treatments prior to seeding. Piles will be seeded quickly after burning.	Fall burn on a 5-10 year interval, spot spray or pull noxious weeds	1-2 years for tree cover, 10+ years for species composition
	H	Initial treatments include cut/pile/burn, lop and scatter or girdling of trees to reach target tree cover if not too steep. Most high % slopes are too steep for other native plant restoration treatments. Piles will be seeded quickly after burning.	Burn if possible. spot spray or pull noxious weeds	Unattenable in terms of native composition
Perennial non-native grass field	L,M	Initial treatments include cut/pile/burn or girdling of trees to reach target tree cover. Spring herbicide application (milestone/glyphosate) followed by fall burn, repeat glyphosate applications for following two years, followed by seeding.	Fall burn on a 5-10 year interval, spot spray noxious weeds	1-2 years for tree cover, 10+ years for species composition
Remnant bunchgrass/forb	L,M	Initial treatments include cut/pile/burn or girdling of trees to reach target tree cover. Piles will be seeded quickly after burning.	Fall burn on a 5-10 year interval, spot spray or pull noxious weeds	DFC currently met for species composition,1-2 years for tree cover DFC

Starting Condition	Slope (L,M,H)	Treatment Description	Maintenance Treatments	Timeframe to Achieve DFC
	H	Initial treatments include cut/pile/burn or girdling or lop and scatter of trees to reach target tree cover if not too steep. Piles will be seeded quickly after burning.	Burn if possible, spot spray or pull noxious weeds	DFC currently met for species composition,1-2 years for tree cover DFC if treatment possible
Mix of invasive and native species	L,M	Employ similar cut/pile/burn and herbicide and burn treatments used to control invasive dominated areas. Use spot spray techniques and avoid remnant native areas or modify herbicide, timing and rate to control germinating annual grasses over established bunchgrasses. Or use burn only techniques to reduce annual grasses. Piles will be seeded quickly after burning.	Fall burn on a 5-10 year interval if possible, spot spray or pull noxious weeds	1-2 years for tree cover, 10+ years for species composition
	H	Initial treatments include cut/pile/burn or girdling of trees to reach target tree cover if not too steep. Most high % slopes are too steep for other native plant restoration treatments. Piles will be seeded quickly after burning.	Burn if possible, spot spray or pull noxious weeds	1-2 years for tree cover if treatment possible, unattenable or partially met in terms of native composition

Slopes [L,M (Low to Moderate-0-60%), H (>60%)]

M. Monitoring Components, Methods, and Timeline

Monitoring Resource:	Method of Assessment:	Timeline:
Tree Component (Overstory & Understory)		
Size Class Distribution	Walk-through	During and After Treatment, Periodic
	Forest Inventory*	Every 10 years
Age Class Dist.	Walk-through	During and After Treatment, Periodic
	Forest Inventory	Every 10 years
Patch Size	Remote Imagery	Periodic
	Walk-through	During and After Treatment, Periodic
Composition	Walk-through	During and After Treatment, Periodic
	Forest Inventory	Every 10 years
Stocking (Basal Area, TPA)	Walk-through	Periodic
	Forest Inventory	Every 10 years
Spatial Patterns	Walk-through	During and After Treatment, Periodic
	Forest Inventory	Every 10 years
Understory Vegetation		
Composition/Percent Cover	Walk-through Forest Inventory	During and After Treatment, Periodic Every 10 years
	Repeat Photography*	Year 1, 5,10, periodic thereafter
Noxious Weeds	Walk-through	During and After Treatment, Periodic, and bi-annual weed survey
Dead Wood	Forest Inventory	Every 10 years
Snags/Decayed live trees	Walk-through	During and After Treatment, Periodic
	Forest Inventory	Every 10 years
Down Wood	Walk-through	During and After Treatment, Periodic
	Forest Inventory	Every 10 years
	Repeat Photography	Year 1, 5,10
Road Condition/Slope Stability	Walk-through	During and After Treatment, & Bi-annual road survey
W. Gray Squirrel Nests	Walk-through	Before thinning in oak/fir/pine stands

** Forest inventory plots are also photo points. Additional photo plots may be installed in treatment areas to provide additional monitoring. Repeat photography at forest inventory plots may also be completed more frequently than during 10-year plot re-measurement.*

N. Snag Management Guidelines

Increasing Dead Wood throughout LWSBR

Given the paucity of snags and down wood in desired areas on the LWSBR, increasing dead wood is a reasonable venture. Down wood levels can be increased during commercial thinning operations by leaving low value material such as logs with high defect and those only making chip grade[38]. Snag creation can be done by girdling, frill treatment with herbicide or tree topping[39]. Tree topping above the lowest live branch whirl is the most effective snag creation method (creates longest standing snag and best cavity substrate), but is also considerably more expensive than the other approaches. The estimated cost of creating 2 snags/ acre in trees >20" DBH, and two snags >12" DBH by girdling or frill treatment on 113 acres (Stands 1,2,3,5,7,8,9, and 10) is $14,040 ($50/topped tree, $10/tree for double kerf snagging or frill treatment). While prescriptions should be catered to each stand based on current snag conditions vs. DFC, even a simplified prescription such as above would increase habitat conditions for a host of cavity nesting species including the pileated woodpecker, a focal management species. Topping large diameter trees would create long-term cavity sites for this species, while girdled snags would benefit other cavity nesting and snag foraging species in the short term and increase DWD levels faster due to more rapid fall rates. Species such as Pileated woodpecker would benefit from both methods; topped trees for cavities, and girdled trees for forage sites and as CWD[40]. All snag recruitment should occur from trees with a minimum DBH of 12"-20".

[38] Slash or boles up to 4 "diameter does not constitute as down wood.

[39] Girdling is usually done by cutting two lines around the tree at DBH through the bark and cambium, using a chain saw (width of chain). With frill treatment, a hatchet is used to notch the tree at DBH and undiluted herbicide is applied to each cut.

[40] Pileated woodpecker heavily utilizes down wood because its main prey base is carpenter ants in down logs.

O. Vegetation Polygon Photos

Polygon 2000 & 2001

Stand 2002

Stand 2003

Stand 2004

Stand 2005

Stand 2006

Stand 2007

Stand 2008

Stand 2009

Stand 2010

Stand 2011

Stand 2012

Polygon 2013

Stand 2014

Stand 2015

Stand 2016

Stand 2017

Stand 2018

Stand 2019

Stand 2020

Stand 2021

Stand 2022

Polygon 2023

Stand 2024

Polygon 2025

Stand 2026

Stand 2027

Stand 2028

Stand 2029

Stand 2030

Stand 2031

Stand 2032

Stand 2033

Stand 2034

Polygon 2035

Stand 2036

Stand 2037

Stand 2038

Stand 2039

Stand 2040

Stand 2041

Polygon 2042

Stand 2043

Stand 2044

Stand 2045

Stand 2046

Stand 2047

Stand 2048

Stand 2049

Stand 2050

Stand 2051

Polygon 2052

Stand 2053

Stand 2054

Stand 2055

Stand 2056

Stand 2057

Stand 2058

Polygon 2059

Stand 2060

Stand 2061

Stand 2062

Stand 2063

Stand 2064

Polygon 2065

Stand 2066

Stand 2067

Stand 2068

Stand 2069