Swamp Lake Forest
Forest Stewardship Plan

A Framework for Conservation and Management

Prepared by Darin Stringer

For the Kittitas Conservation Trust
205 Alaska Avenue, Roslyn
Washington 98941

October 27, 2009

INTEGRATED
RESOURCE
MANAGEMENT
Consulting Foresters & Restoration Ecologists

TABLE OF CONTENTS

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Swamp Lake Forest Summary Details

Date:	October 27, 2009
Landowner:	Kittitas Conservation Trust PO Box 428 Roslyn, Washington 98941 (509) 649-2951
Legal Description:	Lots 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 & 16 of that Survey recorded October 18, 2002, in Book 28 of Surveys, page 42, under Auditors File No. 200210180040, records of Kittitas County, Washington; being a portion of the North Half of Section 13, Township 21 North, Range 12 East, W.M., Kittitas County, Washington.
Ecoregion:	Borderline of the Western Cascades Montane Highlands and North Cascades Highland Forest
Total Acreage:	Approximately 71 acres
Fire Protection Entity:	Washington Department of Natural Resources
Special Zoning:	None Noted
Zoning:	Rural-3 (Low Density), allows 3-acre minimum lots
Elevation:	2,450 to 2,600 feet
Forest Types:	Douglas-fir-Pacific Silver fir (Mixed Conifer)
Soil Types:	Kachess Gravelly Ashy Sandy Loam
Water Resources:	No perennial water or fish bearing habitat. Several intermittent overland flow areas.
Watershed:	Keechelus-Kachess sub basin, within the Upper Yakima River subwatershed of Columbia River Basin
Road System:	Kachess Lake Road borders south property line. Roads and skid trails on the ownership are inaccessible due to tree and brush in-growth

Known Listed Species:	Pileated Woodpecker excavations observed. No other species in the record or noted during fieldwork as currently occurring on ownership. Future use by focal species is likely with local and regional restoration efforts
Grant Source:	U.S. Fish and Wildlife Service's Cooperative Endangered Species Conservation Fund, Award E-33-HL-1 Amendment #1.
Requirement for Planning:	Washington Department of Natural Resources Cooperative Agreement #09-141 required the development of this plan for Swamp Lake Phase II.
Property Agreements:	WA DNR Cooperative Agreement #09-141 and Conservation Easement for Swamp Lake Phase II USFWS's Endangered Species Conservation Award E-33-HL-1, Amendment #1

Introduction

Overview and Conservation Role

A partnership of the Washington State Department of Natural Resources (DNR), the US Fish and Wildlife Service (USFWS), The Trust for Public Land (TPL), and Kittitas Conservation Trust resulted in the acquisition of the Swamp Lake Forest (SLF) from a private landowner for the benefit of endangered and other focal wildlife species. This acquisition was funded by the USFWS"s Habitat Conservation Plan (HCP) Land Acquisition program of the Cooperative Endangered Species Conservation Fund (Section 6). The specific purpose of this acquisition"s funding is to benefit federally- and state-listed threatened, endangered, proposed, or candidate species covered by the Central Cascades HCP. This stewardship plan presents specific goals and recommendations to achieve this purpose. This acquisition is part of a larger conservation effort to protect land in this important ecosystem corridor. In an earlier phase of this effort, the adjacent 300 acres were acquired from private landowners by a partnership of DNR, USFWS, and TPL, and conveyed to the Cascade Land Conservancy for management.

"The SLF plays a small but important role in landscape level recovery efforts for many at-risk wildlife species."

The subject of this stewardship plan is the Swamp Lake Forest ownership, a 71-acre, forested property located approximately 15 miles east of Roslyn in northwestern Kittitas County, Washington (Figure 1). The SLF is situated within the Keechelus-Kachess sub-basin, of the Yakima River Drainage. Dense coniferous forest cover dominates nearly the entire 2,500-foot elevation ownership. The ownership is bordered by US Forest Service (USFS) land to the north and south and private lands owned by the Cascade Land Conservancy to the east and west. The ownership lies within a "checkerboard" of USFS and private lands. The surrounding landscape includes industrial timberlands, public forest, and rural residential development. Areas around the ownership including Kachess Lake, 2 miles east, are popular recreational destinations.

The SLF plays a small but important role in landscape level recovery efforts for many at-risk wildlife species such as Canada Lynx, Pacific Fisher, and Northern spotted owl. The ownership occurs within a portion of the Cascades where forested habitats are geographically constrained by landforms, water and human development. Migration of mammals between the Northern and Southern Cascades Ecoregions must pass through this narrow "bottleneck." As a result, habitat degradation in these areas creates impacts far in excess of the actual acres directly impacted. Protection and restoration of the Swamp Lake Forest will contribute toward several landscape efforts to support species recovery including:

1- The Central Cascades Habitat Conservation Plan (HCP), a 420,000-acre landscape where coordinated management on private and public lands seeks to protect and restore wildlife habitat while allowing some timber harvest to continue with modifications.

2- The Snoqualmie Pass Adaptive Management Area (SPAMA) with goals including restoring habitat connectivity to facilitate critical north-south species migration and dispersal, and generating large unfragmented blocks of mature forest habitat for species such as Northern spotted owl.

3- Plans by the Federal Highway Administration and Washington State Department of Transportation to construct wildlife crossing structures along Interstate-90, including the Swamp Creek Connectivity Emphasis Area, less than 1 mile southwest of the ownership. This highway is a major obstacle to the north-south movement of wildlife. The property is part of a concentration of lands, at the northern entrance to this planned crossing and therefore critical to the effectiveness of these structures.

4- The I-90 East Spotted Owl Special Emphasis Area (SOSEA). Efforts to preserve and restore forest on this, and other private and public lands will provide improved linkages between owl populations to the east, south and west.

5- The North Cascades Grizzly Bear Recovery Zone. The ownership is located within this zone and is expected to benefit grizzly bear recovery efforts. While this population is estimated to be fewer than 20 animals within the 9,500 sq mi North Cascades ecosystem recovery zone (limited to the US), the bears in this ecosystem are warranted for endangered status.

6- The Mountains to Sound Greenway Vision, a multiple partner landmark effort involving the US Forest Service, Cascade Conservation Partnership, and other partners to preserve the visual, recreational and habitat integrity of lands along the I-90 Corridor between Seattle and Central Washington.

At a more local level, the SLF provides undeveloped forested habitats adjacent to Swamp Lake. This wetland complex provides high quality habitat for pond-breeding amphibians, a number of native mollusks, rare plants and fungi (WSDOT 2006). Planned projects to re-establish hydrologic connectivity of aquatic habitats on both sides of I-90 will increase the importance of the SLF as an interface between forest and wetland.

Current and Historic Land Use

The SLF and surrounding lands have a history of extensive logging. The first water powered mill constructed in the 1870s, near Ellensburg, was supplied with logs from river floats from as far as Easton. Site evidence and aerial photography indicate the ownership remained as unmanaged old growth forest until the property and adjacent lands were clearcut in the 1930s. The land has been in private non-industrial ownership since at least the early 1940s.

The area in the vicinity of the SLF has experienced an acceleration of development and logging in the past two to three decades. Industrial timberlands owned by Plum Creek Timber and other private lands have been extensively logged during this period. Timber harvests on the Okanogan-Wenatchee National Forest around this area peaked prior to the Northwest Forest Plan and have declined precipitously since then. Based on aerial photos, it appears extensive clearcut logging of the landscape has occurred in the last 2-3 decades. Recreation development has also accelerated during this time period. Since then, harvests on federal lands have shifted to thinning to promote ecological restoration of mature forest to aid species recovery. The USFS recently completed one such project (Roaring Thin) just north and east of the ownership.

With heightened interest in this area as a recreation destination, new housing and resort developments have increased in the last few decades. This area is a popular and quickly accessed recreation destination for people in the greater Seattle area. Activities include boating and fishing, cross country skiing, snow mobiling, and hiking.

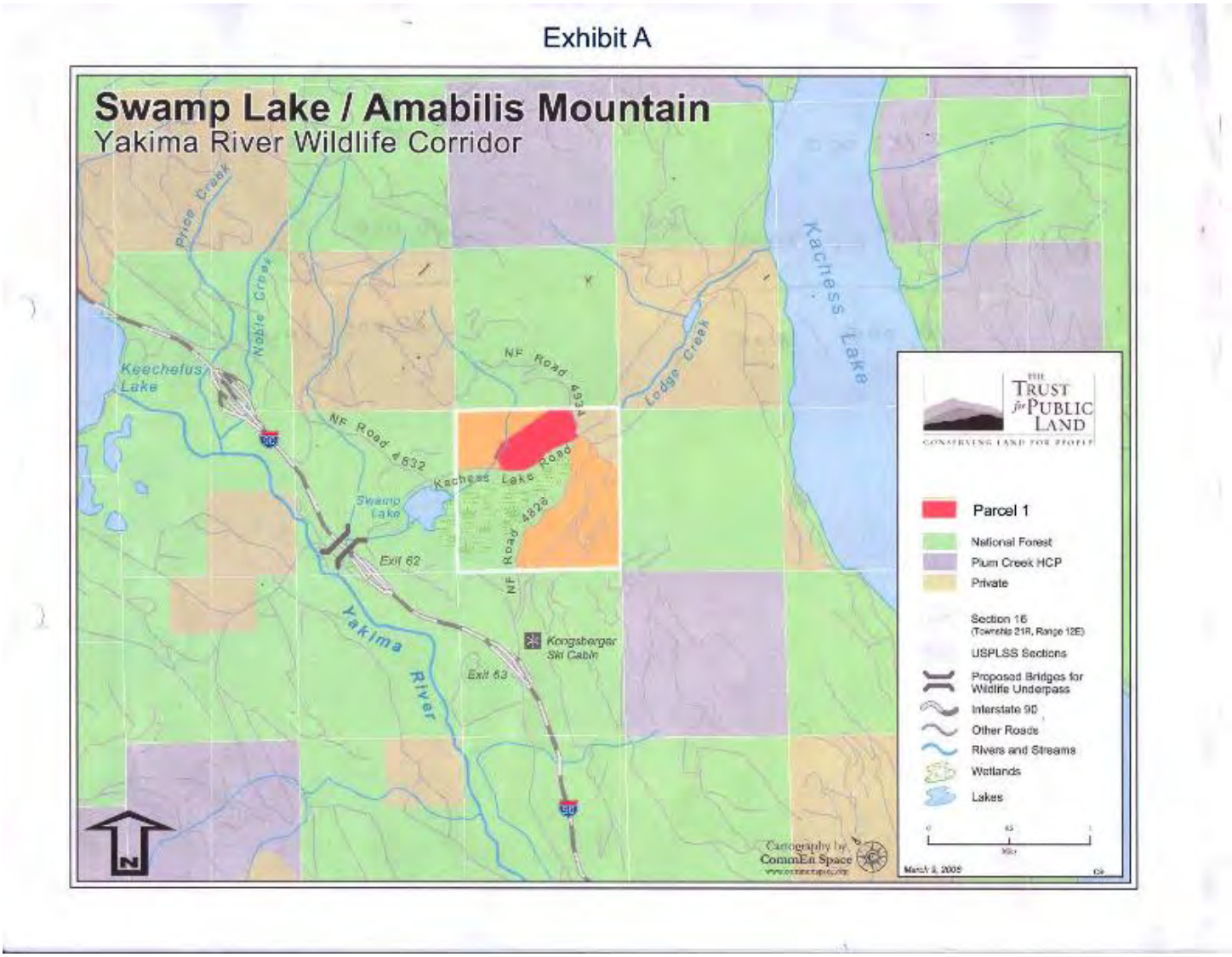


Figure 1. The Swamp Lake Forest ownership (denoted as "Parcel 1" in red) and surrounding lands. The acquisition of these 71 acres for conservation continues a larger conservation effort to protect land in this important ecosystem corridor. In an earlier phase of this larger effort, the adjacent 300 acres (colored orange) were acquired from private landowners by a partnership of The Trust for Public Land, the Washington Department of Natural Resources, and the U.S. Fish and Wildlife Service, and conveyed to the Cascade Land Conservancy for management.

Resource Assessment

Physical Environment

Climate

The Swamp Lake Forest is strongly influenced by both maritime and continental climate forces. Though situated just east of the crest of the Cascade summit, the ownership receives substantial precipitation from Pacific storms traveling east over the mountains. However the Cascade Mountain summits to the west act as a partial barrier (rainshadow effect) to the movement of moisture. As a result, the total annual precipitation at Lake Keechelus (66"), just two miles west of the ownership, contrasts with elevations on the Westside of the Cascades which average well over 100"/year[1]. Much of this precipitation on the property occurs as snowfall, with an annual average of 222" recorded at the Lake Keechelus weather station. Most precipitation (71%) occurs between November and March and snow pack levels persist well into spring most years. Temperatures range from a mean minimum/maximum of 47/73 degrees Fahrenheit in July, to 20/33 degrees Fahrenheit in January. Prevailing winds are generally from the west with occasional east winds in the summer.

Geology and Soils

The SLF is situated in the South Cascades physiographic region of Eastern Washington, an area whose present topography and soils have been shaped by the combined processes of volcanism and glaciation. The property occurs at the southern end of Keechelus Ridge. The topography is gentle across most of the ownership and increases gradually from south to north to a maximum slope of approximately 30%. According to the Soil Survey of Kittitas County Area, the entire ownership is underlain by the ***Kachess Gravelly Ashy Sandy Loam*** soil type (see Table 1)[2]. This soil type consists of ablation till over glaciofluvial deposits with volcanic ash in the upper part. A typical profile consists of a 0-2" layer of slightly decomposed plant material, 2-10"of gravelly ashy sandy loam, 10-30" of very gravelly ashy loam and 30-60"of extremely gravelly loamy sand. The depth to the root restrictive layers is 60". Surface layers are highly organic (60-95%). Soils are well drained and not listed as hydric.

Kachess gravelly ashy sandy loams are fairly low in site productivity. The site index for Douglas-fir is 88 feet. These soils are moderately erodible and rutting hazard is also moderate due to low soil strength. There currently are no known erosion issues on the ownership.

[1] Lake Keechelus is the closest weather station to the ownership.
[2] Type delineations in the survey are more accurate at coarse spatial scales and useful for general planning. More intricate mapping may reveal variation within the current polygons.

Table 1. Soil Types and Properties and Site Productivity

SCS Map #	Name	Acres	Properties	50-Yr SI	Type	Erosion Hazard Off-road	Erosion Hazard Roads
66	***Kachess Gravelly Ashy Sandy Loam***	71	Deep, well-drained glacial/ash soil (5-25% slopes)	88	Basalt/Volcanic Ash	Moderate	Moderate

SCS # Map= Soil Conservation Service Map Unit Number, 50-Yr SI= 50 year site index height (in feet) for dominant Douglas-fir

Hydrology

The SLF is located within the 272 square mile largely forested Keechelus-Kachess sub-basin, within the Upper Yakima River Subwatersheds. These drainages drain into the Columbia River at Richland, Washington.

There are no perennial creeks or other water sources on the SLF. Several small ephemeral overland flows drain into the ditch along Kachess Lake Road. This water flows via culvert into the Swamp Lake wetlands just south of the ownership and eventually into the Upper Yakima River via Swamp Creek. These small drainages on the property were walked by DNR personnel in 2006 and were not found to have an active visible channel, and hence were classified as overland flow areas instead of creeks.

Forest Resources

Classification Systems

In this assessment, forestland is classified using three approaches including:

1- **Current Vegetation Type**, which groups forest by current dominant canopy tree species.

2- **Potential Vegetation Type,** which uses plant associations to group forest according to vegetation conditions that would occur over time in the absence of major disturbance. The latter classification is based on likely successional pathways of forestland toward a "climax condition." Therefore, the Potential Vegetation Type may list species that currently are not dominant. For example, the Western hemlock (*Tsuga heterophylla*) plant association groups are often dominated by Douglas-fir for many years after initiation of a new stand after fire or logging.

3- **Forest development stage** which classifies stands according to phase of ecological development and includes description of structure, composition, disturbance and other key processes.

Current Vegetation Type
The SLF occurs within a transitional zone between lower elevation eastside mixed conifer stands composed of Douglas-fir, grand fir (*Abies grandis*) and ponderosa pine (*Pinus ponderosa*) and higher elevation forests dominated by Pacific silver fir (*Abies amabilis*), subalpine fir (*Abies lasiocarpa*), and mountain hemlock (*Tsuga mertensiana*). Current forest cover on the ownership represents a mix of these converging forest types with dominance by Douglas-fir.

Potential Vegetation Type
The SLF is situated within the interface between grand fir and Pacific silver fir potential vegetation types. In the long-term absence of a high severity disturbance such as fire that favors early-seral species, future tree dominance will probably feature Douglas-fir and Pacific silver fir as dominants with Western hemlock and Western redcedar (*Thuja plicata*) co-dominating. Douglas-fir is a long-lived and fire resistant species that will likely maintain canopy dominance over most of the ownership for hundreds of years. Climate warming will strongly influence future stand composition, favoring species that tolerate warmer and drier conditions, such as Douglas-fir and grand fir species that currently occur on the ownership, and potentially others that currently do not occur.

Forest Development Stage
A number of stand development classification schemes have been developed for Pacific Northwest Westside coniferous forest ecosystems. Each system has merit for use on the SLF. Franklin et al. (2002) is most useful because it incorporates a comprehensive set

of structures and functions pertinent to lands guided primarily by forest restoration goals (see Table 2). Use of this more complex set of development stages is useful when modeling desired forest conditions and silvicultural prescriptions to insure the full range of conditions and functions are included. However, this classification describes development under "natural conditions." In this classification system, the first stage, "Disturbance and Legacy," describes a natural progression of stand structure that initiates with a disturbance event that typically leaves many biological legacies. While the current tree cohort on the SLF was initiated by an initial disturbance event, it was not natural. It was a man-made disturbance event, clearcut logging approximately 70 years ago, and left few biological legacies. However, since this logging event, and without additional human disturbance, the SLF stands have naturally progressed and now have more biological diversity than the "Disturbance and Legacy" stage typically characterizes. Thus, classification beyond this first stage is more appropriate for the SLF forest.

Table 2. Forest Development Classification

Disturbance and Legacy
Cohort Establishment
Canopy Closure
Biomass Accumulation/Competitive Exclusion
Maturation
Vertical Diversification
Horizontal Diversification
Pioneer Cohort Loss

From Franklin et al. (2002)
Shaded is current stage

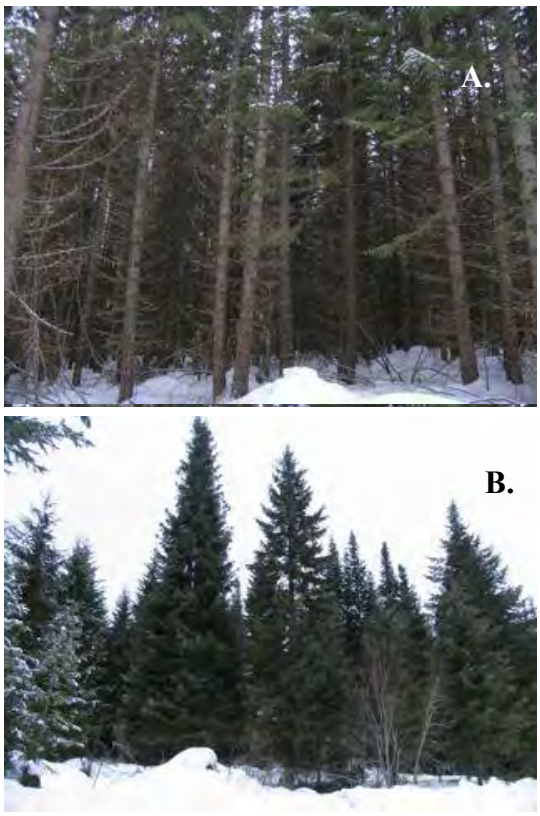
Forests on the ownership are currently in the "Biomass Accumulation/Competitive Exclusion Phase." This stage is characterized by high growth and volume accumulation, high competition among trees for site resources, the stratification of forest canopy into dominant, co-dominant, intermediate and suppressed trees, and the death of smaller trees that cannot survive in subordinate canopy positions. During this stage, the understory plant community is undergoing changes from early-seral species that flourished after harvest, toward species with tolerance for low-light conditions and in some cases increasing duff/litter. A few scattered small areas on the SLF are still in the "Canopy Closure" stage, due to heavy vine maple (*Acer circinatum*) cover, which has slowed colonization by conifers.

Forest Structure and Composition

Tree Canopy Conditions

The 71-acre ownership is nearly completely forested, with heavy cover only broken by scattered small shrub dominated openings associated with wet soils (see Table 3 and Figure 2). This forestland consists of evenage 40-70 year old trees that initiated naturally after logging in the late 1930s. Little residual tree structure was carried over from the previous stand. In the southeast part of the ownership, some suppressed and intermediate sized Western hemlock were left during logging. These are now dominant and co-dominant trees but lack old growth qualities. One old growth Western redcedar was located along the northeast edge of the large opening in the north-central part of the property As a result of natural regeneration of the site, a mix of species occurs. While Douglas-fir dominates the overstory in many areas (44% of basal area), grand fir was also common (29%). Pacific silver fir, Western hemlock, and Western redcedar are minor species (25% combined basal area) and occupy a range of canopy classes. Pacific silver

and grand fir occupy canopy positions ranging from dominants to suppressed. Western hemlock and cedar are more commonly found in subordinate canopy positions. Douglas-fir are largely absent from the understory. Western white pine (*Pinus monticola*), an early seral species, is present but very uncommon and was only noticed in one location along Kachess Lake Road. Black cottonwood (*Populous trichocarpa*), and red alder (*Alnus rubra*) dominate a few small hardwood openings. These hardwoods combined occupy approximately 2% of total stand basal area. Stand productivity is low with a Douglas-fir site index of 88, which equates to a site class 4 on a scale of 1-5 (1=highest productivity, 5=lowest). Forest inventory summary data for tree stocking and other overstory/understory tree characteristics are provided in Appendix B and C.



A- Dense evenage stand conditions cover >90% of ownership, B- Openings and wider tree spacing are a minor but important stand feature, contributing to horizontal and vertical structural diversity in young stands.

Horizontal and Vertical Tree Structure

Forest structure on the ownership has been simplified by timber harvest. In most areas, the forest is well beyond full stocking levels[3]. Vertical structure is low, as most of the canopy is concentrated in the upper crowns of dominant and co-dominant trees. Some variation in spatial patterns of tree density are evident, a common result of natural regeneration. In scattered more open patches, trees have more fully developed crowns. In these areas, the foliage is distributed more evenly from the lower to upper canopy. These canopy gaps occupy less than 10% of forest cover.

Spatial patterns of trees on the SLF are more diverse than in many similarly aged planted stands, but lack the patchiness and aggregation common in more mature stands. These characteristics will take decades to centuries to develop under natural trajectories.

Understory Conditions

Forest understory species composition and structure is strongly influenced by the forest developmental stage, soils, climate, and past management practices. Forestland on most of the ownership is mostly dense and closed-canopied with scattered gaps. As a result, understory plant cover is sparse and composition dominated by species tolerant of low light conditions.

[3] Full stocking refers to single-cohort (even-aged) stands where *differentiation* has resulted in a full range of *crown classes*. Dominant, codominant, intermediate and suppressed trees are present. Full stocking implies high stand densities, at least within the context of a site‟s inherent capacity to support stocking, so trees in fully-stocked stands compete with each other for water, sunlight, and mineral nutrients. If intense competition persists, density-related mortality eventually becomes serious, particularly for suppressed and intermediate trees.

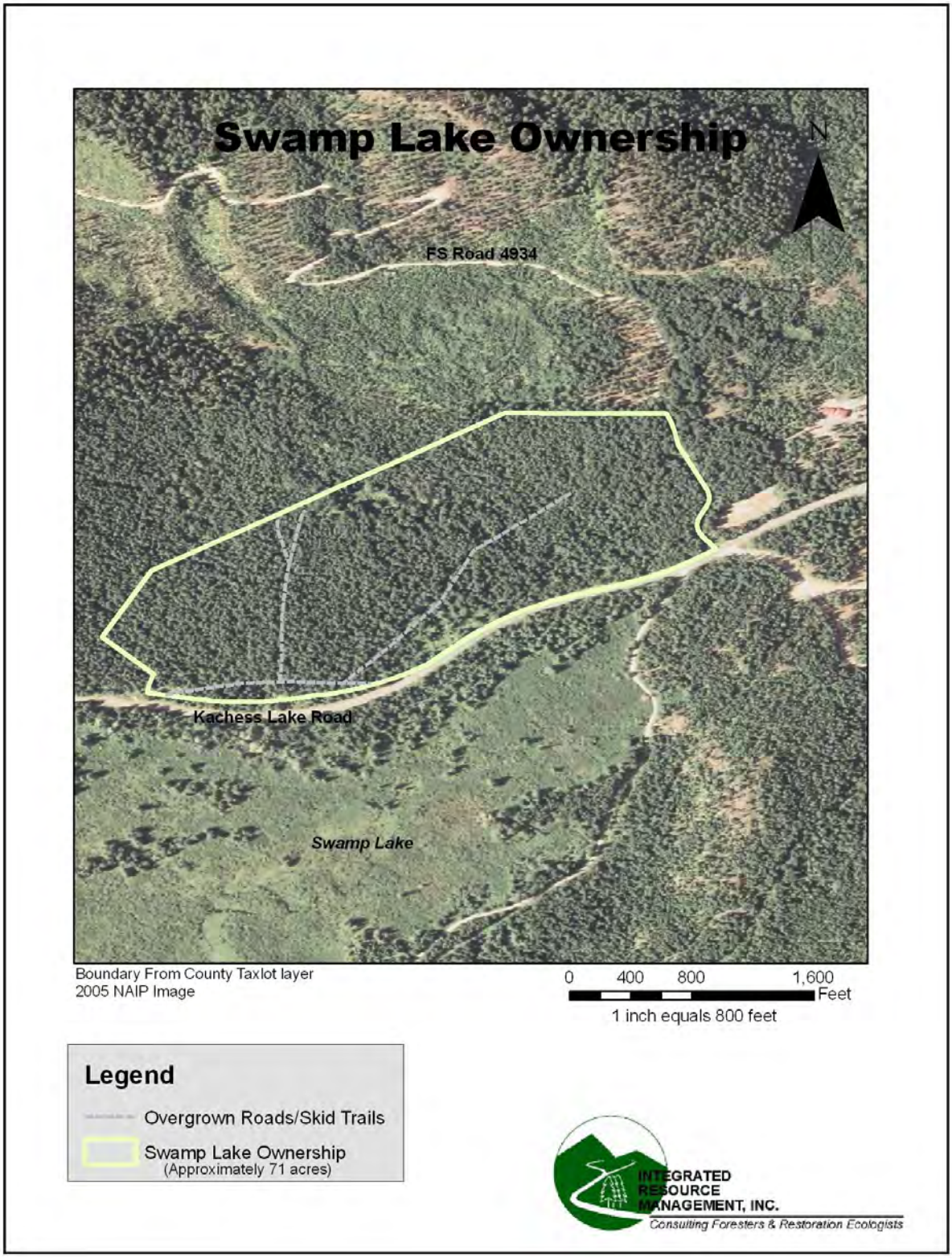


Figure 2. Swamp Lake Forest Ownership Boundary, 2005 Aerial Image. The old logging roads within the property's boundary, likely built in the 1930's, have since revegetated and are not discernable in current aerial images. However, these old logging roads are discernable in a 1954 aerial photo and are superimposed here for documentation purposes.

Table 3. Stand Characteristics

Acres	Age Class	Dominant Species	TPA	DBH	Structure	Site $Index_{50}$	% of Ownership
71	40-70	DF, GF, SF, WH	380	5-25"	Evenage	88	100

DF=Douglas-fir, GF=Grand fir, SF=Pacific Silver fir, WH=Western Hemlock
Site $Index_{50}$=50 year Douglas-fir site index, TPA=Trees Per Acre

Understory plant cover summaries are presented in Table 4. Shrub cover was the most common understory plant structure, averaging 37% across the ownership with a range between 1/10 acre plots of 9% to 100%. Cover by shrubs was highest in canopy gaps, along intermittent drainage depressions, and in hardwood patches. Vine maple was the most dominant shrub species throughout forested portions of the ownership averaging 33% cover and occurring on all plots. Vine maple is a very competitive shrub species, combining tolerance for both shady and open conditions, height advantages over many other understory species and ability to layer (produce roots from stems that are in contact with the ground)[4]. After vine maple, dwarf Oregon-grape, baldhip rose and snowberry were the three most dominant shrub cover species. The combined cover of these three species was just over 2%. These species were also most common in terms of frequency of occurrence, with each found on over half of the sample plots. Cover and frequency by species are summarized in Appendix D.

Table 4. Percent Cover and Frequency of Understory Vegetation

Understory Veg Type	Average % Cover	Frequency
All Shrubs	37%	100%
All Forbs	7%	100%
All Ferns	1%	44%
All Vegetation	45%	

Forbs and ferns are a minor component of total understory vegetation with a combined average cover of 8%. Forb cover averaged 7% and fern cover averaged 1%. Forbs occurred on 100% of plots, while ferns were found on 44% of SLF plots. While these species were frequently found throughout the SLF, average cover was very low. Trillium, star-flowered false solomon‟s seal, and wild ginger were the most commonly occurring forbs, with plot frequencies of 100%, 81%, and 63%, respectively.

[4] Layering is a particularly useful adaptation as it allows shrubs to expand rapidly into new areas when crushed (such as by falling trees or braches).

Current Disturbance Regimes

Timber Harvests

The SLF was extensively logged over the past century. Stumps and current tree age classes suggest the area was harvested in the late1930s. It is unclear, but possible that the area had been selectively logged prior to this.

Insects and Disease

Forest insects and disease play pivotal roles in western forest ecosystems; they support nutrient cycling, soil productivity, and food chains, create dead wood habitat, and influence the structure and composition of stands at fine to broad scales. These agents 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/economic values of the ownership. We found no evidence of insect and disease outbreaks that would warrant management actions. 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. We found no evidence of non-native insects or pathogens.

"We found no evidence of major insect/disease agents that warrant management action."

Bark Beetles and Defoliating Insects

Bark beetles are important forest insects 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 SLF is the Douglas-fir bark beetle (*Dendroctonus pseudotsugae).* We did not find signs of current use by this species on the ownership. Newly recruited Douglas-fir snags and down wood are uncommon on the ownership. 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 or tussock moth. In these areas, Douglas-fir beetles can kill nearby trees, creating additional snags and desired canopy gaps, but also causing economic loss.

The only direct evidence we saw of insect caused mortality in trees was caused by the fir engraver beetle (*Scolytus ventralis*). This is a common bark beetle that attacks grand fir and Pacific silver fir trees. We observed several grand fir that had recently been killed by fir engraver beetles or in combination with another unidentified agent. Grand fir is particularly sensitive to beetle attack (this species lacks the pitching defense that pines have).

It is unlikely that conifer stands on the SLF experience major infestations by insect defoliators that are more common on drier eastside fir dominated forests. Species such as Western spruce budworm (*Choristoneura occidentalis*) and Douglas-fir tussock moth (*Orgyia pseudotsugata*) have periodically defoliated thousands of acres of Douglas-fir and grand fir on the eastside of Washington. These species populations erupt on a cyclical basis, causing serious defoliation of fir trees. There currently is an epidemic of spruce budworm occurring east of the ownership in drier Douglas-fir stands. The above insect defoliators rarely damage stands in moist forest types such as found on the ownership

Forest Pathogens

Pathogens including foliar rusts, and root and stem decays are currently uncommon on the SLF. Stem decays such as red ring rot (*Phellinus pini*), red belt fungus (*Fomitopsis pinicola*), brown top rot (*Fomitopsis cajanderi*), and indian paint fungus (*Echinodontium tinctorium*) are the most common species found in younger Douglas-fir/true fir stands, and likely occurring scattered throughout the forest. Red belt fungus is an important decay agent in dead trees but sometimes occurs in the sapwood of living trees. Indian paint fungus is a particularly important species in grand and Pacific silver fir because it causes a hollowing of live trees, which are used by a myriad of wildlife species including Vaux‟s swifts, flying squirrels, pileated woodpeckers, and owls. This disease is more prevalent in older stands, and will increase over time on the ownership. It infects all diameters of trees, causing some large diameter trees to develop hollow centers, providing suitable den sites for black bears.

The pouch fungus (*Cryptoporus volvatus*) is the most important sap rot of fir, and infects trees immediately after death. While no snags were found containing this fungus, it is common in both old and second growth forests, and likely occurs on the SLF.

We did not find any evidence of current root or butt rot fungi on the SLF. Laminated root rot (*Phellinus weirii*) targets a host of conifer species including Douglas-fir, grand and Pacific silver fir, and Western hemlock trees. Western redcedar and hardwoods are resistant to this root disease. Spread of this disease is typically slow (1-2‟ diameter increase/year) and is highly beneficial to snag, down wood, and canopy gap utilizing species by creating snags and down wood, while also increasing and diversifying understory plant and bryophyte[5] cover that thrive in canopy gaps.

Old evidence of butt rot on old growth Western redcedar stumps and snags was found and likely caused by Brown cubical butt rot (*Postia sericiomollis*), though none was found in younger cedar. The hollowed bases of several of these snags and stumps were large enough to stand inside and can be used as dens by black bears and as roost sites by bats. Brown cubical butt rot is the most common pathogen causing butt and trunk rot in cedar. We did not observe any root or butt rot agents in the hardwoods on the ownership. Hardwood trunk rot (*Phellinus igniarius*), which infects black cottonwood and alder, was not visible though could be present, does not present a management issue.

[5] Bryophyte: A division of non-flowering plant cover comprising the mosses, liverworts, and hornworts.

Armillaria (*Armillaria ostoyae*) and annosus (*Heterobasidion annosum*) root diseases, are infecting trees on USFS lands around Cle Elum Lake, but were not found on the ownership. Annosus root disease can be very problematic in grand fir dominated stands, but this is not a dominant species on the SLF. These stands are probably not at high risk for Armillaria.

Hemlock dwarf mistletoe (*Arceuthobium tsugense* subsp. *tsugense*) was noted in older Western hemlock trees on the ownership. These infected trees are remnants left during last harvest and are the oldest trees on the ownership. This species of mistletoe doesn't tend to produce large branch brooms, compared to Douglas-fir and Ponderosa pine dwarf mistletoe, but may offer some nest and roost structure for some species.

Tree mortality from snow loading and wind. These agents are creating beneficial small canopy gaps.

Mechanical and Fire

Damage and mortality of trees from mechanical forces (lightning, wind, snow, and ice) is apparent but not excessive on SLF. Occasional windthrown and broken trees were found during walk-throughs. This pattern is most common in dense tree patches where trees have high height to diameter ratios[6]. Most of this tree mortality appears to result from heavy wet snow accumulating on unstable tree crowns. These disturbance events are thinning the forest in irregular patterns, removing mostly smaller small canopy sub-dominant trees, creating some down wood (though small diameter) in patterns ranging from single trees to groups. These canopy gaps were observed up to approximately1/20 acre in size. Given ecosystem-restoration goals for the ownership, this tree mortality is beneficial. A few scattered conifer trees show classic spiral scarring, resulting from lightning injury. The SLF has probably not experienced fire since the last timber harvest around 70 years ago. Cedar stumps and snags have numerous fire scars, probably resulting from broadcast burning of logging slash.

If timber harvesting occurs adjacent to the ownership, it will influence vegetation on the SLF by drying the forest edge understory and increasing the risk of blowdown. Windthrow is common along the edges of clearcut stands, which may also lead to increased Douglas-fir beetle activity on live trees, creating additional snags.

[6] Trees with high height to diameter ratios are spindly and unstable because they do not have enough girth to support their height. These trees are predisposed to stem breakage and windthrow from snow, ice and wind.

Current vs. Reference Stand Conditions and Disturbance Regimes

The reference period for this ownership is the general time frame prior to Euro-settlement (mid to late 1800s), during similar climatic conditions, when the ownership likely supported many of the species that are the focus of this plan. Clearly, timber harvests have supplanted fire, insects and disease as the dominant and most influential disturbance regime on the SLF and adjacent landscape since the reference period. 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[7]. These fires burned with high severity over large spatial scales, although varied topography in the Cascades often created areas of varied fire severity (some trees, patches, and stands survived these major fires). While the historic fire regime created high variability with some large patch scales (500+ acres), timber harvests have shaped the landscape into smaller, more fragmented single age class habitat patches. Age class distributions of stands are now weighted toward young cohorts (<50 years), especially on private lands. One result of the altered fire regime and timber harvests on the ownership has been a major reduction of snags, large woody debris and decayed live trees.

"One result of the altered fire regime and timber harvests on the ownership has been a major reduction of snags, large woody debris, and decayed live trees."

In addition to fire, windthrow patterns have changed on the SLF but are probably similar to those that occurred on younger forests developing during the reference era. Forest edge from adjacent harvests can potentially create different windthrow patterns. The size difference between dominant trees in old growth and in the current stands lead to different effects of windthrow on gap size and understory conditions. For example, the falling of a single old growth tree could create a canopy gap much larger than is currently occurring in these young stands. These large gaps would be occupied by an understory plant community, including new tree cohorts that favor open conditions, adding elements of patch-level understory plant diversity and enhanced vertical canopy structure.

Changes in patterns of insect and disease are difficult to assess between the reference and current conditions because of the lack of data of pre-management patterns. Our assessment of these differences is based on observations of insect and disease influences in old growth stands over the last few decades. It is clear that dead wood (snags, down logs and decay in live trees) has decreased markedly under current disturbance regimes. Historic fires in these forest types left huge volumes of this resource. Post-fire insect and disease patterns varied with species. Surviving live trees (both within fire areas and adjacent) were subject to increased beetle attacks (e.g. Douglas-fir bark beetle), while some pathogens were reduced due to hot conditions. Fine-scale patterns of insect and

[7] Research corroborates a low frequency-high severity fire regime in much of the hemlock-fir region even in early Euro-settlement times. In 1902, fires burned 480,000 acres on and near the Gifford Pinchot National Forest. Though this event was caused by slash burning, it demonstrates the severity and extent of these infrequent fires.

disease between large-scale disturbance events have likely also been altered. In particular, heart rot agents were also much more prevalent, due to much older more susceptible trees. The current thrifty fast growing trees are, in general, more resistant to these pathogens. Bark and wood boring beetles were probably also more prevalent in old growth forests, killing senescent older trees. The higher level of dead wood in old growth provides more substrate for these and other insect species.

The discussion of current disturbance patterns would be remiss without acknowledging the influence of climatic factors on these processes. It is probable that global warming will alter the patterns of these agents and subsequently lead to changes in forest structure and composition though it is still unclear how this will play out. One possible scenario includes declining snowpacks and warmer drier growing seasons. Such conditions will reduce the stocking potential of forests on the ownership, and thereby lead to increased tree stress, and subsequent increased mortality due to insects and disease. These conditions may also reduce Pacific silver fir, which is already at its lower elevation limits; climate warming may make this fir more susceptible to infestation and increased mortality by exotic pests, such as the Balsam woolly adelgid (*Adelges piceae*), that favor warm and dry climates. Finally, warming and drying climate trends are likely to increase the frequency and severity of fires.

Fuels and Fire Risk Assessment

Forest fuels, both dead woody material, and live vegetation, play major roles, along with weather and topography in determining fire behavior and effects. On wetter coniferous forests with low frequency-high intensity/high severity fire regimes, forest fuels are generally not as important in managing fire risk as they are in drier Eastside forests. For this reason, assessment of surface fuels in wet Westside stand types is rarely completed by industry or public agencies[8]. Nor are fuel reduction prescriptions considered important in the majority of Westside stands. The SLF is in a steep transitional zone between east and Westside forests. However, its climate and disturbance regimes are more similar to forests on the mid slopes of the western Cascades than to the drier forest types to the east of the ownership. Additional geographic factors including wetlands to the south, and the Yakima River and Keechelus and Kachess Lakes to the west and east, reduce risk of fire spread and intensity. For these reasons, a surface fuels inventory has not been completed. It is worth noting that surface fuel levels[9] in the three most important timelag fuel classes for fire behavior (1, 10, 100-

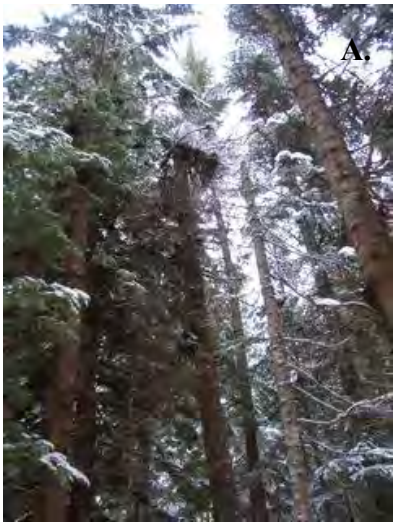
"Management of forest fuels to reduce fire risk is not necessary on this property."

[8] Weather plays a more influential role in determining fire hazard than forest fuels on the Swamp Lake Forest. Westside stands are often very dense and under extreme weather conditions will likely burn with high severity regardless of fuel treatments.

[9] 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.

hr) are low and below the threshold that would trigger management action even if these stands were under Eastside guidelines. In contrast, levels of large woody fuels (1000-hr) are fairly high because of carryover of biomass from the old-growth stand after logging (see Down Wood below).

While forests are more prone to fire during hot, dry summer months, these risk are low on the SLF. Management of forest fuels to reduce fire risk is not necessary on this property. If a fire should occur on the ownership, access for control is good from adjoining lands. While there currently is no access on the ownership for fire fighting vehicles, Kachess Lake Road runs along the southern property line and is within ¼ mile of all areas on the ownership for running hoses. Forest Service Road 4934 borders the eastern property line and provides additional access for fire control. The ownership is within a few miles of water sources along the Yakima River, Keechelus and Kachess Lakes.



A-New snag created from stem breakage at mistletoe weakened section. B- Remnant old growth Western redcedar snag.

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 importance of snags to many species associated with forest types on the SLF is well documented. These species are listed in Appendix G. We identified 61 species from a list of wildlife on the SLF that utilize dead wood. There are 49 species that require snags, including 24 bird species, 14 species of mammals (including 9 species of bats), and 2 amphibians.

Snags

Snag conditions on the SLF are typical for Westside second growth coniferous forest that did not have large snag carryover from original stands. Characteristics of current snag resources on the SLF are summarized in Table 5. Snags sampled included

Douglas-fir, Pacific silver fir, and Western redcedar. Grand fir and Western hemlock snags were observed on the SLF but did not fall within sample plots. Snag density across the ownership averaged 5.1 snags per acre for all trees 10" DBH[10] and greater

[10] DBH – Tree diameter at breast height (4.5" from the forest floor on the uphill side of the tree).

and at least 8" in height. Though some snags were clumped, most were singly distributed (all but one plot with snags contained only one dead tree). Snag density recruited from second growth dead appeared to be correlated with stand density, with the highest numbers of these young dead trees corresponding with dense tree patches. There were very few snags in low tree density areas of the ownership.

Snag density is weighted toward smaller trees (see Table 5). Most of this small tree mortality was related to inter-tree competition (suppression from overtopping and stem breakage from snow loading). There was well under 1 snag per acre in classes 20" DBH and greater. These large dead trees are valued highest by many cavity utilizing wildlife. Small snags tended to be in low decay classes. The few measured and/or observed snags in higher decay classes tended to be in the largest diameter classes and are carryovers from the preceding old growth stand and included several large hollowed Western redcedar snags. These remnant old growth snags provide excellent roosting for species including pileated woodpeckers, and nest and roost habitat for bats. Low to mid decayed large trees (including dominant canopy class second growth) are rare, and hence the habitat niches provided by these types of snags is severely lacking. Additional snag summary data is provided in Appendix E.

Table 5. Snags per Acre by Diameter Class

		Snag Diameter Class (")						
Species	**Decay Class**	**11**	**38**	**40**	**50**	**52**	**57**	**All**
Douglas-fir	4						0.1	0.1
	5	2.2						2.2
Pacific Silver Fir	1	2.2						2.2
Western Red Cedar	3				0.1			0.1
	4		0.2	0.2		0.1		0.5
Total		***4.4***	***0.2***	***0.2***	***0.1***	***0.1***	***0.1***	***5.1***

Sampling was limited to snags 10" DBH and greater and at least 8' tall. Only seven snags were measured on the SLF even with a high plot density (32 plots were installed, 1 plot/2.2 acres). Low snag count with high plot counts indicates low snag density and suggests statistical error of our estimates are likely to be high.

Down Wood

Down wood levels averaged 45 tons/acre (see Table 6). Most down wood was highly decayed (88% of tonnage and 42% of logs were in decay classes 4-5) Down wood ranged from concentrations to scattered logs. Most plots (88%) contained at least one down log. Average volume of down wood at SLF was 2,013 ft^3/. There are two main sources of current down wood on the ownership.

1- Most of down log volume is carryover from the old growth stand. These logs are mostly well-decayed (Classes 4-5) and the

Table 6. Down Wood Characteristics by Decay Class (1-5)

	1	**2**	**3**	**4**	**5**	**Total**
Tons/Acre	1.56	1.53	2.42	32.90	6.88	**45.29**
Ft^3/Acre	69	68	107	1,462	306	**2,013**
Logs/Acre	16	11	39	83	17	**166**
% Cover	0.16%	0.15%	0.09%	0.54%	0.09%	**1.03%**

largest diameter classes of down wood. Logs from these older age classes were predominantly Douglas-fir. The largest sampled down log was 30" diameter and 30" in length.

2- A small portion of total down log volume originates from suppression mortality, windthrow and stem breakage in dense second growth areas. These logs compose most of the small and low decay (Classes 1-2) down wood on the ownership and are a mix of conifer species. Down wood summary data is provided in Appendix F.

Stumps often represent an important component of down wood in second growth stands. Old growth stumps are very decay resistant due to a large proportion of heartwood at the tree base. Cedar stumps often have a hollow core, providing excellent habitat for black bear, marten and various small mammals that form the prey base for forest predators. On the SLF, about X of the down wood sampled were stumps, mostly from old growth trees.

Live Decayed 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 trees with softened heartwood, hollowed cores, broken tops, dead and intact tops, and scarred outer boles. Our inventory showed only X % of measured trees contained such features. These features are most important in large live trees (>20" DBH) but were very rare on the ownership. We noted very little heart rot in trees during exams. The most common decay feature likely to occur in the short-term is broken tops in trees infected with mistletoe.

Invasive Weeds

The invasion of non-native plants has emerged as one of the greatest threats to maintaining biological diversity throughout 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.

"We found no noxious weeds on the ownership…weeds are unlikely to be a problem in the near term assuming disturbance is minimized."

In this assessment, we classify 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" and 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.

The State of Washington maintains an invasive weed list and species are assigned 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.

Examination of the ownership for noxious weeds was not possible prior to completion of the April 2009 draft plan. Some visitors have observed a few small patches of Scotch broom (*Cytisus scoparius*) along the ownership periphery, adjacent to the Kachess Lake Road. Within the ownership, however, it is likely that noxious weeds are not a significant management problem given the lack of human disturbance since logging in the 1930s, and the prevalence of dense canopy conditions. We did not notice any other non-native species including invasive weeds. Most of the common invasive weeds in these forest types do not thrive in undisturbed, closed canopy, shady conditions. These species are unlikely to be a problem in the near term assuming shade is maintained and soil disturbing minimized. However, weeds more tolerant of undisturbed and dark conditions seem to be on the rise. Several of these species [e.g. false brome (*Brachypodium sylvaticum*), shining geranium (*Geranium lucidum*), and garlic mustard (*Alliaria petiolata*)] have been recently spreading in PNW temperate forests. Though these species are not known to occur in the vicinity of the SLF, these types of species probably present the greatest weed threat under current stand conditions. A longer-term assessment of likely weed issues is confounded by warming climate conditions. To the extent that climate change increases disturbance in PNW forests, an increase of invasive species is likely.

Rare and/or Listed Plant Species

The Washington Natural Heritage Programs database lists no known rare and/or listed plant species on the SLF. Rare plant surveys are not planned at this time. However, there appear to be no listed plant species that naturally occur in dense coniferous forest habitats similar to those within the geographic vicinity of the ownership.

Fish and Wildlife

The SLF provides habitat for many wildlife species associated with montane coniferous forests. Though the tract is small and does not contain a high diversity of habitats, it contains some relatively older stand structures within a highly fragmented landscape that contains large acreages of initiation and early stem-exclusion aged stands[11]. Its importance among private lands will continue to increase as industrial lands continue to be managed on short rotations. Though the ownership is smaller than the home ranges of some species (e.g. pileated woodpecker), it is part of a growing network of lands being managed for wildlife, including 300 acres of adjacent private lands managed by the Cascade Land Conservancy. The ownership is within two miles of the Yakima River, an important wildlife corridor linking Ecoregions on the west and east sides of the Cascades. We estimate 114 wildlife species that may currently occur in habitats on the ownership. Some species listed (e.g. Western bluebird) are unlikely using the ownership under current vegetation structure). This total includes 69 bird, 35 mammal, 6 amphibian, and 4 reptile species (See Appendix G)[12]. These species may utilize the ownership for one or more purposes including reproduction/feeding and dispersal. The specific niches presented by this habitat are discussed below by taxonomic class.

Mammals

Our analysis suggests potential current use of the ownership by 35 mammal species. Large mammals have home ranges and habitat needs that spatially exceed the ownership size, though are known to occur on the property. Large mammals known or likely to occur on the ownership include elk, black-tailed deer, black bear, cougar, and bobcat. Gray wolf, wolverine, fisher, lynx, and grizzly bear are listed species that are not believed to currently use the ownership but may in the future with landscape scale recovery actions by the appropriate public and private agencies (see Listed Species). Smaller forest predators include bobcat, coyote, ermine, and marten. However, ermine prefer brushy woodland habitats with edge and water, so their presence on the ownership may be marginal. While marten may use these habitats, they generally prefer older stands with high concentrations of down wood. Smaller mammals are likely present including snowshoe hare, squirrels (Douglas squirrel and northern flying squirrel), Townsend‟s chipmunk, shrews, and voles (Southern red-backed vole) and provide an important prey base for forest predators. Bats comprise the largest group of mammals in these forest settings. Forest habitat on the ownership is potentially suitable

“We estimate 114 wildlife species may occur on the ownership, including 69 bird, 35 mammal, 6 amphibian, and 4 reptile species.”

[11] Stand initiation and stem exclusion – After a clearcut, an initial cohort of trees establishes themselves relatively rapidly (stand initiation), precluding other new establishments for an extended period (stem exclusion).

[12] This wildlife table was created by querying the Matrixes for Wildlife-Habitat Relationships Database (O‟Neil et al., 2001) for species utilizing Westside Douglas-fir forests as a base list, and modifying using species range maps from the Washington GAP Analysis of the University of Washington. It does not include species that are highly unlikely to occur currently, including wolverine, fisher, lynx, gray wolf and grizzly bear.

for 9 species of bats, though lack of permanent water, large hollow snags and live trees, and canopy openings, might be a limiting factor for several of these species.

Birds
Our query suggests 69 bird species may potentially utilize the SLF. Forest conditions are suitable for use by at least 5 woodpecker species, though may not currently be optimal due to lack of snags. Foraging excavation discovered on the property confirms use by pileated woodpeckers. Also, 9 species of forest predator birds, including 6 owls and 3 hawks may use this forest. Owl species including great horned, pygmy 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 SLF may preclude nesting by NSO. Though the ownership does not currently have suitable nesting habitat for NSO, it provides dispersal habitat. Two forest hawks (sharp-shinned and Cooper‟s hawk) are likely using the property. A third accipiter, Northern goshawk, is unlikely using the ownership due to lack of mature habitat, and surrounding heavily fragmented landscape.

Neotropical migratory birds (NTMB) are another guild of birds using the SLF; 25 NTMB species may use this site. 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) and shrub-dominated canopy openings (MacGillivray‟s warbler). Due to dense overall canopies on the ownership, conifer canopy-dwelling species are likely to be most represented.

Remaining species include other common resident 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.

Amphibians
Our query shows potential use of the SLF by 6 amphibian species including long-toed salamander, rough-skinned newt, Western redback salamander, ensatina, Cascade‟s frog and Pacific chorus frog. All the above species except Western redback salamander require water for reproduction, so use of the property may be limited to dispersal habitat. The SLF is adjacent to Swamp Lake, a high quality wetland complex offering habitat to a range of pond-breeding amphibians including northwestern salamander, rough skinned newt, western toad, Cascade and Pacific tree frog and long-toed salamander.

Reptiles
Our query shows potential use of this ownership by 4 reptile species (3 snakes and one lizard) including rubber boa, Northern alligator lizard, common garter and Western terrestrial garter snakes.

Fish
Water sources are limited to intermittent overland flows that feed into roadside ditches. Hence, there are no fish populations on the SLF. Water flows off the property drain into

the Swamp Lake wetland complex, and eventually into the Yakima River. Any sediment delivery from this ownership should be considered part of the cumulative effects to this river and to populations of bull trout and other anadromous and resident fish.

Listed and Focal Species

There are at least 16 State and/or Federally listed wildlife species with historic and or current ranges that overlap the SLF (see Table 7)[13]. This list includes several wildlife species believed or known to be locally or regionally extirpated, but which may utilize the ownership in the future with public and private recovery efforts. All but one species (olive-sided flycatcher) listed in Table 7 and described below are considered focal management species in this plan[14].

Pileated Woodpecker excavations were found during site visits to the ownership. Current habitat is suitable for this species, though a lack of large (20"+ DBH) snags and hollow live and dead trees likely limits nesting and roosting. This species prefers older forest structure but will occupy younger forests if sufficient snags and down wood are available for nesting and ant foraging. The large home ranges of this species (from 1,000 to over 2,000 acres) limits habitat potential on the ownership unless adjacent lands are managed for mature forest conditions. The pileated woodpecker is the largest excavating woodpecker in North America and a keystone species. Its large cavities are widely used by many larger secondary cavity nesters that cannot occupy the holes of smaller woodpeckers.

Northern Goshawk require large landscapes composed mostly of closed canopy mature and late successional forest. Home range size for this species in the Upper Yakima watershed 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). The current landscape surrounding the SLF is poorly suited to the required forest conditions required by this species due to extensive timber harvesting. Future use by this species is feasible if nearby USFS lands are managed for late seral conditions, conservation group owned lands are stewarded toward older more complex conditions and industrial lands are grown on longer rotations with snag and down wood retention.

"There are at least 16 State and/or Federally listed wildlife species with historic and/or current ranges that overlap the SLF."

[13] While WDFW lists the genus *Myotis* on its Priority Habitat 2 list, it does not list individual species of this genus. We determined the SLF may be used by five Myotis species, though they are treated as one focal species in this plan.

[14] Olive-sided flycatcher is not a focal management species of this plan because this species generally prefers early-seral forests and highly disturbed sites; all the focal species selected for this plan generally prefer old growth forests, this ownership"s Desired Forest Condition.

Bald Eagles are found on lakes, rivers, bays, wetlands and other large water bodies with mature forest used for perching, roosting, or nesting. This federally listed species of concern and state-listed sensitive species uses the lakes and wetlands around the ownership. Eagle use of the property is probable given its position between Kachess and Keechelus Lakes and its adjacency to Swamp Lake and other wetlands. Habitat function of the property is primarily for roosting and will improve if desired structures (tall snags and large broken top trees) are available.

Vaux's Swifts are colonizing neotropical migratory birds that prefer mature coniferous forests throughout the PNW. Unlike many species described above, they don't require large contiguous blocks of older forest. 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.

Current and past use of the SLF by Vaux's swifts is unknown. This was likely high quality habitat for this species prior to logging, especially given the presence of large old hollow cedars and proximity to a mix of forest and open areas (Swamp Lake) for foraging. The lack of large hollow snags and trees probably limits current use of the ownership to aerial foraging assuming suitable nest/roost trees and snags are nearby[15].

Myotis spp., Townsend's big eared and big brown bats are listed as Priority Species by the Washington Department of Fish and Wildlife. Myotis species that may use the SLF include 5 species (long-legged, long-eared, California, little brown, and Yuma myotis). The common habitat needs for these priority bat species are large snags and decayed trees, forest canopy gaps and water. Forest dwelling bats require these structures for day, night maternity/nursery, and hibernation roosting. Though much of bats water needs come from the food they eat, open water sources are required for drinking and also provide good foraging areas for insects. Canopy openings and/or edge structure (meadow openings, windthrow patches, and water bodies) provide excellent habitat for feeding bats.

It is possible the SLF is currently providing foraging habit for some of the above bat species in scattered openings, though the paucity of large broken topped and hollowed live trees and snags limits roosting use. Past use prior to old growth removal was likely high for the above species, though the lack of water on or directly adjacent to ownership may have been and continue to be limiting factors for species tied closely to water (Yuma myotis).

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

Table 7. Focal and Listed Wildlife Species

Species:	Scientific Name:	Federal Listing	State Listing	State Priority	Current Presence	Focal Species
Pileated Woodpecker	*Dryocopus pileatus*	None	Candidate	PH1	Yes	Yes
Northern Goshawk	*Accipiter gentilis*	Concern	Candidate	PH1	Unlikely	Yes
Bald Eagle	*Haliaeetus leucocephalus*	Concern	Sensitive	PH1	Possible (P)	Yes
Vaux's Swift	*Chaetura vauxi*	None	Candidate	PH1	Possible (F)	Yes
Northern Spotted Owl	*Dryocopus pileatus*	Threatened	Endangered	PH1	Unlikely	Yes
Olive-Sided Flycatcher	*Contopus borealis*	Concern			Possible (P,F)	No
Myotis Bat (Various)	*Myotis* spp.	None	None	PH2	Unlikely	Yes
Big-Brown Bat	*Eptesicus fuscus*	None	None	PH1,2	Unlikely	Yes
Townsend's Big Eared Bat	*Corynorhinus townsendii*	Concern	Candidate	PH1,2	Unlikely	Yes
Fisher	*Martes pennanti*	Candidate	Endangered	PH1	Unlikely	Yes
Marten	*Martes americana*	None	None	PH3	Possible (F,D)	Yes
Gray Wolf	*Canis lupus*	Endangered	Endangered	PH1	Unlikely	Yes
Canada Lynx	*Lynx canadensis*	Threatened	Threatened	PH1	Unlikely	Yes
Wolverine	*Gulo gulo luscus*	Concern	Candidate	PH1	Unlikely	Yes
Grizzly Bear	*Ursus arctos*	Threatened	Endangered	PH1	Unlikely	Yes
Cascades Frog	*Rana cascadae*	Concern			Possible (D)	Yes

PH=Priority habitats (1=State-listed and Candidate Species, 2=Vulnerable Species, or aggregations, 3=Species of recreational, commercial and/or tribal importance, Presence is based on forage, roost, nest and/or dispersal use on the ownership. Possible(F)= possible forage use, Possible(P)= possible perch use, Possible(D)=possible dispersal use.

Northern spotted owls (NSO) are currently not utilizing the SLF for nesting or foraging as forests on the ownership lack the mature forest structure required by this species. However, this ownership may play a positive role in recovery efforts of this species. The ownership is situated within the I-90 East Spotted Owl Special Emphasis Area, with suitable habitat occurring within a few miles of the SLF; NSO are currently nesting on two sites within three miles east and northeast of the ownership. Modeling has demonstrated that forests around Swamp Lake currently provide dispersal habitat for NSO (USDA and USDI 1997). The SLF, combined with other conserved lands, will help provide critical connectivity between the Western Cascades and these and other Eastside owls. These lands may also provide future nesting and foraging habitat as more complex forest structure develops on the SLF. While the Swamp Lake Forest is insufficient in size to meet the home range requirements for NSO, it is part of a larger and growing landscape of conserved lands that will eventually offer improved habitat for this species. For example, the SLF combined with adjacent Cascade Land Conservancy lands, and directly adjoining sections of publicly owned forestland, contains nearly 3,000 acres of potential future connectivity and long-term nesting habitat. 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 populations. Continuation of short-rotation evenage forestry, expanding barred owl populations, and large, intense, out-of-context fires are negative risk factors for future use of the ownership by NSO.

Fishers are medium sized forest carnivores in the weasel family that prefer structurally complex older coniferous forest similar to the condition on the ownership prior to logging. Specific preferred structure includes dense canopies, large trees, some with mistletoe or broom rust deformed branches, large deformed trees, large snags and high volumes of down wood. These features provide resting sites and maternity dens, and support a diverse prey base. Dense forest with some openings provides optimal thermal conditions. The species was apparently extirpated in Washington but an effort is underway to re-introduce the species with an initial release in Olympic National Park in 2008. Furthermore, the ownership is encompassed within the state-designated Cascades Recovery Area and large blocks of suitable habitat are currently located on federal lands to the northeast and southwest. Fishers are far ranging species and could potentially utilize SLF if the following conditions are met: 1-Species is re-introduced to the Cascades, 2- Forests on the ownership develop more structural complexity, 3- Adjacent habitats are restored, fragmentation reduced, and connectivity improved.

Marten are small forest carnivores in the weasel family that prefer structurally complex older coniferous forest similar to the condition on the ownership prior to logging. Past use of the SLF prior to logging was highly likely, while current use is probable. Museum records document past marten use within a few miles of the ownership. Similar to fishers, marten prefer semi to dense canopied coniferous forest, large trees, some with mistletoe or broom rust deformed branches, large deformed trees, large snags, and high volumes of down wood. These features provide resting sites and maternity dens, and support a diverse prey base. Marten prefer more snow pack and tend to occupy higher elevation forests than fishers. In winter, marten use subnivean structures (habitat beneath snow under down wood and slash piles) for cover and hunting opportunities.

"With Regional conservation efforts, the ownership will provide critical dispersal habitat for listed wide-ranging forest carnivores."

Canada Lynx are rare and wide-ranging feline carnivores associated with upper-elevation montane forests. Current populations in Washington are estimated at around 100 animals distributed in the North Central and Northeast parts of the state. Lynx are a state and federally listed threatened species. It is believed this species range once also included parts of the Southern Cascades. Lynx are relatively tolerant of low to moderate levels of human activity, but have been negatively impacted by more extensive development and over trapping. While the ownership is probably not core habitat for this species, it is part of an essential corridor that may eventually provide connectivity to the Southern Washington Cascades. One of its main prey items, snowshoe hares, is common on the SLF.

Wolverines are large, highly secretive members of the weasel family and inhabit a range of upper montane forest and open alpine environments. They are rare in Washington and populations poorly understood. Wolverines are a state candidate species and a federally listed species of concern. They historically occurred along the entire length of the Cascades, but their current range is probably limited to a few wilderness strongholds in the North Cascades. Museum records confirm past wolverine use of habitats in western Kittitas County, and tracks were recently found within a few miles of the SLF[16]. Wolverines are extremely sensitive to human disturbance. Developments and recreation in mountainous areas (ski resorts, logging, roads, heli-sking, and snowmobiling) have pushed this species out of prime habitats. For these reasons, wolverine use of the ownership is probably limited to dispersal. As with other wide-ranging species, the importance of this ownership is its strategic position in the narrow north-south habitat corridor.

The ***Gray Wolf*** is a wide-ranging carnivore formerly well distributed throughout the state. Wolves thrive in a variety of forest and open habitats. The closest confirmed sightings to the SLF are in Western Okanogan County, about 80 miles north. They are sensitive to roads and human interactions. Past use of the SLF prior to extirpation in the 1930s was likely. While current use is undocumented, the ownership is probably more important wolf habitat today than historically, due to its strategic position in this anthropogenically narrowed north-south habitat corridor. Protected by Federal law, gray wolves will likely continue expanding their range and population south along the east and west slopes of the Cascades. With this movement, the SLF will become part of this range.

Grizzly Bear historically ranged throughout the entire state. Its current population of fewer than 20 bears in the North Central Washington Cascades region, is classified as self-sustaining only with active recovery effort. Habitat for this wide-ranging carnivore includes a wide variety of forest and open landscapes. The Washington population of grizzly bears remains threatened by continued habitat fragmentation, road impacts, human interactions, and genetic isolation. The SLF may eventually be part of habitat used for dispersal and support of deer and elk prey-base, as larger-scale recovery efforts progress. The proximity of the ownership to roads, major highways, residual development and recreation lands probably precludes core use of this forest by grizzly bears.

Olive-sided flycatcher is a neotropical migratory bird that inhabits high severity burned forests and other open disturbed forest sites such as harvested areas and large windthrow patches, as well as naturally induced edge habitat. It is listed as a Federal species of concern. Use of the SLF is limited due to mostly closed canopy conditions, though some use may occur in scattered open areas and in the southern part of the forest, along the edge nearest the Swamp Lake wetlands. Habitat for this species will

[16] Wolverine tracks were documented on Amabilis Mountain, approximately 1 mile north of I-90, in March 1998 by a member of a snow tracking field crew recreationally skiing in the area (Singleton and Lehmkuhl, 2000).

continue to decline as the ownership's forest matures, unless large-scale disturbance events revert the forest to early-seral conditions. Even if the habitat for this species declines over time, the edge nearest the Swamp Lake wetlands may continue to be used, especially if snags are located in these areas.

Summary of General Habitat Trends

Several general trends are evident regarding wildlife/habitat relationships on the SLF.

1- Late-successional interior forest conditions have been reduced due to landscape-level fragmentation by extensive logging over the past 100 years[17].

Species Impacts: Reduction of habitat for species requiring mature and complex forests

2- Snag densities, sizes and ranges of decay classes have been seriously reduced compared to old growth reference. Spatial patterns of snag distribution have likely been altered with less clumping of dead trees.

Species Impacts: All snag utilizing species listed in Appendix G have suffered habitat loss. Primary cavity nesters requiring large snags (pileated woodpecker and Northern flicker), other species using large hollow snags (marten, bats) and those requiring high snag densities are impacted the most.

3- Down wood resources have changed, with reductions of volume, less inputs of large down logs, and less down wood in low decay classes.

Species Impacts: All down wood utilizing species listed in Appendix G have suffered habitat loss. Species that forage extensively in down wood (pileated woodpecker) and those using large hollow down logs (black bear, marten, fisher) are impacted the most.

4- Habitat has declined for species preferring/requiring open and areas. These early-seral habitats have been replaced by dense conifer cover and duff/litter dominated understories over many parts of the ownership over the past 70 years.

Species Impacts: Use has declined by species using open early-seral forest habitats (Western bluebird and common nighthawks), open shrubby habitats (white crowned sparrow and willow flycatcher) and shrubby understories with forested areas (Wilson‟s warbler).

Infrastructure

Roads and Access

The SLF has no currently active roads within its boundary. The property is accessed via Kachess Lake Road (See Figure 1 and 2). This paved county road runs along the southern

[17] It is noteworthy that Swamp Lake may have been significantly larger historically and bordered the southern boundary of SLF, creating edge habitat on the ownership.

boundary of the ownership. The northeast portions of the ownership can be accessed from FS Road 4934, which intersects Kachess Lake Road at the eastern-most point of the property. Kittitas County maintains Kachess Lake Road year-round. Though surfaced with gravel, FS Road 4934 is not plowed in the winter. A network of old unsurfaced logging roads and skid trails were constructed throughout the ownership for logging, probably in the 1930s. This network is discernable from a 1954 aerial photo. These roads and trails have revegetated, and are no longer visible from current aerial photos (see Figure 2 for a 2005 aerial photo). We located no culverts along these old roads and they do not show evidence of active erosion.

Structures and Utilities

There are no structures or observed above ground utility lines on the ownership. The appraisal report describes power and telecommunication lines accessible from Kachess Lake Road. These are understood to be across the street from the property, in the adjacent development.

Cultural Resources

While no artifacts have been found on-site by project partners, the SLF was once part of lands used by the Confederated Tribes and Bands of the Yakama Nation (Yakama Nation). The current Yakama Nation Reservation is situated approximately 60 miles to the south. The ownership falls within the Kittitas Archeological Model, which lists the area as having a high potential for containing cultural values of interest to the Yakama Nation.

Recreation

There are few current recreational uses of the ownership. Dense young stands combined with lack of maintained trails, and private status have limited uses to a few hunters[18]. The surrounding area is well used by a variety of recreation users including high summer (hikers, mountain biking, ATV, and fishing and other boating activities) and winter (cross country skiing and snowmobiling) use. There is concern, given the proximity of SLF to heavy recreation areas, that any activities to improve access to the forest will result in more use, including motorized off-road traffic.

Summary of Assessment Findings

Table 8 summarizes the important findings of this assessment and links issues with management recommendations provided later in this plan.

[18] One fairly new hunting stand was found.

Table 8. Summary of Assessment Findings and Issues

Resource	Summary Findings	Issue/Need
Soils	Single soil type, low productivity and moderate erosion risk	None
Hydrology	No permanent water, only overland flow	None
Forest Structure/Composition	Young stands, lack structural complexity	Restore complex forest- See Recommendation # 4
Disturbance Regimes	No abnormal I/D patterns, small group and single stem breakage and windthrow occurring	None
Fuels/Fire Risk	Fuel levels normal, fire risk low, good fire control access though no passable roads within property.	None
Dead Wood Resources	Snag, down wood and decayed lived trees are low compared to desired levels for focal and other wildlife species.	Increase dead wood- See Recommendation # 4
Invasive Weeds	None found and unlikely to occur in near term under minimal management scenario	Monitor for early detection See Recommendation# 3
Rare and/or Listed Plant Species	None known to occur from Natural Heritage Records	None
Listed and Focal Species	At least 16 listed species may eventually use this ownership. Use by one (Pileated Woodpecker) is documented. Fifteen are focal management species.	Restore conditions for use by focal species- See Recommendation # 4
Roads	No passable roads occur on the ownership	Reduce Access- See Recommendation # 1
Structures and Utilities	No structures, possible buried utility lines	Conduct utility locate before site disturbing activities are completed
Cultural Resources	The ownership is within the Kittitas Archeological Model (high potential for containing cultural values of interest to the Yakama Nation).	Consult with Tribes before conducting land disturbing activities
Recreation	Use on ownership is minimal and limited to occasional hiker and hunter. Adjacent lands are heavily used.	Reduce Access- See Recommendations # 1-3

Forest Stewardship Synthesis and Recommendations

Management Goals and Objectives

The Swamp Lake Forest is part of a growing network of private lands that have been prioritized for conservation within the I-90 Corridor. The area around Swamp Lake has been under increasing development pressure from recreation users and vacation home seekers. This ownership, along with the adjacent 300 acres of land purchased in the earlier phase of the Swamp Lake/Amabilis Mountain project are integral to a number of regional conservation efforts described previously (see "Overview and Conservation Role"). Thus, management priorities center on restoration of habitats to help recovery effort of the focal species. Other secondary goals include research and demonstration of forest ecosystem recovery pathways using primarily passive management.

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 Kittitas Conservation Trust to guide future management of this property.

1. Preserve desired habitats throughout the ownership and protect from current and future threats.

A. Protect critical habitats and unique features.
B. Limit human activities on the ownership to insure minimum disturbance to sensitive wildlife species.
C. Work with adjacent landowners to encourage protection of lands and reduce degradation by such activities as rural residential and commercial development, off-road motorized use, and dumping.

2. Recreate old growth forest conditions and restore a full-range of ecological functions associated with reference era forests.

A. Maintain and enhance habitat for a variety of wildlife associated with mature forest and reference conditions using:
    1- Passive restoration strategies as main strategy to move stand conditions towards mature/old growth conditions and,
    2- Targeted treatments to accelerate/enhance habitat creation for focal species, and to enhance unique habitat features, only as new funding becomes available (or the action is shown to be revenue neutral), and only if such actions can be shown to benefit focal species without negatively impacting other resources.
B. Integrate and encourage stewardship planning and efforts with adjacent landowners to reduce landscape-related limiting factors on ownership of habitat use by focal species (e.g. reducing fragmentation around ownership).

3. Use the ownership as a model to demonstrate restoration strategies and techniques and as a research site for public and private agencies to evaluate passive or minimal treatment management approaches.

A. Use permanently located monitoring plots to compare stand development and other aspects of ecosystem change over long time frames.
B. Encourage research and repeat monitoring to assess habitat changes and validate use of innovative forest management practices if implemented.
C. Allow periodic tours to promote landscape-conservation goals (e.g. species recovery plans and efforts).

Synthesis and Desired Forest Conditions

The Swamp Lake Forest is being purchased with very specific and narrowly defined goals centered on protection and restoration of high-quality habitat for at-risk wildlife species. In designing a set of Desired Forest Conditions (DFC) for this ownership we considered key wildlife/habitat relationships for each species. Four of the focal species (grizzly bear, gray wolf, lynx and wolverine) are not as highly sensitive to forest development stage as they are to landscape patterns of human developments and disturbance. Since remaining species require various structure and composition components that are associated with mature to old growth forests, DFC designated for the Swamp Lake Forest are based on this range of conditions.

"The long-term DFC for the Swamp Lake Forest is late-successional forest structure typical of reference stand conditions."

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. DFC should consider the temporal element, and include intermediate stages of stand development. Many of the focal wildlife species will utilize habitats that are structurally diverse and contain certain key elements, even though these stands are not technically old growth. In this plan, DFC are described along a continuum based on stand development classes outlined in Franklin et al. (2002). The DFC also include a discussion of key stand development and disturbance processes, as they are central to structural development.

To establish DFC we have synthesized information from the following three sources:

1. **Reference Conditions -** The use of on-site reference conditions[19] to define management targets is generally consistent with core management goals of restoring habitat of focal and key management species. Past conditions and some disturbance patterns can be partially re-constructed using on-site evidence such as old stumps, down logs, snags, and residual old cohort trees. These features help indicate tree patterns, size and species, but provide few clues on understory plant community, and may not accurately depict the full range of trees as smaller logs and stumps don‟t persist as long.

2. **Old-Growth Research** - Literature that describes late-successional and old growth forest conditions provide some clues of the historical conditions of the ownership. These papers can provide guidance but taken alone are likely to miss site nuances and specific features common at fine scales. Studies from similar areas, types and plant associations are useful but not always available. Finally, the historic range of old growth conditions is probably not accurately captured in the literature as many of the most productive stands were harvested well in advance of old growth research.

3. **Wildlife-Habitat Relationships** - Research that correlates habitat use by focal species with specific forest conditions is a practical tool to guide specific and measurable DFC. Wildlife research can be particularly useful because it may provide relevant data to guide interim DFC (described below). Knowledge of specific habitat components (large hollow snags for bats and Vaux‟s swifts) allows managers to improve habitat particularly for species that are closely tied to a few specialized structures even if within younger forests.

[19] 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 forest conditions.

Summary of Desired Forest Conditions (DFC)

To create the DFC, each of the above resources were used, while mindful of their limits. Based on the analysis and synthesis of this data, it is determined that the optimum DFC for the Swamp Lake Forest that will best support the plan‟s goal to improve habitat for the focal species is a late-successional forest structure typical of reference stand conditions. The general structural and compositional features of this condition include the following:

- *Multiple species forest containing a mix of early-seral (primarily Douglas-fir) and late seral shade tolerant species including Western hemlock, Pacific silver fir, grand fir and Western redcedar*

- *A multi-layered canopy, with multi-cohorts that are arranged closely over small spatial scales so layering occurs*

- *Canopy dominance by original tree cohort composed of large diameter trees, giving way over time to more shade-tolerant species*

- *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*

- *Uproots (root wads and holes)*

- *Diverse ground community development composed of 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*

Given the importance of dead wood, DFC should contain levels to support maximum levels of snag and down wood utilizing wildlife species. The DecAID dead wood advisory model was used to determine density, size and decay class targets of snags and down wood[20]. Data from unharvested Westside forest plots shows total snag levels as high as 47 snags/acre >10” DBH, with 14-20 snags/acre >20”. Currently available research indicates providing at least 36 snags/acre total, with 14 snags/acre > 20” DBH meets a full range of wildlife needs for species associated with Westside coniferous stands. These targets will provide optimal habitat all focal species. Desired conditions also include a few very large snags (40” DBH+) per acre, to meet highly specialized

[20] 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.

habitat functions associated with species such as roost sites (pileated woodpecker, various forest bats). Snags distribution should be both clumped and scattered to capture species needs for spatial variation of dead wood.

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. Because the Swamp Lake Forest is at the upper elevation edge of this forest type, and less productive than many lower Westside forests, this level probably exceeds historic site levels of down wood. Therefore, we have established 10% cover as a long-term DFC as a reasonable compromise given the uncertainty of reference down wood conditions. Distribution of these resources should be patchy and scattered with some high concentrations of down wood.

"Dead wood DFC are long-term targets and will be achieved over many decades to centuries."

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 have not yet been designed by ecologists. Fine-scale disturbance and tree senescence in older forest created low to high levels of defect in live trees[21]. These features including hollowed, scarred and topped trees, 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 property. These dead wood DFC are long-term targets and represent levels that will be achieved over many decades to centuries. Unfortunately, little legacy dead wood was carried over from the previous stand, so the forest is likely to be a lower dead wood condition, compared to similar aged forest that originated from logging or some other natural disturbance.

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 be tolerated on more than 5% of inventory plots and should not exceed 1% of overall percent cover. Ideally, no non-natives will occur on the ownership.

The idealized structural development of forest on the Swamp Lake ownership is described below.

DFC- 30-50 Year Window (Current-120 year stand age)

This interim DFC is classified as ***Biomass Accumulation/Competitive Exclusion***. Under these desired conditions, stand growth is rapid both in diameter and height. Small canopy

[21] The percentage of live volume defect provides information on decayed live trees in older forests. Defect in timber cruises in Westside old growth range from 10-50% or more.

gaps continue to form as a result mainly from snow/wind induced uprooting and breakage. However, most canopy gaps will be small (<1/10 acre) and rapidly close with expanding adjacent crowns. Competition mortality reduces tree canopy, removing trees mainly from lower diameter classes. Sub-dominant canopy trees (particularly Western redcedar) will remain in subordinate positions except where main canopy is opened from disturbance. In these areas, smaller cedar will be released and will lead to localized diversification of vertical canopy structure. However, foliar[22] canopy structure remains fairly low in this stage, with most foliar volume in the upper canopy. Down wood levels will decline as older forest floor accumulations decay. Recruitment will only partially offset these losses and mostly be small diameter (< 20" logs). Snag density will likely increase, mostly from competition mortality of smaller trees (suppressed and intermediates), though some larger co-dominants trees will be recruited through snow/wind breakage, especially in trees with mistletoe infections. Under the scenario described above, understory plant community diversity will increase slightly as canopy gaps will create variable light environments but will remain low.

Wildlife habitat during this stage of forest development provides preferred (moderate to high quality) habitat for 4 of the 15 focal species (see Appendix I).

DFC- 50-130 Year Window (120-200 year stand age)

During the ***Maturation*** phase on the Swamp Lake Forest, some of the desired old growth characteristics emerge including the recruitment of large diameter snags, deformation and hollowing of large trees, and the opening of canopy gaps large enough to induce substantive changes in understory plant communities including increased species diversity of shrubs/forbs, grasses, and mosses and liverworts. Douglas-fir will remain a dominant canopy species along with the shade tolerant species listed above. Establishment of new cohorts of shade tolerant understory trees may occur in some gaps. Down wood levels will reach a low point, and then start to accumulate during this period as snags and weakened trees fall. Snag recruitment shifts from competition to disturbance and age related decline factors, which lead to creation of snags from larger canopy class trees. During this stage, the very important structural components of deformed and hollow trees are created on the Swamp Lake Forest.

Wildlife habitat during this stage of forest development provides preferred habitat (medium to high quality) for all 15 focal species (see Appendix I).

DFC- 130-280+ Year Window (200-350+ year stand age)

During the ***Vertical and Horizontal Diversification*** phase on the Swamp Lake Forest old growth characteristics continue to develop including a continuous canopy layer, increasing inputs of large snags and down wood, hollow and deformed trees and small

[22] Foliar – Canopy structure composed of tree needles and leaves.

gaps. Major horizontal diversification accelerates during the later stages of this development with spatial patterns of trees, openings, snags, and down wood continuing to diversify. Large gaps form during these stages as dominant trees succumb to insects (e.g. bark beetles) and disease (root rot).

Wildlife habitat during this stage of forest development provides preferred habitat (high quality) for all focal species.

DFC- Unique Habitat Areas

Hardwood Patches

Hardwood patches in the Swamp Lake Forest are transient habitats because the dominant deciduous species are short-lived and shade-intolerant species. DFC in the short term in these areas include overstories dominated by cottonwood and red alder and understories composed of native woody shrubs, forbs, grasses, sedges and rushes. Hardwoods will probably persist on the site beyond 100 years. During this time-frame, declining and dead hardwoods will provide a short-lived but high value dead wood source for some cavity nesting species (downy woodpecker, red-breasted sapsucker). In the absence of major disturbance, long-term DFC (beyond 100-year stand age) will be coniferous forest. These areas will provide unique conditions (emerging younger canopy composed of shade-tolerant conifers, more open grown crown structure of dominant edge trees, and wet understory plant communities).

Western Redcedar Patches

These scattered small patches with concentrations of Western redcedar are highly desirable. DFC both short and long-term include persistence and development of the cedar component in these areas.

Management Pathways to Achieve DFC

The desired forest conditions described above for the Swamp Lake Forest center on developing complex forest conditions to aid recovery efforts of focal wildlife species. Past harvests have simplified forest structure and reduced habitat quality. Forest restoration strategies for this ownership can employ either passive or active restoration strategies, or a combination of both. "Active" management options available to achieve goals for this property include thinning, gap creation, snag and down wood creation, tree inoculation, and native plant seeding. These restoration "tools," if used intelligently can accelerate development of DFC. They also may create unintended and negative impacts (e.g. invasive weed spread, erosion, and opening the ownership to increased public access). In contrast, "passive" restoration relies on natural processes to recreate desired conditions. A strategy is adopted after synthesizing objectives, acceptable time-frames for achieving DFC, self-correcting capacity and other site factors, economics and available technologies. While such plans should not be overly swayed by expediency, they should remain responsive and adaptive to emerging ecosystem science, new methods and technologies.

The Swamp Lake Forest currently meets the habitat requirements of four (Lynx, Gray Wolf, Wolverine, and Grizzly Bear) of the 15 focal wildlife species[23]. These wide-ranging species are more general in habitat type requirements. The remaining species require habitat more closely associated with the set of conditions found in old well-developed stands. The estimated timeframe to meet these habitat requirements are provided for each focal species in Appendix I. While effective stewardship will improve within-ownership conditions, actual use by various focal wildlife species is strongly tied to A) Habitat restoration on adjacent lands, B) The development and maintenance of viable populations within the Central Cascades HCP area, and C) Regional habitat recovery efforts.

Passive Approaches and Timeframes

The Swamp Lake Forest is currently in the Biomass Accumulation/Competitive Exclusion stage of development and provides habitat suitable for four of the focal species. Under "natural" patterns of succession, we predict the forest will begin to produce moderate quality habitats for another four of the remaining focal species within a 50-100 year timeframe, during the Maturation stage. The forest will likely remain low quality as nest habitat for Northern spotted owl for at least 130 years but may provide dispersal habitat during this interim period. Forest development in later stages of the Vertical Diversification stage are predicted to produce habitat for Northern spotted owl and moderate to high habitat quality for all but one species. After approximately 170 years, we predict the SLF will produce high-quality habitat for all species.

[23] None of these species currently are believed to occur in the Central Washington Cascades. While current conditions on the SLF are viable as dispersal habitat, landscape-level habitat conditions and development currently limit use.

Active Approaches and Timeframes

The following candidate treatments have been identified for potential use on the SLF:

1-**Density Management** is the most effective "active" restoration practice available to manipulate tree canopy conditions. A growing body of forest science research supports the use of thinning under specific guidelines to accelerate creation of some older forest conditions. For example, thinning in dense evenage stands can increase tree diameter growth, the range of diameter classes, and horizontal diversity of tree distribution. Thinning increases light penetration to the forest floor, which can increase understory ground cover, plant diversity, and lead to new tree cohort regeneration and multiple canopy conditions. The degree of these changes is strongly related to the type of thinning employed, and age and current density of the stand. We considered two thinning treatments in this plan. The first, ***Mosaic Thinning,*** is an application of variable density thinning, whereby stands are thinned to tree densities in distinct Treatment Groups up to 1 acre or more in size. Trees are marked using a modified low thinning approach, whereby smaller stems are removed to release large trees while clumps and small openings are created or enlarged. This treatment is typically applied over an entire stand and requires machinery to cut and remove trees, and requires road, landing, and skid trail construction. The second, ***Targeted Tree Release***, involves the felling of trees around identified trees where release is desired. This technique would be prescribed around dominant and co-dominant trees to accelerate growth and increase live crown. It could also be done to create small openings around created or natural snags or decayed live trees. Felled trees would be left on site. No roads or skid trails are needed for this treatment.

2- **Snag, down wood, and decay tree creation** by the methods below can augment dead wood levels (see Table 9). Though natural recruitment of these features is ongoing, dead wood levels do not typically reach optimal habitat levels until stands reach later stages, typically 200+/- years of natural stand development. The accelerated creation of these features does not necessarily create desired habitat, as stands may lack other needed structural characteristics. Combining dead wood creation with some thinning would address, with time, other structural needs.

Table 9. Dead Wood Creation Techniques

Dead Wood Feature:	Creation Method:	Notes:
Snag	Pheromone[24]	Douglas-fir beetle
	Topping	Most common and effective method- woodpecker foraging immediate, cavity use with 5-10 years for some species
	Girdling	Higher fall rates than topping
Down Wood	Falling	Simple and effective, but no hollow logs unless fallen tree is hollow
	Wood Piling	Substitutes some functions for down wood, but use for variety of species is poorly understood
Live Tree- Broken Top	Topping	Effective and allows heart rot formation
	Explosives	Expensive and dangerous, not used much anymore, but creates desirable jagged top
	Inoculation	Tree may eventually break at point of heart rot
Live Tree- Dead Top	Girdling	Creates good drumming, perch sites. Nest sites for species preferring upper boles.
Live Tree- Hollow	Inoculation	Studies are too young to be conclusive, but probable that this practice will be effective.

[24] Pheromone baiting is used to encourage the aggregation of Douglas-fir beetles at sites targeted for snag development. Mass attacks by many beetles will overcome the natural resistance of the tree to pitch beetles out, and will result in the death of the tree.

Management Recommendations

The core management goals for this property center on developing complex forest conditions to aid recovery efforts of focal wildlife species. The question of whether to apply active restoration approaches on the Swamp Lake Forest ownership depends mostly on acceptable timeframes to achieve desired forest conditions and undesirable effects of treatments. Forest on the ownership are young, structurally simple and will likely remain in fairly low diversity stages for many decades. However, left to its own devices, these stands will likely develop into excellent mature forest habitat over time. There appears to be no urgent management need to reverse ecological degradation that will not self-correct over time.

The candidate treatments described above ("Active Approaches and Timeframes") could accelerate some of the key features and processes by increasing snag density, releasing suppressed desirable trees (e.g. Western redcedar), and stimulating understory plant diversity and crown complexity. However, these prescriptions have trade-offs. For example, mechanized thinning treatments will require roads to be re-opened and new forwarding/skid trails and landings to be created. These disturbed areas are prone to invasive weed spread, and create new access to illegal activities such as off road vehicles. More open conditions resulting from thinning, while beneficial to stand development, provide more access in general to the property.

Given the following:

1. One significant impediment to creation of quality habitat on SLF for more wide-ranging focal species is the threat of human-disturbance. The proximity of the site to nearby developments and popular recreation areas will negatively impact recovery efforts if access to the property is increased by the side effects of „active" management, such as creating new roads, skid trails, and landings.

2. The Swamp Lake Forest ownership appears to be progressing toward more structurally diverse and mature conditions and improved habitat for focal species, without human intervention.

3. There is a need for a demonstration site to measure and evaluate the results of a passive management approach. As mentioned earlier, restoration ecology is still a new „science"; opportunities to evaluate the progress of a „passively" managed forest will inform future restoration projects within the region.

Given these findings, we recommend that the Kittitas Conservation Trust adopt „passive" management approaches in order to best achieve the Desired Forest Conditions and thereby provide the greatest benefit for focal species. We also present several optional „active" stewardship activities that can be pursued if there is interest and funding. However, as mentioned earlier, these „active" strategies will only accelerate some forest processes; they will not substitute for the naturally created structural diversity and complexity that will best be achieved over time, by natural succession.

To meet the goals of this plan, we recommend the following actions:

Recommendation #1
Resource: Roads and Access (Page 33)
Related Goal/Objective: Preserve desired habitats throughout the ownership and protect from current and future threats.
Issue/Opportunity: Road Access to ownership and illegal activities
Management Recommendations: Block access by placing logs across road entrance at west end of property and maintain these barriers as needed.

Recommendation #2
Resource: Roads and Access (Page 33)
Related Goal/Objective: Preserve desired habitats throughout the ownership and protect from current and future threats.
Issue/Opportunity: Off-road access by snowmobiles, ATV, and motocross.
Management Recommendations: Maintain dense unthinned stand conditions around perimeter of ownership for at least 100‟ to thwart off-road vehicles and limit foot travel.

Recommendation #3
Resource: Roads and Access (Page 33), Forest Habitats (Page 10)
Related Goal/Objective: Preserve desired habitats throughout the ownership and protect from current and future threats.
Issue/Opportunity: Dumping and other illegal activities, and invasive/noxious weeds
Management Recommendations:

1- Conduct bi-monthly drive-by to check for dumping along Kachess Lake Road, and annual property visit to look for illegal activities and invasive/noxious weeds (See “Monitoring Design” below) and to monitor general forest conditions. Early detection and control are key to successful weed management.
2- Hang signs indicating approved uses of property if deemed important to protect resources.
3- Cleanup garbage on an as-needed basis.
4- Control invasive/noxious weeds, if new populations are discovered, using integrated weed management approaches and after consultation with agency partners. Techniques may include spot herbicide application, pulling, propane burning, and bio-control agents.

Recommendation #4
Resource: Forest Habitats (Page 10)
Related Goal/Objective: Recreate old growth forest conditions and restore a full-range of ecological functions associated with reference era forests.
Issue/Opportunity: Lack of suitable habitat for some focal species
Management Recommendations:

1- Allow stands to develop on natural trajectory.
2- Consider implementing targeted tree release and dead wood creation treatments if funding is made available, and project plans address other resource concerns. These treatments are optional and can be implemented in a phased/incremental manner.

Recommendation #5
Resource: All Resources
Related Goal/Objective: Use the ownership as a model to demonstrate restoration strategies and techniques and as a research site for public and private agencies to evaluate passive or minimal treatment management approaches.
Issue/Opportunity: Maintain science-based and adaptive management of the ownership.
Management Recommendations:

1- Share restoration goals and strategies of this ownership with adjacent landowners and encourage them to support this plan‟s goals by undertaking complementary actions on their own properties.
2- Update management plan every 10-years or as needed to reflect new science or monitoring results.
3- Conduct monitoring by re-measuring baseline inventory plots and taking repeat photos every 10 years.

Budget

The estimated costs to implement this stewardship plan are summarized in Table 10. These costs can be reduced through the use of volunteer labor. The assumptions used in creating this budget are outlined below.

1) **The one partial road entering the property would be blocked using logs per Recommendation #1.** The cost is for equipment rental and one paid day with a professional forester and faller.

2) **The site would require one annual site visit to monitor the property**. This site visit would involve walking the property to check for illegal activities, general condition of the forest, noxious weeds, and any other potential management issues.

3) **The site would require a bi-monthly (once per two months) drive-by** to check for garbage or roadside signs of illegal activity.

4) **Administration costs (outreach, meetings, reporting, etc) are completed by land trust staff** and limited to 3 days of staff time per year.

5) **Maintenance costs are limited to periodic garbage removal.** Since the site has a history of garbage dumping, we have included 1 day per year for collection and proper disposal.

6) **There will be no annual costs associated with noxious weed control.** If populations are discovered, this work could be done on a volunteer basis and/or through grants.

7) **Property taxes are not included in budget.**

8) **Possible contingency costs not included in this budget might include:** cleanup of an illegal drug operation, legal costs associated with property disputes, liability, etc.

9) **Forest Stewardship Plan will be updated once every 10 years.**

10) **If signs are posted, they will be very basic in design.** Elaborate signage will cost more.

11) **Budget does not include a specific line-item cost for outreach activities related to Recommendation #5 (Demonstration).** These costs are included as part of Administration Costs and are assumed to be minimal. Promoting the availability of this ownership for research purposes will be accomplished through communications with partners DNR and USFWS, research institutions, and existing Kittitas Conservation Trust conservation community relationships.

12) **Budget does not include funds for implementation of <u>optional</u> treatments associated with Recommendation #4.** This work could only be done if it would not adversely impact the ownership‟s resources, and if new grant funding was secured to cover the costs, or the work was completed by volunteers.

Table 10. Budget Estimates to Complete Recommended Management Tasks

		Estimated Costs			
Rec #	**Expense Type:**	**Annual**	**Periodic**	**One-Time**	**Timeframe:**
1	Block Road			$1,000	2010
3	Site Visits/Monitoring Garbage Removal/Neighbor outreach	$2,000			Annual Walk-through, Bi-monthly drive by
3	Signs		$200		As-Needed
5	10-Year Inventory		$5,000		Every 10-years
5	Forest Plan Update		$2,500		Every 10-years
	Total	$2,000	$7,700	$1,000	

Rec # = Recommendation Number

Monitoring Design

Forest Inventory

The Swamp Lake forest inventory has been designed to achieve the following goals:

1- *To provide baseline documentation of forest conditions for DNR's easement, and to be used to compare current with future stand development as a basis for evaluating progress towards stewardship plan goals and objectives.*

2- *To provide data for comparison of current stand conditions (structure and composition) in relation to a historic/reference condition.*

3- *To provide data to assess viability of existing habitat for focal species.*

4- *To rapidly assess invasive and noxious weeds.*

This inventory will be installed in Summer 2009 with repeat measurements and photos to be taken every ten years. To achieve the above goals, these inventory plots will be permanently located and will use a systematic point sampling design for data collection. The target plot intensity will be 5 acres/plot.

A concentric (nested) plot design will be used for the collection of vegetation data. A variable-radius plot will be used to measure trees 5+"DBH. Fixed-area circular plots will be used for understory vegetation, saplings, and seedlings. Down wood data will be collected using a planar intercept transect. Supplemental variable plots

Table 11. Vegetation/Dead Wood Data

	Trees >5"DBH	Seedlings	Saplings	Understory Veg	Snags	Down Wood	Stumps
Species	X	X	X	X	X	X	X
Diameter at Breast Height	X		X		X		
Diameter (Stump Height)							X
Crown Class	X						
Height to Crown Base	X		X				
Broken Top	X						
Silvicultural Code	X						
Height	X	X	X	X	X		
Damage	X	X	X				
Severity	X	X	X				
Tree Breast Height Age	X						
5-Year Radial Growth	X						
Percent Cover				X			
Log Intercept Diameter						X	
Small End Diameter						X	
Large End Diameter						X	
Log Length						X	
Decay Class					X	X	
Distance to Plot Center							X
Invasive/Noxious Weeds				X			
Wildlife Use	X				X		

will be temporally installed, in addition to permanent plots, for measuring snags to increase sample size. The inventory technician will monitor for invasive and noxious weeds while traveling throughout the ownership, and note discovered populations and locations on a survey sheet.

Plot data collected is outlined in Table 11. Summary descriptions of plot specifications and measurement protocols are provided below.

Plot center stake and adjacent reference tree

Variable Radius Plot 1: This plot will measure trees 5" DBH and greater. Tree selection will be determined using a Relaskop and basal area factor (BAF) that provides 5-8 trees/plot.

Variable Radius Plot 2: This plot will measure snags 5" DBH and greater. Tree selection will be determined using a Relaskop and the smallest BAF possible, which provides the largest plot size while allowing accurate determination of "in or out" snags.

Fixed Radius Plot 1: An 11.78-foot (1/100 acre) radius plot will be used to measure saplings less than 5" DBH and greater than 4.5' in height.

Fixed Radius Plot 2: An 11.78-foot (1/100 acre) radius plot will be used to measure seedlings less than 4.5' in height.

Fixed Radius Plot 3: A 16.65' (1/50 acre) radius plot will be used to estimate understory vegetation including invasive/noxious weeds.

Planar Intercept Transect: A 50' down wood transect will measure down wood. The transect will originate at plot center and follow the direction of travel towards the next plot.

Plot sampling procedures are described below.

Variable Plot 1

Plots will be established along line transects. Two strands of flagging will be hung where cruise lines cross roads with azimuth written on flagging. Plot centers will be marked with a metal stake and an aluminum rod. The metal stake will allow easy plot location years later, even if rod and reference trees are lost, while the aluminum rod will make the plot center visible. Two pieces of flagging will also be hung at plot center.
Two reference trees will also be recorded and marked in the field for plot relocation purposes. These two trees will be at least ninety degrees apart when possible and painted with a band of orange tree paint at eye level. A metal tag will be nailed into the tree, facing plot center, and will read the azimuth and distance to plot center.

GPS coordinates will be taken at each plot center to provide accurate plot locations within the GIS maps. A Basal area factor (BAF) will be used at each plot. BAF will not vary within stand polygon. Trees will be sited in and out using the Relaskop.
Data recorders will be used to record all cruise data. Tree species, diameter (to the nearest inch), insect/disease and wildlife use will be recorded for every tree and notes will be made on unique wildlife uses such as stick nests, nesting cavities, perches, etc.
Total tree height and live crown percent will be measured using a Relaskop and Spencer tape or a Laser Range finder. Approximately every third tree will be measured for height and crown ratio, and the remaining heights will be regressed.

Variable Plot 2
Variable Plot 2 will occur at same point as Variable Plot 1, with additional plots installed at the midpoint between each permanently established point. Interval plots between Variable Plot 1 are not permanent. Two strands of flagging will be hung where cruise lines cross roads with azimuth written on flagging. Two pieces of flagging will also be hung at plot center.

A Basal area factor (BAF) will be used at each plot. BAF will not vary within stand polygons. Trees will be sited in and out using the Relaskop. Data recorders will be used to record all cruise data. Tree species, diameter, height, decay class, and wildlife use will be noted.

Fixed Radius Plot 1
1. A 1/100th-acre circular plot will be established using the plot center from the variable radius plot for measurement of saplings.

2. Tree height, diameter (to the nearest inch) and species will be tallied on all trees less than 5" DBH and taller than 4.5".

Fixed Radius Plot 2
1. A 1/100th-acre circular plot will be established using the plot center from the variable radius plot for measurement of seedlings.

2. A count of each species will be tallied for all trees less than 4.5" tall. Comments on seedling health may be noted.

Fixed Radius Plot 3
1. A 1/50th -acre circular plot will be established using the plot center from the variable radius plot for measurement of vegetation.

2. Percent cover (by ocular estimate), species, and average height will be recorded for all understory vegetation species using the Forest Service vegetation codes.

3. Plant association will be recorded using Lillybridge et al. (1995).

Down Wood Transect

A 50‟ transect will be installed on the same azimuth as the cruiser uses to navigate to the next plot. One down log transect will be installed for each concentric plot.

The following data will be collected for down wood 4‟ in length and greater: Species, intersect diameter, length and decay class. Where species cannot be determined due to decay, a “hardwood” or “conifer” call will be made.

Photo points

1. Digital photos will be taken at each plot center (one in each cardinal direction, one overhead and one at ground over plot center. Digital camera should be set so photos are high resolution (at least .5 MB/photo). Photo files will be named according to following protocol: A photo taken at 90 degrees in plot 3 will be titled: “plot3east”.

Weed Monitoring

This weed monitoring plan has been designed to achieve the following goals:

1- To provide rapid detection of all weeds (invasive, noxious, and other non-native species).

2- To provide practical information to managers on identified weed populations to facilitate quick and effective treatment.

This protocol is designed for simplicity and cost-effective monitoring of weeds using the following methods:

Annual Walk-through: During annual visit to assess general forest condition, managers should walk the perimeter of the ownership, while focusing particularly along Kachess Lake Road and FS Road 4934. Additional areas to monitor include the open wet area in the north-central part of the ownership, open forest along the southern property border and any areas where treatments have been completed. If weeds are found, they should be identified, a GPS point collected, an estimation of population size and # of plants made, and noted whether population is within an area of open water. If the population spills over onto adjacent lands, note these conditions and notify landowner.

10-year Forest Inventory: Forest inventory technicians will note any weeds they see between plots and during travels around the property, as well as plants that fall within the permanent understory vegetation plots. Species, GPS position, and size of weed occurrence should be recorded and will be presented in the inventory report submitted to landowner.

Newly discovered weed populations should be quickly eradicated (See Recommendation # 3).

Appendices

A. Literature Cited

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B. Overstory Stand Summary Data

Species	DBH Class	TPA	BA/Ac	NetBF/Ac	GrsBF/Ac	CF/Ac
Cottonwood	37	0	3	811	854	139
Total CW		**0**	**3**	**811**	**854**	**139**
Douglas-fir	7	11	3	208	219	38
Douglas-fir	8	8	3	319	336	63
Douglas-fir	9	6	3	339	357	78
Douglas-fir	11	13	9	1,104	1,162	269
Douglas-fir	13	9	9	1,714	1,804	329
Douglas-fir	14	8	9	1,446	1,522	309
Douglas-fir	15	10	12	2,006	2,112	432
Douglas-fir	16	6	9	1,773	1,866	354
Douglas-fir	17	4	6	910	958	204
Douglas-fir	18	8	15	3,147	3,313	625
Douglas-fir	19	7	15	2,939	3,094	601
Douglas-fir	20	1	3	521	548	113
Douglas-fir	21	4	9	1,306	1,375	296
Douglas-fir	22	4	12	2,353	2,477	480
Douglas-fir	23	4	12	2,207	2,323	449
Total DF		**104**	**126**	**22,295**	**23,469**	**4,640**
Grand Fir	5	21	3	-	-	-
Grand Fir	7	22	6	616	649	123
Grand Fir	8	9	3	354	372	64
Grand Fir	9	19	9	1,103	1,162	235
Grand Fir	10	15	9	1,266	1,333	282
Grand Fir	11	9	6	727	766	189
Grand Fir	12	12	9	1,641	1,728	331
Grand Fir	13	10	9	1,590	1,674	317
Grand Fir	14	8	9	1,597	1,681	326
Grand Fir	15	5	6	1,268	1,334	251
Grand Fir	16	2	3	512	539	114
Grand Fir	19	3	6	1,174	1,236	241
Grand Fir	20	1	3	329	346	86
Grand Fir	21	1	3	613	645	126
Grand Fir	24	1	3	595	626	119
Total GF		**138**	**85**	**13,387**	**14,092**	**2,805**
Pacific Silver Fir	6	13	3	242	254	44
Pacific Silver Fir	7	10	3	192	202	48
Pacific Silver Fir	9	7	3	387	407	73
Pacific Silver Fir	10	6	3	388	408	80
Pacific Silver Fir	11	9	6	671	706	161
Pacific Silver Fir	12	7	6	900	947	190
Pacific Silver Fir	13	3	3	405	426	97
Pacific Silver Fir	14	3	3	492	518	105
Pacific Silver Fir	15	5	6	1,210	1,273	241

Species	DBH Class	TPA	BA/Ac	NetBF/Ac	GrsBF/Ac	CF/Ac
Toal SF		**62**	**35**	**4,886**	**5,143**	**1,038**
Red Alder	9	6	3	362	381	79
Total RA		**6**	**3**	**362**	**381**	**79**
Western Hemlock	5	18	3	-	-	-
Western Hemlock	8	9	3	336	353	74
Western Hemlock	13	3	3	242	254	69
Western Hemlock	16	2	3	368	388	92
Western Hemlock	17	2	3	380	400	93
Western Hemlock	22	1	3	494	520	111
Total WH		**36**	**18**	**1,820**	**1,915**	**439**
Western Red Cedar	6	15	3	142	149	28
Western Red Cedar	8	9	3	177	186	44
Western Red Cedar	12	3	3	100	105	50
Western Red Cedar	16	2	3	206	217	67
Western Red Cedar	21	1	3	309	326	81
Western Red Cedar	22	1	3	304	320	79
Western Red Cedar	25	1	3	266	280	73
Total RC		**33**	**21**	**1,503**	**1,582**	**421**
All Species	5	40	6	-	-	-
All Species	6	28	6	384	404	71
All Species	7	43	12	1,016	1,070	209
All Species	8	36	12	1,185	1,248	246
All Species	9	38	18	2,192	2,307	464
All Species	10	21	12	1,654	1,741	362
All Species	11	30	21	2,503	2,634	619
All Species	12	22	18	2,641	2,780	571
All Species	13	26	23	3,951	4,159	811
All Species	14	19	21	3,536	3,722	740
All Species	15	19	23	4,484	4,720	924
All Species	16	12	18	2,860	3,010	626
All Species	17	6	9	1,290	1,358	297
All Species	18	8	15	3,147	3,313	625
All Species	19	10	21	4,114	4,330	843
All Species	20	3	6	850	895	199
All Species	21	6	15	2,228	2,346	502
All Species	22	7	18	3,151	3,317	670
All Species	23	4	12	2,207	2,323	449
All Species	24	1	3	595	626	119
All Species	25	1	3	266	280	73
All Species	37	0	3	811	854	139
Total All Species		**380**	**290**	**45,064**	**47,436**	**9,560**

DBH Class=Tree diameter at 4.5',TPA=Trees per acre, BA/Ac=Tree basal area (ft3) per acre, NetBF/Ac=Net board foot volume per acre, GrsBF/Ac=Gross board foot volume per acre, CF/Ac=Cubic foot volume per acre

C. Understory Seedling and Sapling Trees Per Acre

Species	0-5	6-10	11-20	21-30	31-40	41-50	50+	All	Average
Douglas-fir			6.3					6.3	20.0
Grand Fir	6.3	6.3	12.5		6.3			31.3	15.6
Pacific Silver Fir	12.5		12.5	6.3	12.5			43.8	20.1
Western Hemlock	6.3	37.5	37.5		6.3			87.5	12.5
Western Red Cedar	43.8	68.8	50.0	12.5				175.0	9.6
Totals/Averages	**68.8**	**112.5**	**118.8**	**18.8**	**25**	**-**	**-**	**343.8**	**12.4**

D. Percent Cover and Frequency of Understory Vegetation

Species	Average % Cover	Frequency
Shrubs		
Baldhip rose	0.6%	56.3%
Big huckleberry	0.1%	6.3%
Devil's club	0.4%	6.3%
Dwarf Oregon grape	1.0%	56.3%
Dwarf bramble	0.1%	6.3%
Oregon boxwood	0.2%	18.8%
Red huckleberry	0.2%	18.8%
Snowberry	0.6%	62.5%
Serviceberry	0.1%	12.5%
Thimbleberry	0.2%	18.8%
Trailing blackberry	0.3%	31.3%
Vine maple	33.3%	100.0%
Whitevein pyrola	0.4%	37.5%
All Shrubs	**36.9%**	**100.0%***
Forbs		
Bedstraw	0.1%	6.3%
Coolwort foamflower	0.1%	12.5%
False lily of the valley	0.1%	6.3%
Fairybells	0.4%	37.5%
False solomon's seal	0.2%	18.8%
Little prince's pine	0.1%	6.3%
Pathfinder	0.1%	12.5%
Prince's pine	0.1%	12.5%
Queencup beadlily	0.6%	56.3%
Star flowered false solomon's seal	2.1%	81.3%
Sitka columbine	0.1%	6.3%
Starflower	0.3%	25.0%
Stream violet	0.4%	37.5%
Sweet cicely	0.2%	18.8%
Trillium	1.0%	100.0%
Twinflower	0.5%	43.8%
Vanilla leaf	0.6%	31.3%
Wild ginger	0.6%	62.5%
Wild strawberry	0.1%	6.3%
All Forbs	**7.4%**	**100.0%**
Ferns		
Bracken fern	0.6%	37.5%
Sword fern	0.1%	6.3%
All Ferns	**0.6%**	**43.8%**
All Vegetation	**44.9%**	**100.0%**

*Percent of plots that have at least one of the species in each category (e.g. 100% frequency for all shrubs means every plot had some cover by shrubs.

E. Snags by Diameter and Height Class

		Diameter Class (")						
Species	**Height Class (')**	**11**	**38**	**40**	**50**	**52**	**57**	**All**
Douglas-fir	0-10	158					6	164
Pacific Silver Fir	81-90	158						158
Western Red Cedar	0-10					7		7
	11-20		13	12				25
	81-90				8			8
Total		**316**	**13**	**12**	**8**	**7**	**6**	**361**

This table describes snag density for the entire ownership, not per acre.

F. Down Wood Characteristics

Species	DBH Class(“)	Tons/Acre
Douglas-fir	0-5	1.55
Douglas-fir	12	5.97
Douglas-fir	14	3.13
Douglas-fir	16	3.44
Douglas-fir	26	16.54
Total DF		**30.63**
Grand Fir	0-5	1.02
Grand Fir	6	0.95
Total GF		**1.96**
Misc. Conifers	0-5	0.53
Misc. Conifers	8	4.71
Misc. Conifers	12	1.78
Misc. Conifers	16	3.44
Total Misc. Conifers		**10.46**
Western Hemlock	0-5	0.43
Total WH		**0.43**
Western Red Cedar	0-5	1.81
Total RC		**1.81**
All Species	0-5	5.33
All Species	6	0.95
All Species	8	4.71
All Species	12	7.75
All Species	14	3.13
All Species	16	6.88
All Species	26	16.54
Total All Species		**45.29**

Diameter is taken at midpoint of log

G. Wildlife Species Associated with Habitats on the Swamp Lake Forest

The following table was created by querying the Wildlife-Habitat Relationships in Oregon and Washington Matrix (Northwest Habitat Institute 2001), utilizing Westside Douglas-fir forests as a base list, and modifying using species range maps from the Washington GAP Analysis of the Washington Cooperative Fish and Wildlife Research Unit at the University of Washington. This list includes all species generally associated with similar habitats and does not represent only species known to occur on SLF. This list also does not include all the species that are the focus of this plan since some of these species, such as wolverine, fisher, lynx, gray wolf, and grizzly bear, are highly unlikely to presently occur on the ownership, though may occur as the site approaches the Desired Forest Conditions and landscape-scale recovery actions are taken by the appropriate public and private agencies.

DWD= Down wood debris

Species	Association	Activity	Dead Wood	Comments
Birds			Snag or DWD	
Bald Eagle	Generally Associated	Reproduces	Snag	
Turkey Vulture	Generally Associated	Feeds/Breeds	Snag/DWD	Uses hollow logs for nesting.
Sharp-shinned Hawk	Generally Associated	Feeds/Breeds		
Cooper's Hawk	Generally Associated	Feeds/Breeds		
Northern Goshawk	Generally Associated	Feeds/Breeds	Snag/DWD	
Ruffed Grouse	Closely Associated	Feeds/Breeds	Snag/DWD	
Blue Grouse	Closely Associated	Feeds/Breeds	Snag/DWD	
Western Screech-owl	Generally Associated	Feeds/Breeds	Snag	
Great Horned Owl	Generally Associated	Feeds/Breeds	Snag	
Northern Pygmy-owl	Closely Associated	Feeds/Breeds	Snag	
Spotted Owl	Closely Associated	Forage/Dispersal	Snag	Probably marginal habitat
Barred Owl	Closely Associated	Feeds/Breeds	Snag	
Northern Saw-whet Owl	Closely Associated	Feeds/Breeds	Snag	
Vaux's Swift	Generally Associated	Feeds/Breeds	Snag	
Rufous Hummingbird	Generally Associated	Feeds/Breeds		
Red-breasted Sapsucker	Generally Associated	Feeds/Breeds	Snag	
Downy Woodpecker	Generally Associated	Feeds/Breeds	Snag	Needs hardwoods
Hairy Woodpecker	Generally Associated	Feeds/Breeds	Snag	
Northern Flicker	Generally Associated	Feeds/Breeds	Snag/DWD	
Pileated Woodpecker	Generally Associated	Feeds/Breeds	Snag/DWD	
Common Nighthawk	Generally Associated	Feeds/Breeds		
Olive-sided Flycatcher	Closely Associated	Feeds/Breeds	Snag	
Western Wood-pewee	Generally Associated	Feeds/Breeds		
Willow Flycatcher	Generally Associated	Feeds/Breeds		
Hammond's Flycatcher	Generally Associated	Feeds/Breeds		
Pacific-slope Flycatcher	Closely Associated	Feeds/Breeds	Snag	
Cassin's Vireo	Generally Associated	Feeds/Breeds		
Warbling Vireo	Closely Associated	Feeds/Breeds		

Species	Association	Activity	Dead Wood	Comments
Gray Jay	Generally Associated	Feeds/Breeds		
Steller's Jay	Generally Associated	Feeds/Breeds		
American Crow	Generally Associated	Feeds/Breeds		
Common Raven	Generally Associated	Feeds/Breeds		
Black-capped Chickadee	Generally Associated	Feeds/Breeds	Snag/DWD	
Chestnut-backed Chickadee	Generally Associated	Feeds/Breeds	Snag	
Bushtit	Generally Associated	Feeds/Breeds		
Red-breasted Nuthatch	Generally Associated	Feeds/Breeds	Snag	
Brown Creeper	Generally Associated	Feeds/Breeds	Snag	
House Wren	Generally Associated	Feeds/Breeds	Snag	
Winter Wren	Closely Associated	Feeds/Breeds	DWD	
Golden-crowned Kinglet	Closely Associated	Feeds/Breeds		
Ruby-crowned Kinglet	Generally Associated	Feeds/Breeds		
Western Bluebird	Closely Associated	Feeds/Breeds	Snag	
Townsend's Solitaire	Generally Associated	Feeds/Breeds	DWD	Marginal Habitat
Swainson's Thrush	Generally Associated	Feeds/Breeds		
Hermit Thrush	Generally Associated	Feeds/Breeds		
American Robin	Generally Associated	Feeds/Breeds		
Varied Thrush	Closely Associated	Feeds/Breeds		
Cedar Waxwing	Generally Associated	Feeds/Breeds		
Orange-crowned Warbler	Generally Associated	Feeds/Breeds		
Nashville Warbler	Generally Associated	Feeds/Breeds		
Yellow-rumped Warbler	Generally Associated	Feeds/Breeds		
Black-throated Gray Warbler	Closely Associated	Feeds/Breeds		
Townsend's Warbler	Generally Associated	Feeds/Breeds		
Hermit Warbler	Closely Associated	Feeds/Breeds		Edge of range
Macgillivray's Warbler	Generally Associated	Feeds/Breeds		
Common Yellowthroat	Generally Associated	Feeds/Breeds		
Wilson's Warbler	Closely Associated	Feeds/Breeds		
Yellow Warbler	Closely Associated	Feeds/Breeds		
Western Tanager	Closely Associated	Feeds/Breeds		
Chipping Sparrow	Present	Feeds/Breeds		
Song Sparrow	Generally Associated	Feeds/Breeds		
White-crowned Sparrow	Generally Associated	Feeds/Breeds		
Golden-crowned Sparrow	Generally Associated	Feeds		
Dark-eyed Junco	Generally Associated	Feeds/Breeds	DWD	
Black-headed Grosbeak	Generally Associated	Feeds/Breeds		
Brown-headed Cowbird	Generally Associated	Reproduces		Reproduction only
Red Crossbill	Generally Associated	Feeds/Breeds		Probably marginal habitat
Pine Siskin	Generally Associated	Feeds/Breeds		
Evening Grosbeak	Generally Associated	Feeds/Breeds		
Mammals				
Masked Shrew	Present	Feeds/Breeds	DWD	
Vagrant Shrew	Generally Associated	Feeds/Breeds		
Trowbridge's Shrew	Closely Associated	Feeds/Breeds	DWD	
Montane Shrew	Closely Associated	Feeds/Breeds	DWD	
Shrew-mole	Closely Associated	Feeds/Breeds	DWD	

Species	Association	Activity	Dead Wood	Comments
Coast Mole	Closely Associated	Feeds/Breeds	Snag/DWD	
California Myotis	Closely Associated	Feeds/Breeds	Snag	Uses rock crevices, hollow trees, mines or caves for breeding.
Yuma Myotis	Generally Associated	Feeds/Breeds	Snag	Closely associated with water. Uses caves, mines, loose bark and bark crevices typically close to water.
Little Brown Myotis	Generally Associated	Feeds/Breeds	Snag	Uses caves, mines, or hollow trees, often near water.
Long-legged Myotis	Closely Associated	Feeds/Breeds	Snag	Uses caves or mines for hibernation. Uses hollow trees, loose bark or rock crevices for maternity colonies.
Townsend's Big-eared Bat	Generally Associated	Feeds/Breeds	Snag	
Long-eared Myotis	Generally Associated	Feeds/Breeds	Snag/DWD	Uses caves, mines, hollow trees, loose bark or rock crevices.
Silver-haired Bat	Closely Associated	Feeds/Breeds	Snag	Uses trees, bark crevices, and snags for summer roosts.
Big Brown Bat	Closely Associated	Feeds/Breeds	Snag	Requires snags, caves, mines, rock crevices, or bridges for breeding and roosting.
Hoary Bat	Generally Associated	Feeds	Snag	Requires trees for roosting, but forages in openings and at edges of forests.
Snowshoe Hare	Generally Associated	Feeds/Breeds		
Townsend's Chipmunk	Closely Associated	Feeds/Breeds	DWD	
Douglas' Squirrel	Closely Associated	Feeds/Breeds	DWD	
Northern Flying Squirrel	Closely Associated	Feeds/Breeds	Snag/DWD	
Forest Deer Mouse	Closely Associated	Feeds/Breeds	DWD	
Bushy-tailed Woodrat	Closely Associated	Feeds/Breeds	DWD	
Southern Red-backed Vole	Closely Associated	Feeds/Breeds	DWD	
Creeping Vole	Generally Associated	Feeds/Breeds	DWD	
Common Porcupine	Closely Associated	Feeds/Breeds	DWD	
Coyote	Generally Associated	Feeds/Breeds		
Cascades Red Fox	Generally Associated	Feeds and Breeds		Probably marginal habitat
Black Bear	Generally Associated	Feeds/Breeds	Snag/DWD	
Raccoon	Generally Associated	Feeds/Breeds	Snag/DWD	
Ermine	Generally Associated	Feeds/Breeds	DWD	

Species	Association	Activity	Dead Wood	Comments
Striped Skunk	Generally Associated	Feeds/Breeds	Snag/DWD	
Mountain Lion	Generally Associated	Feeds/Breeds	DWD	
Marten	Generally Associated	Feeds/Breeds	Snag/DWD	
Bobcat	Generally Associated	Feeds/Breeds		
Roosevelt Elk	Generally Associated	Feeds/Breeds	DWD	
Black-tailed Deer	Generally Associated	Feeds/Breeds	DWD	
Amphibians				
Long-toed Salamander	Generally Associated	Feeds/Breeds	DWD	Requires ponds, shallow lake edges, seasonal pools (like elk wallows) or slow streams for breeding.
Rough-skinned Newt	Generally Associated	Feeds/Breeds		Requires ponds or stream backwaters with abundant aquatic vegetation for breeding.
Western Redback Salamander	Closely Associated	Feeds/Breeds	Snag/DWD	
Ensatina	Closely Associated	Feeds/Breeds	Snag/DWD	Requires logs, woody debris, or moist talus with woody debris.
Pacific Chorus (Tree) Frog	Generally Associated	Feeds/Breeds		Requires ponds, seasonal pools, temporary rain-filled depressions or slow streams for breeding.
Reptiles				
Rubber Boa	Generally Associated	Feeds/Breeds	DWD	Usually does not occur far from water.
Northern Alligator Lizard	Generally Associated	Feeds/Breeds	DWD	
Common Garter Snake	Generally Associated	Feeds/Breeds		
Western Terrestrial Garter Snake	Generally Associated	Feeds/Breeds		

H. Definitions of Listed Species Codes

PHS definitions

PRIORITY HABITAT:

"Priority habitat" is a habitat type with unique or significant value to many species. An area identified and mapped as priority habitat has one or more of the following attributes:

- comparatively high fish and wildlife density
- comparatively high fish and wildlife species diversity
- important fish and wildlife breeding habitat
- important fish and wildlife seasonal ranges
- important fish and wildlife movement corridors
- limited availability
- high vulnerability to habitat alteration
- unique or dependent species

A priority habitat may be described by a unique vegetation type or by a dominant plant species that is of primary importance to fish and wildlife (e.g., oak woodlands, juniper savannah). A priority habitat may also be described by a successional stage (e.g., old growth and mature forests). Alternatively, a priority habitat may consist of a specific habitat features (e.g., talus slopes, caves, snags) of key value to fish and wildlife.

PRIORITY SPECIES:

"Priority species" are fish and wildlife species requiring protective measures and/or management actions to ensure their survival. A species identified and mapped as priority species fit one or more of the following criteria:

Criterion 1. State-Listed and Candidate Species:
State-listed species are native fish and wildlife species legally designated as Endangered (WAC 232-12-014), Threatened (WAC 232-12-011), or Sensitive (WAC 232-12-011). State Candidate species are fish and wildlife species that will be reviewed by the department (POL-M-6001) for possible listing as Endangered, Threatened, or Sensitive according to the process and criteria defined in WAC-232-12-297.

Criterion 2. Vulnerable Aggregations:
Vulnerable aggregations include species or groups of animals susceptible to significant population declines, within a specific area or statewide, by virtue of their inclination to aggregate. Examples include heron rookeries, seabird concentrations, marine mammal haulouts, shellfish beds, and fish spawning and rearing areas.

Criterion 3. Species of Recreational, Commercial, and/or Tribal Importance:
Native and non-native fish and wildlife species of recreational or commercial importance, and recognized species used for tribal ceremonial and subsistence purposes, whose biological or ecological characteristics make them vulnerable to decline in Washington or that are dependent on habitats that are highly vulnerable or are in limited availability.

FEDERAL AND STATE STATUS:

The "federal and state status" describes whether a species is listed by Washington State as a Species of Concern (i.e., endangered, threatened, sensitive, or candidate), and/or is listed by the federal governments under the Endangered Species Act. For the latest Species of Concern List, call (360) 902-2515, or visit http://wdfw.wa.gov/wlm/diversty/soc/soc.htm.

I. Quality of Habitat on the Swamp Lake Forest for Focal Species by DFC Stage

Suitability estimates do not consider home range requirements and surrounding landscape conditions, though these factors strongly influence use of habitat on SLF.

		Focal Species												
Years	**Stage**	**PIWO**	**NOGO**	**BAEA**	**VASW**	**SPOW**	**BATS**	**FISH**	**MART**	**GRWO**	**LYNX**	**GRBE**	**CAFR**	**WOLV**
30-50	Biomass Accumulation/Competitive Exclusion	Low	N, PF,F (Low)	Low	Low	Low	Low	Low	Low	High	High	High	Low	High
50-130	Maturation	Low	N,PF,F (Low)	Mod	Mod	N-(Low),F,D (Mod)	Mod	Mod	Mod	High	High	High	High	High
130-200	Vertical Diversification	Mod	N, PF,F-Mod to High	High	High	N-(?),F,D (Mod)	High	High	High	High	High	High	High	High
200-280	Horizontal Diversification	High	N, PF,F-High	High	High	High	High	High	High	High	High	High	High	High
280+	Pioneer Cohort Loss	High	N, PF,F-Mod to High	High	High	High	High	High	High	High	High	High	High	High

Years=Years since stewardship plan development in 2009, PIWO=Pileated Woodpecker, BAEA=Bald Eagle, VASW=Vaux's Swift, SPOW=Spotted Owl, Bats=forest dwelling bats, represents Myotis spp., big-brown, and Townsend's big eared bats, FISH=Fisher, MART=Marten, GRWO=Gray Wolf, LYNX=Canada Lynx, GRBE=Grizzly bear, CAFR=Cascades Frog, and WOLV=Wolverine.
N=Nest, PF=Post-fledge, F=Forage, D=Dispersal

J. Information about Integrated Resource Management

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Philomath, Oregon 97370
Phone: (541) 929-3408
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Established in January 1994, Integrated Resource Management is a full service forestry consulting firm based in Philomath, Oregon. IRM is dedicated to planning and implementing sustainable and restorative forestry. IRM assists private landowners, land trusts, natural resource agencies and other forest proprietors in reaching a diverse range of stewardship goals. IRM offers a full range of forestry services including management planning, cruising and forest inventory, stumpage appraisals and forest investment analysis, low impact timber harvest, and ecological restoration. For clients seeking a balanced approach to forest management as an investment, IRM‟s innovative forestry practices provide reasonable financial returns while protecting ecological function and productivity.

Darin Stringer, Senior Project Manager, Owner

Mr. Stringer is IRM's senior project manager and specializes in the design and implementation of restoration forestry. His work focuses on developing innovative forest restoration systems using a strong interdisciplinary background that combines forestry, wildlife, and restoration ecology. His project background includes development of silvicultural prescriptions for multi-cohort and extended rotation systems on both public and non-industrial ownerships throughout the Pacific Northwest. He brings expertise in the design of non-traditional silvicultural approaches, forest modeling (including stand growth & yield, at-risk wildlife habitat suitability, and fuel and fire behavior effects), monitoring and inventory systems, noxious weed control, native plant community establishment, and low impact thinning technology. Mr. Stringer's understanding of forest ecology and silviculture ranges from coastal and montane temperate forests to the drier vegetation types of the intermountain west. He has emerged as one of the leading restoration practitioners working to develop methods for recovering ponderosa pine, Oregon white oak, and aspen habitats in the Pacific Northwest. Beyond these declining habitats, Mr. Stringer has worked extensively in designing management systems for Douglas-fir forests that provide economic returns while restoring ecological structure and function. Darin works closely with private landowners, watershed councils, and local and federal government agencies to design and complete forestry stewardship and restoration projects. He holds a Master‟s of Science degree from Oregon State University in Silviculture and Forest Ecology.