Willamette Late-Successional Reserve Assessment

USDA Willamette National Forest
USDI Salem District BLM
USDI U.S. Fish and Wildlife Service OSO

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I. INTRODUCTION

II. HISTORY AND INVENTORY OF CONDITIONS

III. CONDITIONS OF LSRS FOR WILDLIFE AND PLANT SPECIES

IV. Treatment Criteria and Needs

V. Fire Management Plan

VI. Individual LSR Summary Sheets

VII MONITORING

References

Appendices

Tables

Figures

DOCUMENT MAPS

APPENDIX MAPS

I. INTRODUCTION 1

I. INTRODUCTION

Late-Successional Reserve Assessments (LSRAs) are required by the *Northwest Forest Plan* (NFP) (USDA et al. 1994). Assessments of the conditions and functions for each Late-Successional Reserve (LSR) or for a group of LSRs provide information to managers, planners and the public. This allows them to evaluate proposed activities and facilitate implementation of appropriate management activities for the LSRs. The assessment assures that activities meet the LSR standards and guidelines and further LSR objectives.

Our analysis emphasizes terrestrial habitats in the LSRs. Aquatic habitats are analyzed in detail through watershed analyses that are done on a fifth field watershed level. Completed watershed analyses are available at the Bureau of Land Management (BLM) District Offices, the Willamette Forest Supervisor’s Office and Ranger District Offices. We recommend consulting this LSR assessment and the applicable watershed analysis to obtain links with aquatic and terrestrial resources in a specific area.

This assessment is based on current knowledge and understanding of the ecosystem conditions and processes within and between the LSRs. Recognizing that our knowledge of the ecosystem and the actual conditions will change over time, we recommend a periodic review of this assessment and revisions or updates to reflect new information or changed conditions.

BACKGROUND

LSRs were designated to provide a distribution, quantity, and quality of late-successional forest habitat sufficient to avoid foreclosure of future options for the management of late-successional forest species (USDA et al. 1994, ROD B-4,5). The network of LSRs throughout the range of the northern spotted owl is assumed to provide the quality and quantity of habitat over time for viable populations of terrestrial plant and animal species that are associated with late-successional forests.

The NFP includes the following goals and objectives as the basis for this assessment of LSRs in the mid-Willamette Province:

Goals: Maintain late-successional and old-growth habitat and ecosystems on federal lands. Maintain biological diversity associated with native species and ecosystems in accordance with laws and regulations on federal lands.

Objective: To protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional forest species. Late-successional reserves are designed to maintain a functional, interacting ecosystem.

In response to these goals and objectives, management within LSR boundaries on federal lands must assure the protection and/or enhancement of conditions of late-successional forests. The standards and guidelines of the *Record of Decision* (USDA et al. 1994) (ROD) govern management activities in the LSR. This assessment is meant to assist the understanding and implementation of the ROD.

AREA INCLUDED IN THIS ASSESSMENT

The area covered by this assessment includes lands managed by the Willamette National Forest (NF), the Salem BLM District and the Eugene BLM District. We assess 11 designated LSRs as listed below (Table 1-1) and shown on Map 1. These LSRs occupy 328,656 acres of federal lands. We also summarize the condition and functions of the network of 414 core LSRs that occupy 44,443 acres within the assessment area. The total land base in the assessment area is approximately 2,350,000 acres (Map 1). The assessment boundary is based on fifth field watersheds, trimmed closer to the federal ownership boundaries along the Willamette Valley or western edge of the assessment area. There are six large wilderness areas and many Administratively Withdrawn lands overlapping or within the assessment area that extend the effectiveness of the late-successional forests beyond the LSR boundaries. These other reserve land allocations were analyzed for their role in augmenting the LSR network for habitat elements such as connectivity between LSRs. Map 10 illustrates the land allocations listed in Table I-2. We have not listed Riparian Reserves because of incomplete mapping but the currently mapped riparian areas occupy an additional 154,000 acres of the assessment area. Further information on these land allocations can be found in the BLM District Resource Management Plans (RMP) and the Willamette NF Plan.

Table I-1. LSRs and their ownership included in this assessment.

LSR		BLM Acres	Willamette NF Acres	Total Acres
Whitcomb Creek	RO212	3,880	0	3,880
Quartzville	RO213	26,525	57,141	83,666
Jefferson	RO214	0	40,016	40,016
South Santiam	RO215	0	27,722	27,722
Wiley	RO216	0	608	608
Hagan	RO217	0	9,162	9,162
Horse Creek	RO218	0	26,911	26,911
Fall Creek	RO219	0	65,928	65,928
Waldo West	RO220	0	51,728	51,728
Hills Creek	RO221	0	16,592	16,592
Thomas Creek	RO246	2,389	0	2,389
TOTAL		**32,794**	**295,862**	**328,656**

Table I-2. Major land allocations within the assessment area.

Land Allocation	Acres
Private	597,408
Wilderness	391,478
LSRs[1]	421,154
Core LSRs	44,325
Administratively withdrawn	124,478
Matrix	765,538

[1] Includes part of the South Cascades LSR not covered by this assessment.

The assessment area is within the Willamette Province and ranges from the Middle Fork Willamette River drainage in the south to the North Santiam River drainage in the north, east to the crest of the Cascades and west to the foothills in the Willamette Valley. We selected this group of LSRs for this assessment due to their proximity to each other, location in the province and the connectivity issues within this portion of the Cascade Range. South Cascades LSR (RO222) overlaps the Willamette and Umpqua National Forests and has recently been completed in a separate assessment (USFS, 1997). Opal Creek LSR (RO209C) lies partially on the Willamette and the Mt. Hood National Forests. The Mt. Hood NF and the Salem BLM are currently doing an assessment for Opal Creek LSR and other associated LSRs to the north. The agricultural, residential and urban areas in the Willamette Valley allow little or no connection with the LSRs that lie in the Coast Range. We assume the high elevation peaks along the crest of the Cascade Range on the east create barriers while areas of lower elevation in the Cascade Range provide some needed east-west connections to LSRs on the Deschutes NF.

We assessed features and conditions associated with late-successional forest conditions and key ecosystem functions as the basis for evaluating future management of each LSR. This assessment will also analyze the LSRs in this assessment area as a group for certain key functions such as connectivity and the functioning of this group of LSRs as part of the larger network of reserves throughout the Cascade Range and within the range of the northern spotted owl.

CONTEXT OF THIS LSRA AREA WITHIN THE WILLAMETTE PROVINCE

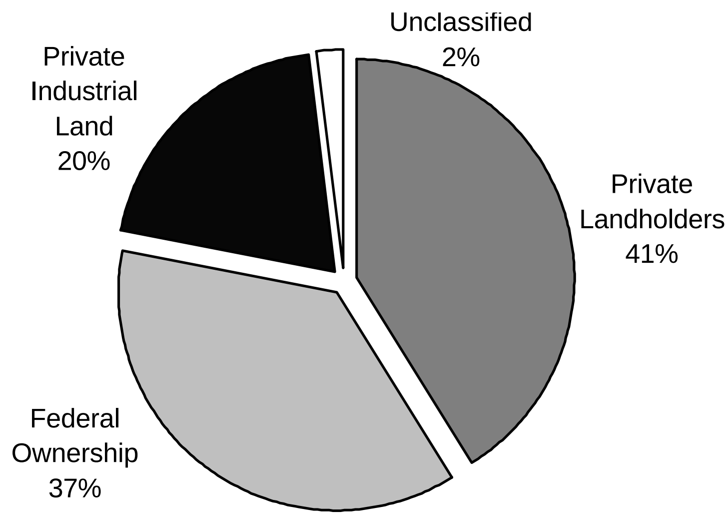

Figure I-1. Ownership within the Willamette Province.

The Willamette Province occupies 7.7 million acres of land in northwestern Oregon. Land use within the Willamette Province includes urban and suburban development, agriculture, and forestry. The major ownership categories in the Province are private landholders, federal ownership, and private industrial forestlands, with mixed/unclassified ownership for the remainder (Figure I-1). This assessment will cover 43 percent of the 754,734 acres of large LSRs (includes acres for LSR RO222) within the province.

HOW THIS ASSESSMENT WILL BE USED

The LSR Assessment is not a decision document. It does not result in specific projects or activities. For any projects or activities proposed in the LSRs, agency policies and procedures regarding the National Environmental Policy Act (NEPA) and planning regulations should be followed. Managers should use this assessment to establish criteria and guidelines in reaching prudent site-specific decisions.

This assessment provides context at a landscape scale for disturbance regimes, connectivity, and functional roles of different elements as they pertain to LSRs in the landscape. Used with other planning documents, including forest plans and resource management plans, this LSRA provides a landscape strategy for implementation of restoration activities by prioritizing treatment areas and listing types of appropriate treatments. The advantage of this assessment is the broad landscape perspective and the ability to identify key attributes of individual LSRs not just as single reserves, but also as contributions within the network of reserves. Recognition of the role of each LSR in the network, together with the specific conditions within that LSR, help identify and prioritize future restoration activities.

We provide a broader scale perspective of terrestrial conditions in this assessment than watershed analyses. Watershed analyses address relationships between terrestrial and aquatic systems at a finer scale, consider the influence of past management activities, and recommend specific type, location and sequence of future management activities within a watershed. Table 1-3 lists watershed analyses that contain information about the LSRs and should be consulted as part of any project planning and design.

Table I-3. Watershed Analyses within the assessment area.

LSR	Watershed Analyses Completed	Watershed Analyses in Progress or not Initiated
RO212 Whitcomb Creek		Not initiated
RO213 Quartzville	Middle Santiam, Blowout	Quartzville (FY99)
RO214 Jefferson	Upper North Santiam, Breitenbush	
RO215 South Santiam	South Santiam	
RO216 Wiley		Not initiated
RO217 Hagan	Blue River	Lower McKenzie Tribs (FY98)
RO218 Horse Creek	Horse Creek, South Fork McKenzie	
RO219 Fall Creek	Fall Creek, North Fork Middle Fork Willamette	
RO220 Waldo West	Salt Creek, Salmon Creek	
RO221 Hills Creek	Hills Creek	
RO246 Thomas Creek	Thomas Creek	

RELATED LSR ASSESSMENTS

Between 1994 and 1996 several interim LSR Assessments were completed for several of the LSRs covered by this Assessment. The purpose of the interim assessments was to guide specific project activities in the LSRs and ensure consistency with the standards and guidelines. Those assessments were limited in scope because of the specific activity focuses and did not fully meet the LSR assessment purposes as described in the NFP. Treatment criteria and recommendations in this assessment replace those in the interim assessments.

In 1997, an LSR assessment was completed for the Fall Creek LSR, reviewed and approved by the Regional Ecosystem Office LSR Group. The Fall Creek LSR also is included in this assessment. We reviewed the Fall Creek LSRA and did not see any inconsistencies in the baseline information. The only difference in treatment recommendations is for Coarse Woody Debris (CWD). The CWD recommendations were based on the preliminary results of the CWD analysis done for this assessment. The recommendations have changed as a result of additional analysis and evaluation. Therefore, the recommendations for CWD in this assessment will be applied to management prescriptions in the Fall Creek LSR. Another important difference between this assessment and the individual assessment is that this assessment categorized the Fall Creek LSR into landscape blocks based on existing vegetation conditions and patterns (see Chapter IV). The result is more detailed treatment considerations for some areas than are found in the individual Fall Creek Assessment. This assessment also provides a more in-depth evaluation of the inter-LSR connectivity and the functioning of Fall Creek as part of the LSR network than the individual assessment was able to do. Both assessments should be consulted when proposing activities in the Fall Creek LSR.

ASSESSMENT TEAM MEMBERS

Table I-4. Mid Willamette LSRA team members

Name	Home Unit	LSRA Team Role
Barbara Raible	Salem BLM	Co-Team Ldr, BLM Veg
Neal Forrester	Willamette NF	Co-Team Ldr.
Ray Bosch	USFWS, Portland Office	Wildlife
Pat Ormsbee	Willamette NF	Wildlife
Cindy McCain	Willamette-Siuslaw NFs	Vegetation Dynamics
Jane Kertis	Willamette-Siuslaw NFs	Vegetation Dynamics
Amy Unthank	Willamette NF	Physical, Aquatic, Fish
Michelle Davis	Willamette NF	GIS Analysis
Bruce Ahrendt	Salem BLM	GIS Analysis
Allison Reger	Willamette NF	Analysis, Info Mgmt.
Sam Caliva	Salem BLM	Fire, Fuels
Sam Swetland	Blue River Ranger District	Fire, Fuels
Jennifer Dimling – Lippert	Willamette NF	Botany
Karen Austin	Willamette NF	Wildlife

In addition to the persons listed above, many other FS and BLM staff have provided valuable assistance in assembling data, reviewing interim drafts reports and providing advice and feedback to the LSRA team.

THE ASSESSMENT PROCESS

As specified in the ROD, LSRAs are to address eight components:
1) A history and inventory of overall vegetative conditions.
2) A list of identified late-successional forest associated species known to exist within the LSR.
3) A history and description of current land uses in the LSRs.
4) A fire management plan.
5) Criteria for developing appropriate treatments.
6) Identification of specific areas that could be treated under these criteria.
7) A proposed implementation schedule tiered to higher order plans.
8) Proposed monitoring and evaluation components to help evaluate if future activities are carried out as intended and achieve desired results.

We used the memo from the Regional Ecosystem Office (REO) which details the process (Appendix A).

The specialists on the team worked separately in their areas of expertise (Table 1-4). The team met often during this time to share progress, information, and results. Near the end of the analysis stage the group met to build a consensus on the findings and resulting management recommendations. The subsequent draft assessment went through critical review by the team and affected districts before being submitted to REO.

BASELINE DATA

The LSRA is largely a habitat-based analysis. We focused on identifying the characteristics, amount and distribution of late-successional forests in the LSRA. We used plot data, stand databases, remote sensing, and models to derive a current seral stage map that was key to assessing LSR functions at the network and landscape scale. To reference past vegetation conditions we used surveys from the mid 1900s before intensive logging practices were in effect.

We used the ecology program vegetation plots and Current Vegetation Survey (CVS) inventory plots to provide species and stand structure data for characterizing unmanaged stand conditions for all subseries in the LSRA area.

We reviewed the categorized seral stages and further delineated them into landscape blocks based on similarities in area, distribution, and vegetative patterns. We used these landscape blocks to identify landscape level treatment criteria for the LSRs.

Based on local knowledge of the LSRs, we reviewed and verified with district botanists and biologists the late successional related species lists.

We obtained present land uses from current planning maps and questionnaires sent to each administrative unit verifying these uses.

BUILDING BLOCKS

This assessment outlines the methods and results of five key analyses (interior habitat, connectivity, disturbance, coarse woody debris, and landscape patterns) that influenced subsequent LSR team management recommendations.

We assessed interior habitat by identifying contiguous patches of mature and old growth stands greater than a specified width from the edge of early seral stands. We also used a similar method to identify where stand treatments in early-mid and mid seral stands may reduce interior habitat based on their proximity to late seral stands.

We assessed connectivity within and between LSRs to show where network functions could be improved. We approached this analysis by identifying late-successional seral stages and land allocations in a reserved status and using GIS to model a connected route possible for dispersal of a low- mobility terrestrial wildlife species. It was our objective to identify possible barriers to habitat connectivity (early seral patches, high road densities, and other ownership) within LSRs and prescribe treatments and protective measures to correct or compensate for habitat breaks.

To analyze risk of habitat loss through natural disturbance, we developed a fire risk map based on climate, topography, fuels, and lightning activity. The objective is to identify high fire risk areas where treatment can decrease the risk.

We used data from CVS inventory to summarize snag and down wood ranges by vegetation series for natural stands. These numbers are supplied to characterize reference and desired conditions. We used the values in the CVS tables to generate management recommendations fitting for various LSR objectives (see Chapter IV “Coarse Woody Debris section.)

We used existing data related to spotted owl occupancy of LSRs from Appendix G of the FSEIS of the NFP. Analysis of current conditions was accomplished using GIS data from the Willamette NF (OHAB) and Salem and Eugene BLM (SHB) data. Data for the spotted owl critical habitat analysis was derived using GIS analyses of critical habitat and suitable habitat layers.

Finally, we examined amounts, patch sizes, and distribution of late-successional and interior forest conditions at two time periods, mid-1900s and current. When used in conjunction with disturbance regimes, the comparison will provide us with a context for current conditions.

II. HISTORY AND INVENTORY OF CONDITIONS

SOCIAL CHARACTERIZATION

HISTORICAL LAND USES

Human uses of the lands and resources in the area included in this assessment extend over an estimated 8,000 years. Previous American Indian inhabitants within or adjacent to the assessment area at the time of historic contact included the Mollala, Kalapuya, Tenino and Northern Paiute. The Mollala and Kalapuya peoples wintered at sites along streams in the lower elevations and traveled to higher elevations to hunt game, gather wild plant foods, collect obsidian for tool making, and other necessities of life. Indians from the Warm Springs Tribes to the east came over the mountains by way of Mt. Jefferson and utilized resources in the western Cascades. Though we do not know to what extent, there are historical and vegetative conditions that indicate these original inhabitants of the assessment area used fire to manipulate the forest vegetation in areas where they hunted, gathered food or traveled.

Numerous American Indian sites exist throughout the LSRs in this assessment area. Several are significant cultural sites such as long used habitation and campsites, traditional food gathering areas and religious sites. The FS and BLM have surveyed known sites and have measures in place to protect the integrity of these sites. The agencies also consult with the Tribal governments on a regular basis to ensure the cultural and religious aspects of these sites are protected from adverse impacts.

European-American settlers, miners, trappers and loggers began arriving and influencing forest vegetation in the mid-1800's. Most of the early uses of the forest in the assessment area included the construction of trails, wagon roads, railroads, homesteads (usually in the valleys in the lower elevation), sheep camps, sheep grazing and mines. Gold mining was a significant activity in and around the current location of the Quartzville LSR (RO213). Sheep grazing was mostly in the meadows associated with the high elevation areas such as in the Jefferson LSR (RO214). The Santiam Wagon Road was one of the earliest east-west routes across the Cascades in this area. It is speculated that the fires in the late 1800s that burned much of what is now the South Santiam LSR (RO215) were deliberately or accidentally set fires associated with traffic on the wagon road.

In the early 1900s, the FS began managing much of the forest in the assessment area. BLM management of the remaining lands occurred later in the century. The most significant impact of the early FS management on the forests that are now the LSRs was the exclusion of fire. The early management emphasis was to eliminate all human ignited fires and to extinguish all lightning caused fires quickly. This emphasis has remained consistent within the agency until recent years. The potential impacts this has had on forest stands and stand conditions is discussed in the Vegetation section and Chapter V (Fire Management Plan). In the 1920s-1930s, significant timber harvesting occurred within the assessment area and current day LSRs. The earliest harvests were limited to highly accessible areas closest to lumber mills. After World War II, in the 1950s, the high demand for lumber nationwide led to an increased timber harvesting and roading throughout the NF and BLM lands within the assessment area. The amount of acres harvested increased steadily in the decades of the 1960s, 1970s and until the late 1980s. All the LSRs in this assessment area, with the exception of Hagan (RO217), have had timber harvest and road construction during the previous three decades. The amount of logging and roading varies among and within the LSRs as discussed later in this Chapter

In summary, the lands in the LSRs and areas surrounding these LSRs have been used and manipulated by humans for thousands of years. The extent and intensity of the manipulation has varied over time and from place to place. The history of logging and road construction during the later half of the 1900s was probably the most extensive and most intense manipulation of the vegetation. However, earlier land uses and manipulations from the deliberate use of fire by American Indians to the exclusion of fires by the FS since the turn of the century may have also had significant, but perhaps more subtle, impacts on forest conditions and ecosystem processes.

CURRENT LAND USES

Current uses of the LSRs are largely a reflection of FS and BLM resource management programs over the past 30-40 years. Since the LSRs are generally, large contiguous blocks of land, they include not only forested lands but a variety of land uses and management area allocations that were in place prior to designation of the LSRs in the NFP.

Current uses of the LSRs within the assessment area are summarized in Table II-1. We gathered the current uses from a variety of maps, databases and information from FS Ranger Districts and the Salem District BLM staff. The Standards and Guidelines for the NFP address existing uses and developments with the LSRs (C-16 to C-19). Most existing uses and developments were envisioned to remain within the LSRs, although subject to modification or elimination if they were identified to pose adverse impacts. As a rule, nonsilvicultural activities associated with these uses and developments that are neutral or beneficial to the creation and maintenance of late-successional habitat are allowed (C-16).

We reviewed the uses listed in Table II-1 considering the type of use (the intensity of possible impacts on late-successional habitat) and the number and extent of those uses (the scope of possible impacts on late-successional habitat). The activities associated with the current uses and developments, specifically maintenance and on-going operations were assumed to be carried out in a manner consistent with the NFP Standards and Guidelines.

The most extensive current use in the LSRs is the transportation system of roads and trails. There are 37 identified trails and 36 trailheads within the LSRs. The most common trail maintenance activities are clearing brush and undergrowth from the trail tread, bucking down trees from the trail tread, and removing hazard trees around trailheads. All of these activities are consistent with NFP Standards and guidelines, and we determined that, in general, they have a neutral impact on late-successional habitat in the LSRs included in this assessment area.

Highway and forest secondary road corridors are another extensive current use in the LSRs. The impact of the secondary forest road system on late-successional habitat and management recommendations regarding these roads are discussed later in this assessment. This discussion focuses on the heavily traveled federal and state highways and the paved, FS and BLM through routes that bisect several of the LSRs. As shown in Table II-1, the Jefferson LSR is bisected by US Highway 22, and South Santiam LSR is bisected by US Highway 20. Both are major east-west routes that converge at the Santiam Pass. In addition to these highways, there are several paved FS roads, notably the Breitenbush Road through the Jefferson LSR, the Quartzville Road (BLM/FS) in the Quartzville LSR, and the Fall Creek Road in the Fall Creek LSR that is heavily used by the public as well as federal employees and contractors. Use on these roads in 1997 was measured in excess of 1,000 vehicles per day for single day measurements and monthly averages exceeding 500 vehicles per day. We identified the removal of hazard trees as one of the most significant potential impact to late-successional habitats resulting from these roads. We considered the extent of the area (roughly 1 tree height or 100-200 feet on either side of the highway) that could be affected by the maintenance of these primary travel routes, the intensity of the impact on late-successional habitat, and the direction for road maintenance in the NFP standards. (C-17). Much of the area adjacent to the highways and major roads is not high quality late-successional habitat because of the road opening, habitat disturbance as a result of the original road construction, and/or heavy vehicle traffic. The NFP standards for roads in LSRs recognizes that road maintenance activities may include felling hazard trees.

The Oregon Department of Transportation recently completed an Environmental Assessment of proposed improvements on US Highway 20 to address serious safety problems. One of the areas planned for safety improvements is the junction of the House Rock Campground access road, which is within the South Santiam LSR. This road also accesses trailheads and private lands. The improvements planned for this area will relocate the current access road by 50 meters to provide a safer junction with Highway 20. The abandoned access road segment will be obliterated and revegetated. The project will result in the clearing of approximately one hectare mature forest within the LSR adjacent to the highway. Overall impacts to the LSR will be minimal and some habitat will be restored by the partial road obliteration. The project minimizes impacts to late-successional habitat while addressing public safety issues.

Several types of recreation sites, in addition to trails, are also found in the LSRs in this assessment area including 17 developed campgrounds or day use areas, a wildlife viewing area, 82 recreation residences, and a wild and scenic river corridor. The scope or spatial extent of these areas is minor both for individual LSRs and even more so when considered from the total LSR acres in this assessment area. Potential adverse impacts to late-successional stands are minimal and are limited to a very small area. Other than the disturbance created by long periods of human occupancy and use, we again identified the removal of hazard trees within and immediately adjacent to these areas as potentially the most significant impact to late-successional habitat. The NFP standards recognize continued use and maintenance of these areas, including the removal of hazard trees, as consistent with LSR management. It should be noted that recreation management objectives for these sites include maintaining a forested environment, including mature trees. Consequently, there is some overlap of the LSR and recreation area vegetation objectives.

Many popular dispersed recreation sites can receive tens of thousands of visitors in a recreation season. In addition, these sites are almost always located near streams, rivers, or lakes which limits the number of sites while presenting difficulties meeting Aquatic Conservation Strategy objectives. Closure of such areas can be hard to enforce, particularly without the provision of alternative recreation facilities. Closure can also simply shift the use to and strain the capacity of other popular recreation sites. In areas of concentrated dispersed recreation areas, it is recognized that new facility development should or must be designed to mitigate the effects on late-successional habitat and provide appropriate alternative recreation sites.

Another existing development is a BPA powerline corridor through the Jefferson LSR and an electronic site (communications dishes and antennas) in the Hills Creek LSR. The impacts of the powerline corridor are similar to those described above for roads and trails. No impacts to late-successional habitat are expected as a result of the existing electronic site maintenance.

Where hazard trees must be removed to provide for public safety or maintenance of existing development as identified in Table II-1, alternatives such as topping or leaving all or parts of the felled trees to provide coarse woody debris should be considered. Because of the costs associated with tree felling and the slash and fuels created in areas of concentrated human use, small timber sales are effective and sometimes the only administratively feasible way to eliminate the hazards and are an acceptable option to remove hazard trees.

Other current uses listed on Table II-1 include several categories of administratively withdrawn land allocations on the LSRs that were in place prior to the adoption of the NFP. Examples include Special Interest Areas, Old Growth Groves, Research Natural Areas, and Special Habitat Area. The NFP allocation of the LSR supercedes all but the Research Natural Area (RNA) designations. The FS and BLM continue to consider the management direction of these land allocations, however, whenever any activities are proposed. Because of the similarity of management objectives between these administratively withdrawn areas and the LSRs, no conflicts have been identified to date, and none are anticipated.

Table II-1. Current uses in LSRs

Current Land Uses	Whitcomb Cr. RO212	Quartzville RO213	Jefferson RO214	South Santiam RO215	Wiley RO216
Administrative Sites	None	Chimney Peak Guard Station	Marion Forks, Brietenbush Guard Stations	None	None
Recreation Sites	None	Yellowbottom Campground - Dogwood Day-use Area (BLM) Quartzville Rec. Corridor, intergov. coop. agreement. 3 Wilderness Trailheads, 6 nonwilderness trailheads. (FS)	Riverside & Wispering Falls Campgrounds, McCoy Snowpark, Shelter; 11 Wilderness Trailheads, 3 nonwilderness trailheads.	House Rock, Fernview, Yukwah, Trout Creek Campgrounds; Longbow Organizational Camp; 2 Wilderness Trailheads; 3 nonwilderness trailheads.	None
Trails	None	10 trails - #3387, 3397, 3401,3402, 3388, 3383, 3382, 3380, 3385, 3102.	3 trails - #3366, 3424, 3423	Santiam Wagon Road Historical Trail, 4 trails - #3365, 3404, 3394, 3421.	None
Special Uses	None	None	72 Recreation Residences; Chemekata Organization site; Powerline corridor.	10 Recreation Residences.	None
Fed/State Highways	None	Back Country Scenic Byway	US Hwy 22 Breitenbush Road – National Scenic Byway; Cascade Scenic Byway.	US Hwy 20. (Highway improvements scheduled for 1999 in House Rock area)	None
Mining	None	Rec. Corridor open to recreational mining, several unpatented claims.	Recreational use in N.Santiam River.	None	None
Research Natural Areas	None	Carolyn's Crown RNA; White Rock ACEC;	None	Three Creeks RNA	None
Land Exchanges		(Proposed)			
Other Admin Wthdrn	None	Special Interest Area Old Growth Grove; Quartzville Creek National Wild & Scenic River	Old Growth Grove	Old Growth Grove Special Interest Area Roadless dispersed rec. site	Doe Mountain Special Interest Area
Other Uses	None	None	8 easements or road permits for private inholdings	Grazing Permit and Wildlife Viewing Area (Walton Ranch).	None

Table II-1. Current uses in LSRs, continued.

Current Land Uses	Hagan RO217	Horse Creek RO218	Fall Creek RO219	Waldo West RO220	Hills Creek RO221	Thomas Ck RO246
Administrative Sites	None	None	Cowhorm Mt. Lookout	None	None	None
Recreation Sites	None	Horse Creek Campground; 4 Wilderness trailheads.	Bedrock and Puma Campgrounds; Clark Ck. Group Site;	1 nonwilderness trailhead	Wolf Mtn. Day use area, 3 Wilderness Trailheads	None
Trails	Administrative	1 - #3321	Fall Ck. National Rec. Trail (#3455)	9 trails - #3559, 3553, 3585, 3584, 3592, 3568, 3570, 3572, 3591.	1 trail - #3620	None
Special Uses	Electronic Site	None	1 Forest Road Easement	None	Wolf Mtn Electronic Site	None
Fed/State Highways	None	None	None	None	None	None
Mining	None	None	Ironside Mine (patented)	None	None	None
Res. Natural Areas	Hagan RNA	Ollalie Ridge RNA	None	Warner Creek RNA (proposed)	None	None
Land Exchanges		(In progress)				
Other Admin. Wthdrn	None	Special Interest Area	None	3 Old Growth Groves, Several Special Habitat Areas, North Fork, Middle Fork Willamette W&S River, Roadless Rec. Area.	Several Special Habitat Areas.	Special Interest Area
Other Uses	None	None	None	None	None	None

SPECIAL FOREST PRODUCTS

Special forest products is a broad category that potentially includes everything but sawlogs. Some of the more commonly collected products are mushrooms, berries, floral greens (beargrass, salal), mosses, boughs, fence posts, and poles. Special forest product use can be categorized into four types:

- American Indian Tribal Use – Plant materials that are collected for various cultural, medicinal and subsistence uses by American Indian tribes. The Confederated Tribes of the Warm Springs have a small area of the Jefferson LSR that is covered by treaties with the US Government. Other tribes, including the Klamath, Siletz, and Grand Ronde have customarily and traditionally gathered plant materials from the area covered by this assessment, including the individual LSR locations.
- Incidental use – This type of use is the on-site consumption or use of the plant materials and is generally associated with recreation activities such as camping and hiking.
- Personal use – Plant materials are gathered for off-site personal use and consumption. The materials are not sold or processed for resale. Permits are generally issued for personal use.
- Commercial Use – Plant materials are gathered with the primary purpose of being sold or processed and sold. Permits are always issued for the commercial collection of special forest products.

In December 1993, an environmental assessment was completed that amended the Willamette NF Plan to add specific standards and guidelines for the management of special forest products. These standards and guidelines identify appropriate rates of harvest for various categories of special forest products, appropriate methods for collecting various materials, and where, by management area, collection is allowed. Directly pertinent to this assessment is the direction for special forest product collections in the LSRs. The current direction in the Willamette NF Plan is that only tribal, incidental, and personal use collection of special forest products is permitted in the LSRs. This direction is also consistent with the Salem BLM District’s policy for special forest products.

The Willamette NF Plan standards and guidelines do allow for any type of collection (salvage) of special forest products in any land allocation if the collection is coincidental to normal maintenance, restoration, or enhancement activities that are consistent with the goals and objectives for that land allocation. An example of this is the commercial collection of boughs from a young, dense plantation in an LSR where thinning was identified as needed to accelerate the development of late-successional habitat. Where the coincidental collection of special forest products is neutral (as in the bough example) or beneficial to the objectives for LSRs, commercial use may be permitted.

The NFP states that special forest product activities must be evaluated to determine whether these activities have adverse effects on LSR objectives. Where collections are extensive, we are directed to evaluate whether they have significant effects on late-successional habitat (ROD p. C-18). Limiting special forest products collections to tribal, incidental, and personal use in the LSRs makes it unlikely that the intensity of collection will result in adverse impacts in the LSRs. Other concerns include the possibility of harvest of NFP Table C-3 Strategy 1 species such as truffles or other fungi. Again, because of the low intensity of the collection associated with tribal, incidental, and personal use the likelihood of harvest of these extremely rare species may be low. American Indian rights to collect products within the late-successional reserves will not be limited or restricted.

Commercial collection of products will be allowed only in situations consistent with current Willamette NF Plan and Salem BLM RMP and where the impact to late-successional reserves is neutral or beneficial. These collections are anticipated to be primarily limited to early seral stands and plantations and involve products such as floral greenery and boughs.

Incidental and personal use collection of products will be allowed consistent with current Forest Plan and RMP direction.

PHYSICAL CHARACTERIZATION

GEOLOGY

The LSRs in this assessment occur primarily in the Western Cascades and “Mixed Cascades” Physiographic Zones (Table II-2). The Western Cascades Zone occupies areas of thick sequences of successive Tertiary lava flows, tuffs (ash origin), and intrusive rock deposits. The western Cascades geology had a well developed mature erosional landscape (e.g. the Little Butte Formation) over which the Columbia River Basalt and the Sardine Formations poured molten lava, resulting in the development of intracanyon flows in the valleys. The Mixed Cascades Zone is named because it defines the transition between the older geology of the Western Cascades and the recent geology of the High Cascades. The High Cascades consist of volcanic flows, ash, and breccia from the late Miocene and earlier age, including some lava flows from the post-glacial period. Only the Jefferson LSR is are located primarily within High Cascades geology. However, the LSRs that have a large amount of Mixed Cascades have landscape origins that are influenced by the recent lava flows of the High Cascades.

The physical characterization of each LSR is represented by low and high elevations (above mean sea level; major streams flowing through the LSR (Table II-3); and landtypes). Landtypes stratify the landscape and define an area by slope steepness, length and dissection; geologic origin and/or major geologic; and fluvial/glacial influence. Further discussion on landtypes can be found in Appendix B.

Table II-2. Distribution of geologic landscapes within LSRs

LSR (number/name)		Western Cascades (acres/percent)		Mixed Cascades (acres/percent)		High Cascades (acres/percent)	
		Acres	Percent	Acres	Percent	Acres	Percent
Whitcomb	RO212	3,880	100%				
Quartzville	RO213	54,840	65%	28,370	34%	456	1%
Jefferson	RO214			21,749	54%	18,267	46%
South Santiam	RO215	16,562	60%	11,160	40%		
Wiley	RO216	608	100%				
Hagan	RO217	9,162	100%				
Horse Creek	RO218			26,143	97%	768	3%
Fall Creek	RO219	64,933	98%	995	2%		
Waldo West	RO220			50,587	98%	1,195	2%
Hills Creek	RO221			16,141	97%	451	3%
Thomas Creek	RO246	2,389	100%				
TOTAL (acres)		152,374		155,145		21,137	

Table II-3. Physical characterization of LSRs

LSR (number/name)		Low Elevation High Elevation (feet/meters)	Major streams within the LSR
Whitcomb	RO212	1,001ft/305m to 3,507ft/1,069m	Whitcomb Creek, Green Peter arm of Quartzville
Quartzville	RO213	1,030ft/314 to 5,614ft/1,711m	Quartzville Creek, Middle Santiam River
Jefferson	RO214	1,821ft/555m to 5,909ft/1,801m	N. Fk Breitenbush, S. Fk Breitenbush, Devil’s Cr, North Santiam River, Whitewater Cr, Woodpecker Cr, Pamelia Creek
South Santiam	RO215	1,070ft/326m to 5,357ft/1,636m	South Santiam River, lower Sheep Creek, lower Soda Fork Creek
Wiley	RO216	1,260ft/384m to 2,677ft/816m	Wiley Creek
Hagan	RO217	1,112ft/339m to 4,482ft/1,366m	Gate Creek trib, Elk Creek
Horse Creek	RO218	1,378ft/420m to 5,764ft/1,757m	Horse Creek, Hills Creek
Fall Creek	RO219	971ft/296m to 5,203ft/1,586m	Fall Creek, Hehe Creek, Delp Creek
Waldo West	RO220	1,913ft/583m to 5,988ft/1,825m	Salmon Creek, N. Fk. of the Middle Fork River
Hills Creek	RO221	2,575ft/785m to 6,467ft/1,971m	Hills Creek
Thomas Creek	RO246	866ft/264m to 4,298ft/1,310m	Thomas Creek, headwaters of Crabtree and Neal Creek

SOILS

Soil productivity and characteristics, such as stability (e.g. potential for mass wasting) varies within and among the LSRs due to varying site characteristics including elevation, parent material, slope, and aspect. The soils of the older western Cascades geology generally are more well developed and fertile than the soils originating from the High Cascades geology. Parent material of a majority of the soils is of volcanic origin. Soils formed from soft volcanic rocks, such as breccias and tuffs, tend to form plastic and clay soil types that can be dominated by slump-earthflow movements (USDA FS 1990). These soils occur predominately on Soil Resource Inventory (SRI) landtypes 25, 33, 35, and associated complexes. Shallow noncohesive soils over hard bedrock are prone to debris torrents and debris avalanches (primarily SRI types 3, 8, 9, 21, 31, 61, 94, and associated complexes). Site-specific soil resource information is available from the Willamette NF and BLM Salem District.

AQUATIC CHARACTERIZATION

FLUVIAL GEOMORPHOLOGY BACKGROUND

The landscape encompassed within the LSRs is typical of the older, more deeply eroded Western Cascades portion of the Cascade Mountain physiographic province. Volcanic eruptions, uplift of the land surface due to oceanic and continental plate collisions, glacial scour, fluvial erosion and massive downslope earth movements have influenced the stream channel characteristics present within the LSRs today.

Streams generally originate from glacial terraces and exhibit deeply incised channels. Stream densities are high, particularly upslope ephemeral first order streams. Progressing downslope, these stream channels increase in gradient and become steep, high-energy streams with incised, steep valley walls. These high-energy streams generally form river systems with a geologically constricted valley bottom. Within the main stem tributary rivers of these LSRs, small areas of deposition occur as a result of earthflow and or bedrock outcrop constrictions. A majority of the non-fishbearing tributary streams are steep high-energy channels typed as A or Aa+ (Rosgen 1996).

Most of the third to fourth order, fish-bearing streams have substrates dominated by bedrock/boulder/cobble. The areas of boulder/cobble and finer particles are very mobile during 10- to 20-year return interval storm events.

Site specific information on riparian areas is available from individual watershed analyses. In general, findings in watershed analysis indicate that management activities were most extensive in riparian areas from 1960 through 1990. The effect has been a loss of large conifers within riparian areas on non-fish bearing and fish-bearing streams. Increased stream temperatures, channel condition alteration, and loss of instream large woody debris resulted in many stream segments. Management practices within riparian reserves were modified beginning in 1990 for the Willamette NF and in 1994 for Eugene and Salem BLM Districts.

VEGETATION CHARACTERIZATION

POTENTIAL VEGETATION

The vegetation in the LSR assessment area has been stratified into major vegetation zones, which reflect the climate, soils, and topography of the area. Distribution of the plant associations at the plant series or subseries level indicates important biophysical environments. Plant series are named for the dominant tree species that would be maintained over time without disturbance. In the assessment area, there are four major series: western hemlock, Douglas-fir, Pacific silver fir, and grand fir (Table II-4). The plant associations composing these series are more fully described in Hemstrom and others (1987). Ecology plots installed on BLM lands in the Quartzville area during 1996 support that the Willamette NF classification can be used for the entire assessment area. Since there was very little of the mountain hemlock series (less than 25 percent represented in the LSRs), this series has not been analyzed for structure, and recommendations for this series should be drawn from the cold silver fire subseries or from the silver fir series ranges. The western hemlock and Pacific silver fir series account for 64 percent and 27 percent of the LSRs. We subsequently used the series and subseries strata (jointly called subseries below) to describe late-successional characteristics and successional pathways, and to determine some management recommendations.

The potential vegetation GIS layer has been built by the Area 6 Ecology Program using a GIS model developed by Dr. Jan Henderson, Area Ecologist for the Mt.Baker/Snoqualmie and Olympic National Forests (Map 3). Plot data specific to the Willamette Province were combined with elevation, aspect, slope, slope position, and slope shape to predict occurrence of the vegetation subseries. The model is not field verified and can be expected to be less reliable outside NF lands. Subseries percentages are estimates and indicate relative importance of series or subseries. Field verified data have been collected in Mt. Jefferson, Hills Creek, and surrounding areas. Field data documented more Pacific silver fir and mountain hemlock than the model predicted; however, the discrepancies did not materially effect analysis results.

Table II-4. Descriptions of Series' and Related Plant Associations

Series	Plant Associations[1]	Environment
Douglas-fir	PSME/HODI-BENE, PSME-HODI-WHMO, PSME-HODI/GRASS, PSME/SYMO, PSME-TSHE/BENE, PSME-TSHE/GASH	Low- to mid-elevations on the driest environments supporting closed forest; these open stands can grade into woodlands of Douglas-fir, Oregon white oak, and pines.
Grand Fir	ABGR/ARUV, ABGR/BENE, ABGR/CHUM	Relatively dry southerly facing slopes or excessively well-drained river terraces in the lower elevations; at mid-elevations, often associated with dry, rocky sites in ash and residuum over lava or coarse rock, or deep clay soils in the south end of the assessment area. Stand characteristics are similar to Pacific silver fir series, the other true fir/Douglas-fir type.
Western Hemlock *warm & moist*	TSHE/OPHO, TSHE/BENE/OXOR, TSHE/OXOR, TSHE/POMU	Snowpacks usually not deep or long lasting as in Pacific silver fir zone; more available moisture than in Douglas-fir or grand fir series. The environment is warm, moist, productive; near riparian areas or toe slopes in low- to mid-elevations, and up to mid-slopes at low elevations. The western hemlock/devils club type (TSHE/OPHO) is associated with isolated seepy areas, and is very restricted in occurrence.
Western Hemlock *well-drained, dry*	TSHE/BENE, TSHE/BENE-GASH, TSHE/GASH, TSHE/RHMA-BENE, TSHE/RHMA-GASH, TSHE/RHMA/LIBO2, TSHE/LIBO2, TSHEACTR, TSHE/BENE/ACTR, TSHE/LIBO2, TSHE/RHMA/VAAL/COCA, TSHE/RHMA/OXOR, TSHE/VAAL/COCA, TSHE/RHMA/XETE, PSME-TSHE/RHMA	Mid- to upper slopes in low elevations, moving into lower slope positions where steep or in the mid-elevation range.

Table II-4. Descriptions of Series' and Related Plant Associations, con't.

Series	Plant Associations[1]	Description
Pacific silver fir *Moderate*	ABAM/OPHO, ABAM/ACCI/TITR/ ABAM/OXOR, ABAM/TITR, ABAM/RHMA-VAAL/COCA, ABAM/VAAL/COCA, ABAM/VAME/CLUN, ABAM/BENE, ABAM-ABGR/SMST	Mid- to upper-elevations where cooler temperatures and persistent snow pack shorten the growing season. Douglas-fir is a common pioneer species that can persist in the stand. The more productive environment has generally less severe growing season restrictions than less productive plant associations in the Pacific silver fir series.
Pacific silver fir *Cold*	ABAM/RHAL/XETE,ABAM/ RHAL/TITR ABAM/MEFE, ABAM/VAME/XETE, ABAM/RHMA/XETE	Similar to the higher site Pacific silver fir except the environment is often associated with long winters, deep snowpacks, growing season frost.

[1] Hemstrom et al. 1987

Elevation and precipitation are the keys to subseries distribution (Table II-5). LSRs reaching into higher elevations contain Pacific silver fir, while lower, wetter LSRs including Hagan, Fall Creek, and Wiley have little or none. The small LSRs near the valley (Wiley, Whitcomb, and Thomas Creek) also have the highest proportion of the warm moist western hemlock subseries. Five LSRs (Jefferson, Quartzville, South Santiam, Waldo West, and Horse Creek) exhibit similar patterns of potential vegetation, with approximately 60 percent in the western hemlock series along major valleys and lower slopes and 30 percent in Pacific silver fir along upper slopes and ridges. In the warmer, drier south, Hills Creek is a high elevation LSR with more grand fir and moderate site Pacific silver fir than other LSRs.

Table II-5. Vegetation subseries distribution by LSR.

	Whitcomb (R0212)		Quartzville (R0213)		Jefferson (RO214)		South Santiam (RO215)		Wiley (RO216)		Hagan (RO217)	
Series	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Nonforest	110	3%	2,660	3%	1,643	4%	1,104	4%	0	0%	27	0%
Douglas-fir	3	0%	28	0%	39	0%	387	1%	64	11%	743	8%
Grand Fir	0	0%	0	0%	459	1%	1,015	4%	0	0%		0%
Western Hemlock												
warm & moist	1,926	50%	3,369	4%	127	0%	2,264	8%	219	36%	1,835	20%
well-drained, dry	1,839	47%	47,242	56%	23,587	59%	14,922	54%	325	53%	6,484	71%
Pacific silver fir[1]												
Moderate	2	0%	22,657	27%	10,575	26%	6,618	24%	0	0%	71	1%
Cold	0	0%	7,451	9%	2,746	7%	1,364	5%	0	0%	2	0%
Mountain Hemlock[1]	0	0%	259	0%	840	2%	48	0%	0	0%	7	0%
Total	***3,880***		***83,666***		***40,016***		***27,722***		***608***		***9,162***	

	Horse Creek (RO218)		Fall Creek (RO219)		Waldo West (R0220)		Hills Creek (R0221)		Thomas Creek (RO246)		Total	
Series	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Nonforest	987	4%	314	0%	2,470	5%	520	3%	138	6%	9,873	3%
Douglas-fir	326	1%	2,717	4%	221	0%	275	2%	0	0%	4,803	1%
Grand Fir	739	3%	1,224	2%	2,928	6%	1,653	10%	0	0%	8,018	2%
Western Hemlock												
Warm & moist	1,562	6%	9,373	15%	123	0%	0	0%	889	37%	21,687	7%
well-drained, dry	12,878	48%	50,219	76%	24,288	47%	5,648	34%	854	36%	188,286	57%
Pacific silver fir[1]												
Moderate	6,837	25%	1,771	3%	11,949	23%	6,980	42%	364	15%	67,824	21%
Cold	2,447	9%	303	0%	4,839	9%	876	5%	144	6%	20,172	6%
Mountain Hemlock[1]	1,135	4%	7	0%	4,964	10%	640	4%	0	0%	7,900	2%
Total	***26,911***		***65,928***		***51,782***		***16,592***		***2,389***			

[1] Mountain hemlock and Pacific silver fir series may be underestimated.

LATE-SUCCESSIONAL FOREST STRUCTURE AND COMPOSITION

We analyzed data on current structure and composition of late-successional stands from Willamette NF CVS and Ecology plots to describe characteristics of mature and old growth stages. We included information on species and size classes to illustrate the range of conditions within the late-successional habitats. The information will also guide treatment prescriptions intended to accelerate attainment of late-successional conditions (see Chapter IV, "Treatment and Criteria Needs"). These characteristics are summarized by subseries in Tables II-6, II-7, II-9, and II-10.

Plots were initially assigned to subseries, then composition, size class, and age class distributions were used to stratify the data into seral stages (see Appendix D)

LATE-SUCCESSIONAL FOREST STRUCTURE

Seral development from the mature to old growth stages is characterized by increasing numbers of large (32-48" dbh) and giant (48" dbh) trees, decreasing overall density, and gradual loss of early seral hardwood species. Shade tolerant species begin to move into the medium (21-32" dbh) to large sizes as the stands develop from mature to old growth conditions. Stands accumulate more snags and logs in the large size classes. Key results from Table II-6 indicate:

- Most giant trees are remnants of previous disturbance.

- Mature and old growth seral stages may generally provide different habitat quality for species associated with large and giant trees. With the exception of the more cold Pacific silver fir subseries, the old growth has fewer mediums and smalls (9-21"), but more larges and giants than mature stage:
  mature has 25-50% as many giant trees as old growth
  mature has 50-66% as many large trees as old growth
  mature has 140-195% as many medium trees as old growth
  mature has 130-185% as many small trees as old growth.

- The cold Pacific silver fir environment may be the exception to the mature to old growth development patterns. Although the sample size is very low, the data suggest tree growth does not produce large trees by the mature stage. Poor growing conditions keep trees smaller. Highest pole numbers occurred in this subseries for both mature and old growth. Cold Pacific silver fir mature stands may be the poorest habitat for species associated with the largest tree sizes. In the cold Pacific silver fir subseries, and possibly at the highest elevations of the moderate Pacific silver fir subseries, current environmental conditions may not allow reproducing the oldest and largest Douglas-fir component which may have established during a warmer climatic period.

- The number of small and pole sized trees may be higher for Douglas-fir and grand fir series than is typical of the pre-fire suppression period, when higher frequency/lower severity wildfire killed more of the small trees. In similar fire regimes some stands in the drier western hemlock subseries may also show this effect.

Table II-6. Mean trees per acre and percent by subseries for mature and old growth seral stages.[1]

	Plots	Trees per acre	Giant% (48+ in.)	Large% (32-48in.)	Medium% (21-32 in.)	Small% (9-21 in.)	Pole% (<9 in.)
Douglas-fir Series							
Mature	14	140	1	6	20	57	16
old growth	17	118	2	13	14	36	36
Grand fir Series							
Mature	7	153	1	5	25	43	25
old growth	16	108	3	14	19	44	21
Western hemlock Series *(warm-moist)*							
Mature	17	115	2	5	19	53	21
old growth	29	93	5	12	14	40	29
Western hemlock Series *(well-drained, dry)*							
Mature	45	170	1	5	16	43	36
old growth	87	144	3	10	13	33	42
Pacific silver fir *(moderate)*							
Mature	11	130	1	8	24	40	28
old growth	16	125	2	12	15	32	38
Pacific silver fir *(cold)*							
Mature	5	175	0	1	10	33	56
old growth	7	179	2	7	11	34	46

[1] Mean trees per acre of 0 - 0.5 are noted by 0. Blanks indicate no trees present.

LATE-SUCCESSIONAL FOREST SPECIES COMPOSITION

As stands mature, changing microenvironments favor regeneration of shade intolerant species such as western hemlock, Pacific silver fire, or grand fir. Note that the patterns have been generalized by analysis at the subseries level. Stand prescriptions will require more site specific plant association information to identify the most appropriate species mix. Data for species composition is summarized in Table II-7.

Table II-7. Structural composition of mature and old growth seral stages by subseries.

		Displayed in trees per acre					
Subseries	Species	Giant trees	Large trees	Medium trees	Small trees	Pole	Saplings
Grand Fir							
Mature	Grand fir			4	9	14	24
	Incense cedar		0		1		10
	Douglas-fir	1	8	36	50	2	5
	Western hemlock			1	5	1	3
	Other				0	4	1
Old growth	Grand fir		0	2	9	17	73
	Incense cedar	0	1	3	6	2	1
	Douglas-fir	3	15	13	17	8	36
	Western hemlock	0	0	1	10	13	16
	Other	0	0	1	5	14	
Douglas-fir							
Mature	Incense cedar	0	0	1	9	9	5
	Douglas-fir	1	7	26	61	34	36
	Other	0	0	0	10	13	3
Old growth	Incense cedar	0	1	1	5	11	28
	Douglas-fir	3	15	15	28	25	57
	Other	0	0	0	11	9	9
Western hemlock *(warm, moist)*							
Mature	Big leaf maple		0	0	15	6	
	Douglas-fir	2	6	13	16	1	
	Western red cedar	0	0	1	7	5	60
	Western hemlock	0	0	7	21	18	18
	Other	0	0	1	9	19	60
Old growth	Big leaf maple		0	0	2	1	0
	Douglas-fir	5	9	5	2		
	Western red cedar	0	1	2	5	6	0
	Western hemlock	0	2	6	27	26	24
	Other	0	1	2	5	7	0
Western hemlock *(well drained, dry)*							
Mature	Douglas-fir	1	8	23	42	13	15
	Western red cedar	0	0	1	6	5	22
	Western hemlock	0	0	3	20	22	55
	Other	0	0	1	9	14	40
Old growth	Douglas-fir	4	12	10	10	5	76
	Western red cedar	0	1	4	9	6	17
	Western hemlock	0	1	5	22	24	36
	Other	0	1	4	15	16	44

Table II-7. Structural composition of mature and old growth seral stages by subseries.[1]

		Displayed in trees per acre					
Subseries	Species	Giant trees	Large trees	Medium trees	Small trees	Pole	Saplings
Pacific silver fir *(moderate)*							
Mature	Pacific silver fir		1	4	12	11	85
	Noble fir	0	2	5	4	2	20
	Douglas-fir	1	5	12	11	2	
	Western hemlock		0	4	9	8	15
	Other	0	2	7	15	12	58
Old growth	Pacific silver fir		0	2	15	30	108
	Noble fir	0	3	4	5	3	5
	Douglas-fir	3	8	5	2	1	
	Western hemlock	0	3	5	11	7	17
	Other	0	1	2	6	8	30
Pacific silver fir *(cold)*							
Mature	Pacific silver fir			1	28	65	388
	Noble fir			8	8	2	
	Douglas-fir	0	1	8	6	4	1
	Western hemlock			0	3	3	37
	Other				13	23	36
Old growth	Pacific silver fir		0	5	36	60	295
	Noble fir	0	1	1	1	1	
	Douglas-fir	3	9	5	7	1	
	Western hemlock	0	2	6	10	21	19
	Other		0	3	6	1	3

[1] Mean trees per acre of 0 - 0.5 are noted by 0. Blanks indicate no trees present.

COARSE WOODY DEBRIS

Snags and down logs are critical ecosystem components for wildlife and plant habitats and for sources of soil organic matter. **In this assessment, we refer to coarse woody debris (CWD) as composed of both snags and down logs**. CWD can be expressed as snags or pieces per acre, volume or mass per acre, by size class, and by decay class. Two characteristics of CWD are the temporal and spatial variability. Not only do snags and logs vary with stand age and disturbance history, but even within a stand, patchy distribution presents a challenge in measuring or prescribing CWD levels. In natural stands, the large trees are distributed irregularly, mortality is patchy, and logs may be concentrated in hollows. This section therefore emphasizes ranges in snag and log levels by vegetation series and seral stage. These ranges of CWD are the basis for management recommendations for thinning and salvage prescriptions in Chapter IV. Meeting LSR objectives involves retaining variability in quantity and spatial arrangement of snags and logs in prescriptions and in management over time.

COARSE WOODY DEBRIS LEVELS IN NATURAL STANDS

We used data from the CVS to summarize snag and down wood ranges by vegetation series for natural stands in mature and old-growth stages. These numbers are supplied to characterize reference and desired conditions. We used the values in the CVS tables to generate management recommendations fitting for various LSR objectives (see Chapter IV "Coarse Woody Debris section). Due to limited sample sizes and high variability vegetation, data were analyzed at the series level.

The size class for the big snags (>20" dbh, >16' tall) is consistent with literature values (Spies et al. 1988), and authors cited that the large size class is the most important snag class for cavity-nesting birds (Mannan et al., 1980).
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We compared CVS data to published data for the western hemlock zone in the Cascades (Spies, et al. 1988). Spies' study gives values for the mean and range of mean +/- one standard deviation. As seen in Table II-8 Spies data encompasses the range in the CVS data and demonstrates the effect of variability.

Table II-8. Comparison of coarse woody debris levels between published data and CVS plots.

Seral Stage	Spies cu. ft./ac	CVS[1] cu. ft./ac
Old growth	4950 (3884-6016)	2609 (1091-6240)
Mature	2275 (1715-2836)	1838 (621-5442)

[1] Log transformed to match the analysis done in the Spies study.

Because the data are not normally distributed, we did not use means or standard deviations. Tables II-9 and II-10 report the median and quartile (25%-75%) ranges to describe ranges most typical of the LSRA area.

Table II-9. Snag ranges by vegetation series for mature and old growth in the Willamette NF. (Median values are displayed above the expected range of conditions, 25th to 75th quartiles. Data are from CVS plots on the Willamette NF. Hard logs are in decay classes 1-2.)

Series	Plots	Large (32" + dbh)		Medium (21-32")		Small (9-21")		%Hard snags		Big snags	Total volume
		tpa[1]	Volume	tpa	Volume	tpa	volume	%tpa	%vol	>20",>16"	(cu.ft/ac)
Pacific silver fir											
Mature	16	5 (0-8)	1179 (204-2546)	11 (5-16)	1554 (634-2872)	127 (60-177)	3653 (1752-5400)	63	64	21 (14-29)	6389 (4412-10436)
Old growth	23	11 (0-25)	3000 (61-6043)	16 (11-21)	1787 (1343-3266)	42 (25-89)	1063 (635-2573)	63	64	32 (18-43)	8290 (4360-10145)
Grand fir											
Mature	3	11 (0-22)	1201 (0-2952)	0 (0-11)	0 (0-1549)	77 (41-112)	2258 (1440-2881)	79	66	22 (0-33)	4326 (1594-7328)
Old growth	3	1 (0-17)	1033 (0-5534)	16 (0-21)	2249 (0-2871)	31 (21-37)	559 (432-1681)	41	74	16 (1-38)	4552 (1465-8342)
Douglas-fir											
Mature	5	3 (0-5)	0 (0-721)	0 (0-3)	0	21 (13-35)	98 (88-533)	62	75	0 (0-5)	928 (660-1252)
Old growth	5	16 (11-16)	2773 (1196-3912)	5 (0-5)	264 (0-317)	11 (11-45)	621 (599-670)	79	60	21 (11-21)	3467 (2308-4645)
Western hemlock											
Mature	27	0 (0-5)	0 (0-2020)	5 (0-11)	289 (0-1144)	67 (31-107)	1349 (465-3329)	71	72	11 (5-21)	3705 (1680-6301)
Old growth	42	11 (5-27)	3145 (798-6474)	11 (5-16)	1183 (179-2566)	34 (25-57)	684 (454-994)	57	46	24 (13-42)	5714 (3980-9451)

[1] tpa = trees / acre

Snags of a variety of size and decay classes serve a wide range of ecological functions. Large snags (>20" dbh and >16' height) function as habitat for many prey species of spotted owls, as well as nest sites for this species and sites for colonies of bats and swifts.

Table II-10. Down log ranges by vegetation series for mature and old growth in the Willamette NF. (Median values are displayed above the expected range of conditions, 25th to 75th quartiles. Data are from Current Vegetation Survey plots on the Willamette NF. Hard logs are in decay classes 1-2.)

	Plots	Large logs (32"+)	Medium (21-32")	Small (9-21")	Hard logs	Big logs (>21",>21")	Big logs	Big logs	Total
Series	#	volume cu.ft/acre	volume cu.ft/acre	volume cu.ft/acre	% volume	pieces/acre	volume cu.ft/acre	% total vol.	volume cu.ft/acre
Pacific silver fir									
mature	16	1854 (839-2937)	1375 (959-1634)	421 (238-634)	8	19 (5-13)	1094 (722-1798)	60	1668 (1058-2884)
old growth	23	1880 (835-3488)	924 (321-1487)	220 (52-503)	15	12 (7-16)	1868 (1017-4446)	69	3275 (1954-4887)
Grand fir									
mature	3	1640 (794-2486)	622 (176-1069)	335 (284-386)	17	12 (10-14)	2262 (970-3555)	84	1254 (1063-3941)
old growth	3	3861 na	1601 na	59 na	0	14 na	640 (209-3200)	60	1070 (232-5522)
Douglas-fir									
mature	5	1057 na	284 na	52 na	10	9 na	1281 (716-1341)	84	1394 (268-1477)
old growth	5	1979 (951-3092)	0 na	57 (12-125)	15	13 (9-22)	646 (580-2321)	68	1661 (1332-2412)
Western hemlock									
mature	27	1309 (835-3864)	868 (607-1353)	204 (125-405)	19	11 (8-25)	1391 (561-2832)	69	2066 (1152-3841)
old growth	42	1255 (1893-3334)	910 (705-1500)	166 (71-363)	16	14 (9-21)	2413 (1366-3785)	81	3037 (1875-4953)

Down woody debris provides essential structural and functional conditions for plant and animal species in each seral stage. Large and giant logs (>21”diameter) provide important habitat elements for wildlife and plants. They retain more moisture than smaller logs during the dry season, provide more cover and dens, and persist longer. Large logs are abundant after natural disturbance, particularly in the early seral stage. The supply of large logs in young plantations is not replaced until the stand undergoes understory reinitiation (mature seral stage) and can contribute large snags and hard logs.

CWD LEVELS OVER TIME: INFLUENCE OF DISTURBANCE HISTORY

There is a general pattern of CWD inputs, decay, and slow accumulation after stand replacement fire which is useful in understanding CWD levels (Spies and Cline, 1988). During early and mid seral stages (stand initiation through early stem exclusion), snags and logs from the previous stand are abundant and are the sole sources of CWD. They gradually decay towards the lowest point about 150 years after disturbance when legacy material from the previous stand is gone and accumulation of CWD in large size classes is just beginning. New inputs begin with small, quickly decaying material during mid seral stage (stem exclusion), and build in size and amount during mature seral stage (understory reinitiation). During the old growth stage, CWD slowly builds and then levels off as losses from decay generally balance inputs from tree mortality.

CWD amounts are highly variable within and among stands. Non-stand replacing fire can introduce highly complex patterns of CWD. Even non-catastrophic windthrow, pathogen, or disease impacts generate patchy mortality and CWD accumulation. Frequency, intensity, and timing of successive disturbance result in the overall CWD distribution on the landscape.

SUCCESSIONAL AND STRUCTURAL PATHWAYS

The overriding goal for managing LSRs is to create, protect and maintain late-successional ecosystems. Treatments in LSRs will attempt to accelerate late-successional characteristics to improve connectivity and habitat for late-successional species. Knowledge of the factors affecting vegetation development is useful in determining appropriate treatments to reach this goal.

Little is known about how current old growth forests developed over time. Retrospective studies (Spies et al. 1991, Means 1982) found average low tree densities of large trees, with some variability across the landscape. Tappeiner et al. (1997) found that current old growth stands had low initial tree densities and much higher initial growth rates than young stands regenerating after clearcuts in the Coast Range.

Given the uncertainty surrounding initial vegetation development, we attempted to capture the known information for our area. We used the biophysical environments expressed by vegetation series/subseries to stratify CVS inventory data into seral stages. Information from the Willamette Plant Association Guide (Hemstrom et al. 1987) and field observations and local expertise of Willamette NF and Salem BLM silviculturists and ecologists was also used to develop conceptual models of vegetation development for the dominant series/subseries (Table II-11). The Douglas-fir and grand fir series were not described because they covered only a small percentage of the landscape. Stand characteristics of dominant species in canopy and understory, canopy and understory density, and shrub competition are projected over time. This is a working hypothesis of how these environments commonly develop, and will change as more information becomes available.

Disturbances play a major role in vegetation development. The type, frequency and time in a stand's development when it is disturbed can affect future trajectories (Agee 1993, Oliver and Larson 1990). Severe disturbances, such as stand replacing fires or intense windstorms, can set back stand development to initial conditions. Moderate to low severity disturbances, like partial stand replacing to underburn fires, can accelerate stand development and create diversity. Knowledge of the type and distribution of fire regimes is useful in determining appropriate vegetation developmental pathways to be followed to achieve late-successional habitat.

Structural pathways in this document are intended as a reference to guide treatment decisions in the LSRs. There may be instances where deviations from pathways are necessary to create specific conditions or meet other objectives, such as the Aquatic Conservation Strategy or other species specific objectives.

Table II-11. Common vegetation development pathways following stand replacement disturbance in natural stands

Warm and Moist Western Hemlock Environments

Stand Characteristic	Stem Initiation (Early Seral) (0-20 yr.)	Stem Exclusion (Early-Mid to Mid Seral) (21-75 yr.)	Understory Reinitiation (Late Seral-Mature) (76-200 yr.)	Shifting Gap (Late Seral-Old Growth) (200+ yr.)
Canopy dominants/co-dominants	1. PSME 2. PSME/TSHE 3. PSME/ACMA (low elevation-BLM, Lowell)	1. PSME 2. PSME/TSHE 3. PSME/ACMA (low elevation-BLM, Lowell)	1. PSME 2. PSME/TSHE 3. PSME/ACMA (low elevation-BLM, Lowell)	1. PSME 2. PSME/TSHE 3. PSME/TSHE/ACMA (root rot)
Understory dominants			1. TSHE,THPL 2. TSHE,THPL 3. TSHE, THPL	1. TSHE,THPL 2. TSHE,THPL 3. TSHE, THPL, ACMA
Canopy Density (TPA)+	Moderate (shrub competition) to High (good seed source)	Moderate	Low - Moderate	Low
Understory Density			1.-Moderate	Low
Shrub Competition	Low - High (ACCI)	Low (ACCI)	Low - Mod (ACCI)	Low - Mod (ACCI)

[1] Low = <100 trees/acre; Moderate = 100-1000 trees/acre; High = >1000 trees/acre

Table II-11. Common vegetation development pathways following stand replacement disturbance in natural stands, con't

Well-Drained to Dry Western Hemlock Site Environments

Stand Characteristic	Stem Initiation (Early Seral) (0-25 yr.)	Stem Exclusion (Early-Mid to Mid Seral) (26-100 yr.)	Understory Reinitiation (Mature) (101-250 yr.)	Shifting Gap (Old Growth) (250+ yr.)
Canopy dominants/co-dominants	1. PSME 2. PSME/TSHE	PSME PSME/TSHE	PSME PSME/TSHE	PSME PSME/TSHE
Understory dominants	0		TSHE,PSME,THPL TSHE,THPL	TSHE,THPL TSHE,THPL
Canopy Density (TPA)+	1. Moderate (shrub competition) - High (good seed source) 2. Same as 1	1. Moderate 2. Same as 1	1. Low - Moderate 2. Same as 1	1. Low 2. Same as 1.
Understory Density			1. Low-Moderate 2. Same as 1	1. Low 2. Same as 1
Shrub Competition	Low - High (RHMA, CEVE, ACCI)	Low (RHMA, ACCI)	Low - Mod (RHMA, ACCI)	Low - Mod (RHMA, ACCI)

[1] Low = <100 trees/acre; Moderate = 100-1000 trees/acre; High = >1000 trees/acre

Table II-11. Common vegetation development pathways following stand replacement disturbance in natural stands, con't

Moderate Pacific Silver Fir Environments

Stand Characteristic	Stem Initiation (Early Seral) (0-30 yr.)	Stem Exclusion (Early-Mid to Mid Seral) (31-150 yr.)	Understory Reinitiation (Mature) (150-250 yr.)	Shifting Gap (Old Growth) (250+ yr.)
Canopy dominants/co-dominants	1.ABAM/PSME/ABPR (South Zone) 2.ABAM/PSME/ABGR (South Zone) 3.ABAM/TSHE/PSME/ ABPR (Northern Zones) 4.ABAM/PSME/TSHE	ABAM/PSME/ABPR ABAM/PSME/ABGR ABAM/TSHE/PSME/ ABPR ABAM/PSME/TSHE	ABAM/PSME/ABPR ABAM/PSME/ABGR ABAM/TSHE/PSME/ ABPR ABAM/PSME/TSHE	ABAM/PSME/ABPR ABAM/PSME/ABGR ABAM/TSHE/PSME/ ABPR ABAM/PSME/TSHE
Understory dominants			1.ABAM 2.ABAM/ABGR 3.ABAM/THPL/TSHE 4.ABAM/TSHE/THPL	1.ABAM 2.ABAM/ABGR 3.ABAM/THPL/TSHE 4.ABAM/TSHE/THPL
Canopy Density (TPA)+	Moderate (shrub competition) - High (good seed source)	Moderate	Low - Moderate	Low
Understory Density			Moderate to High	Moderate
Shrub Competition	Low - High (RHMA, CEVE, ACCI)	Low (RHMA, ACCI)	Low (RHMA, ACCI)	Low - Mod (RHMA, ACCI)

[1] Low = <100 trees/acre; Moderate = 100-1000 trees/acre; High = >1000 trees/acre

Table II-11. Common vegetation development pathways following stand replacement disturbance in natural stands, con't

Cold Pacific Silver Fir Environments

Stand Characteristic	Stem Initiation (Early Seral) (0-50 yr.)	Stem Exclusion (Early-Mid to Mid Seral) (51-175 yr.)	Understory Reinitiation (Mature) (175-300 yr.)	Shifting Gap (Old Growth) (300+ yr.)
Canopy dominants/co-dominants	1.ABAM/PSME/ABPR/ TSME [1] 2.ABAM/TSHE/PSME*	1.ABAM/PSME/ABPR/ TSME 2.ABAM/TSHE/PSME	1.ABAM/PSME/ABPR/ TSME 2.ABAM/TSHE/PSME	1.ABAM/PSME/ABPR/ TSME[1] 2.ABAM/TSHE/PSME*
Understory dominants			1. ABAM/TSME 2.ABAM/TSHE	1. ABAM/TSME 2.ABAM/TSHE
Canopy Density (TPA)[2]	Moderate (shrub competition) - High (good seed source)	Moderate [3]	Low - Moderate[3]	Low[3]
Understory Density			Mod to high (500-4000)	Mod to high (500-2000)
Shrub Competition	Low - High (RHMA, XETE)	Low (RHMA, XETE)	Low (RHMA, XETE)	Low - Mod (RHMA, XETE)

[1] PSME in current mature and old growth communities in this type established under warmer conditions than exist today. PSME may not reproduce effectively in this type today.
[2] Low = <100 trees/acre; Moderate = 100-1000 trees/acre; High = >1000 trees/acre
[3] ABAM and ABPR is very sensitive to mistletoe so densities may decrease

DISTURBANCE PROCESSES

FIRE

Fire is an important disturbance process in our landscape. It affects stand composition and structure, as well as landscape level vegetation patterns. Knowledge of the frequency, size, and severity of fires in the LSRA area will help us assess risk and determine appropriate types and frequencies of treatments to apply to maintain and protect late-successional ecosystems. Knowledge of the role of fire in the assessment area is also integral to understanding forest development over time and historical distribution of habitats across the landscape.

FIRE REGIMES

Climate, topography and fuels all contribute to the timing, severity and size of fire across the landscape. A gradient of increased lightning frequency occurs from north to south in the Cascades (Agee 1993). A range of historic fire regimes is reported throughout the western hemlock zone within and adjacent to the LSRA area (Teensma 1987, Morrison and Swanson 1990, Connelly and Kertis 1992, Garza 1995, Weisberg, 1997). We used climatic gradient, variability in fuels, and fire history studies in the LSRA area to describe and map fire regimes to display the variability in landscape and stand patterns.

We examined lightning activity data for the last 25 years, and a statewide precipitation map to assess the gradient of climate related conditions across the LSRA. We delineated landtypes across the LSRA that grouped similar areas of elevation, slope steepness, length and dissection (Appendix B). Physiographic zones were also delineated using the statewide geology map. We overlaid the vegetation series and sub-series layer on the landtypes to get the correlation between topography and potential fuel types. Fire history studies were then located and fire regime results were correlated with appropriate landtypes and vegetation. Fire regime types were then given to like landtypes and vegetation types across the LSRA area. Fire history studies were not available for the entire area, so watershed analysis results and interpretations about the relationship between climate, topography and fuels to fire regime based on local fire experience and knowledge were made to complete the mapping.

The variability in climatic conditions was strongly correlated to the Physiographic Zones, with climatic conditions responsible for splitting out the southern from the northern zone in the West and Mixed Cascades. Landtypes and vegetation types were strongly correlated, thus being a good representation of physical, as well as biological conditions. Average frequency and severity categories were used to describe fire regimes. We assumed a stand replacing fire killed more than 70% or of a stand, with a partial burn having 30 to 70 percent mortality. Fire regimes were mapped (Map 5) using the modified Physiographic Zone, landtypes and vegetation types.

Northwest Fire Zone

Fall Creek (RO219), Hagan (RO217), Wiley (RO216), Whitcomb (RO212), South Santiam-west (RO215), and Quartzville-west (RO213).

Physiographic Zone: West Cascades

Vegetation Type: Western hemlock, Pacific silver fir

Fire regime: Average low frequency (>200 years) stand replacing fires; average moderate frequency (80-200 years) partial burns (Klopsch 1985, Stewart 1986)

Fire Effects: The dominant early seral species regenerating after a stand replacement disturbance in this regime is Douglas-fir. Western hemlock and western redcedar may be components in developing stands in the western hemlock type. Pacific silver fir and noble fir may be components of developing stands in the Pacific silver fir type. One or two intermediate disturbances may occur over the life of a stand. These disturbances can kill the fire intolerant western hemlock and Pacific silver fir, while only slightly affecting the tolerant Douglas-fir. Post-fire seedbeds will vary, with western hemlock and Pacific silver fir able to regenerate under more shady situations than Douglas-fir. These intermediate disturbances serve to increase the within, as well as between, stand heterogeneity. Most stands in this regime reach classic old-growth conditions of multiple layers, large snags and down wood.

Fire Pattern: Stand replacement fires occur over large areas (greater than 1000 acres) of the landscape infrequently, creating large, early seral patches. Stewart (1986) noted stand-replacing fires approximately 450 years ago and 130 years ago. Klopsch (1985) found remnants of a 450-year age class and a 145-year age class in Hagan LSR. Partial burns and underburns occur in a more variable pattern, creating gaps and heterogeneity across the landscape.

Northeast Fire Zone

Jefferson (RO214), Horse Creek (RO218), South Santiam-east (RO215), Quartzville-east (RO213).

Physiographic Zone: Mixed Cascades

Vegetation Type: Dry Western hemlock, Pacific silver fir

Fire regime: Average Moderate frequency (80 - 200 years) stand replacing fires; average moderate frequency (80-200years) partial burns (Teensma 1987, Morrison and Swanson 1990, Connelly and Kertis 1992)

Fire Effects: The dominant early seral species regenerating after a stand replacement disturbance in the dry western hemlock type is Douglas-fir. Western hemlock and western redcedar may be components of developing stands. Some stands in this regime reach classic old-growth conditions of multiple layers, large snags and down wood. Some stands may not develop multilayered canopies before experiencing another stand replacing event. One or two intermediate disturbances may occur over the life of a stand. These disturbances can kill the fire intolerant western hemlock and western redcedar, while only slightly affecting the tolerant Douglas-fir, leaving remnants of various densities. Post-fire seedbeds will vary, with western hemlock able to regenerate under more shady situations than Douglas-fir. These intermediate disturbances serve to increase the within as well as between, stand heterogeneity. Pacific silver fir, noble fir and Douglas-fir commonly regenerate after a stand replacing fire in the Pacific silver fir type. Some stands reach old growth conditions in this type. Intermediate disturbances have a variety of effects in this zone. Pacific silver fir, having thin bark and shallow roots, is very susceptible to fire. Noble fir is moderately susceptible (especially when young), and Douglas-fir is quite fire tolerant. Partial stand replacing fires are quite variable, leaving patches of live stands interspersed with areas of higher mortality.

Fire Pattern: Stand replacement fires occur over large areas (greater than 1000 acres) of the landscape at moderate frequencies (80-200 years) creating large, early seral patches. Most of the fires in the H.J. Andrews area ranged from 1000 - 26,000 acres in size (Teensma 1987). Partial burns and underburns occur in a more variable pattern, creating gaps and heterogeneity across the landscape. Teensma (1987) found an average of two (one area had three) age-classes per site sampled in the H. J. Andrews Experimental Forest.

Vegetation Type: Moist western hemlock

Fire regime: Average low frequency (>200 years) stand replacing fires; average moderate frequency (80-200 years) partial burns (Teensma 1987, Connelly and Kertis 1992).

Fire Effects: These sites are often located in moist, wide valley bottoms. Environmental conditions serve to protect these sites from upland stand replacing fires. Once a site burns, it succeeds much like the fire effects in the dry western hemlock type. Most stands in this type reach classic old growth, with many tree layers, high levels of large snags and CWD. There may be a few intermediate disturbances that occur within the life of the stand. These disturbances increase the diversity within and between stands.

Fire Pattern: Stand replacement fires occur very infrequently in this type, and often cover areas greater than 1000 acres in size. The moist western hemlock types located in the valley bottoms of the South Fork of the McKenzie, for instance, regenerated after a fire in the early 1500's. Since then there have been several scattered partial stand replacement fires that have increased the variability across the valley bottom landscape (Connelly and Kertis 1992).

Southern Fire Zone

Waldo West (RO220), Hills Creek (RO221).

Physiographic Zone: Mixed Cascades

Vegetation Type: Pacific silver fir

Fire regime: Average Moderate frequency (80 - 200 years) stand replacing fires; average moderate frequency (80-200years) partial burns

Fire Effects: Fire effects in this type are similar to those found in the Northeast zone in the Pacific silver fir zone.

Fire Pattern: Stand replacement fires occur over large areas (greater than 1000 acres) of the landscape at moderate frequencies (80-200 years) creating large, early seral patches. Intermediate disturbances create variability on these sites, with patches of live, older stands interspersed with early seral patches. These disturbances create between stand variability in this type. For instance, the Warner Creek fire, burned in a variable pattern in the Pacific silver fir type, leaving all components of pre-burn stands in patches adjacent to high mortality patches.

Vegetation Type: Western hemlock, Douglas-fir, Grand fir

Fire regime: Average moderate frequency (80-200 years) stand replacing fires; average high frequency (< 80 years) partial burns.

Fire Effects: Douglas-fir is the dominant species regenerating after a disturbance in these types. Incense cedar, grand fir and western hemlock may be components in developing stands. Some stands reach classic old growth, with multiple layers and large snags. Intermediate disturbances occur frequently in this type. Western hemlock, with its shallow roots and thin bark is very susceptible to fire. Douglas-fir, grand fir and incense cedar are able to withstand moderate intensity fires, and may remain in the post-fire stand. Partial stand replacing fires may serve to increase or retard succession, may increase or decrease the amount of CWD on site, and may initiate or discourage multiple layered stands from developing. These disturbances create the most variability in within stand and between stand characteristics of all the types in the LSRA area.

Fire Pattern: Stand replacement fires can occur in a more variable pattern in these types than in the Pacific silver fir type. The Shady Beach fire of 1988, Warner Creek fire of 1991, South Zone complex of 1996 displayed a wide variety of post-fire vegetation characteristics, from stand replacing to underburn. The frequency and pattern of these events suggest a complex fire regime in this area.

INSECTS AND PATHOGENS

Insects and pathogens are important components of western Oregon's forested ecosystems. Insects function in the dynamics of LSRs by serving as defoliators, decomposers, prey or hosts to other species (e.g., birds, amphibians, and other insects), and pollinators. The diversity and community composition of insects and pathogens in LSRs influences processes such as nutrient cycling (Schowalter et al. 1991), plant population dynamics, and predator-prey interactions. From the silvicultural perspective, insects and pathogens can affect tree growth rates (Marquis and Whelan 1994), stand structure, fire hazard, and decomposition of woody material.

INSECTS

Much of our current understanding about insects in LSRs comes from studies conducted on the H.J. Andrews Experimental Forest (HJA), located on the Blue River Ranger District of the Willamette NF. Over 3400 insects have been documented from the HJA (Parsons et al. 1991; Lattin 1993), and this may represent only half of the total species actually present (Lattin 1993). Of these 3400 species, 523 moth species (order Lepidoptera) have been recognized and monitored between 1992-1996 (Miller 1995; Miller, unpublished data). Only 9% of these moths feed on conifers, while 48% feed on woody angiosperms (flowering trees and shrubs), and 25% feed on herbs (J.C. Miller, unpublished data; Hammond and Miller 1998). The host plants of the remaining 18 % are unknown, but are suspected to be herb feeders (J.C. Miller, unpublished data). Lepidoptera are vital components of food webs (e.g., they serve as the primary food resource for passerine birds during the breeding season). Up to 90% of Lepidoptera species in the LSRs require non-coniferous plants for their food.

Studies on the HJA also show that insect diversity and functional diversity are much higher in canopies of old-growth trees compared with those of young trees (Schowalter 1989, 1995). Old-growth Douglas-fir stands (> 400 years old) are four times more diverse than Douglas-fir plantations (10-20 years old). Mature Douglas-fir (150 years old) and partially harvested old growth (3-20 years post-harvest) stands have slightly lower diversity rankings than old-growth stands. In addition to being more diverse, mature and old-growth stands are less susceptible to outbreaks of herbivores, and therefore typically suffer less defoliation than young stands (Schowalter 1989). Structurally and functionally diverse forests, such as mature and old-growth stands, maintain predator diversity (Schowalter 1989, 1995) and impede herbivore success in discovering suitable hosts and completing development (Schowalter 1989). Conversely, host monocultures created by selective logging, fire suppression, and planting monocultures have proven vulnerable to mountain pine beetle (*Dendroctonus ponderosae*), western spruce budworm (*Choristoneura occidentalis*), and Douglas-fir tussock moth (*Orgyia pseudotsugata*) (Schowalter 1986).

Although several thousand insect species inhabit LSRs, it is only a few species (primarily specific bark beetles [Coleoptera: Scolytidae] and defoliating caterpillars [Lepidoptera: Lasiocampidae, Saturniidae, and Torticidae]) that significantly affect growth and survival of conifers and thus receive the most attention. Similarly, of the more than 100,000 species of fungi, only a small fraction (< 200 species = 0.2 %) can cause serious damage. The remaining part of this section will briefly outline the occurrence and impact of several economically important species of insects and fungal pathogens. Data for this assessment comes from Region 6 Aerial Insect and Disease Detection Surveys from 1977-1996 and Ground Survey Reports.

Douglas-fir beetle (Dendroctonus pseudotsugae)

Douglas-fir beetle (*Dendroctonus pseudotsugae*) is present in all of the LSR stands. Its populations are maintained at low levels in root disease pockets or on scattered dead or down trees. Endemic populations (i.e., low, relatively static numbers which cause relatively insignificant amounts of defoliation or tree killing) can build up to epidemic levels (i.e., high numbers that cause readily noticed or significant amounts of defoliation or tree killing) following windstorms when a significant number of trees fall down. Data from 50 years of aerial surveys, conducted to detect insect-caused mortality, indicate notable increases in Douglas-fir beetle caused mortality every eight to twelve years, usually two years after stormy winters. Impacts range from scattered mortality (one tree killed per four acres) over large areas to concentrations of 5 to 20 trees killed per acre in areas 1 to 50 acres in size .

Mountain pine beetle (**Dendroctonus ponderosae*****)***

An outbreak of mountain pine beetle (*Dendroctonus ponderosae*) in western white pine occurred in the LSRs during the late 1960's. Thousands of acres were affected as most of the white pine was reaching old age and was being outcompeted by other species. Therefore, western white pine populations have dropped significantly below historic levels in most stands.

Balsam wooly aphid (**Adelges piceae*****)***

An exotic insect, the balsam wooly aphid (*Adelges piceae*), was introduced into the Pacific Northwest in the 1920's on true firs in the Willamette Valley and gradually spread to the Cascades. During the 1960's, aphids caused extensive areas of mortality in Pacific silver fir, especially in the high elevations of Jefferson, Waldo West, Hills Creek, and possibly Horse Creek LSRs. While this insect has had little influence recently, it had a profound influence on the structure of high elevation LSR stands.

PATHOGENS

Laminated root rot (**Phellinus weirii*****)***

Laminated root rot (*Phellinus weirii*), a native disease that affects many conifer species, is the most widespread disease of Douglas-fir in the western Cascades. Various surveys show that laminated root rot is patchily distributed and occurs in 3-5% of the Douglas-fir forest. Trees killed by the disease provide snags and logs, which benefit many wildlife species. However, current management emphasizes planting or retaining resistant or immune species such as western white pine and western redceder.

White pine blister rust (**Cronortium ribicola*****)***

White pine blister rust (*Cronortium ribicola*) can infect nearly all the 5-needle pines including western white pine, sugar pine, and white bark pine in the LSRs. Older, large diameter western white pine, sugar pine, and ponderosa pine populations have dropped below historic levels in the few LSRs where they are found. Disease resistant western white pines have been planted in harvested units within the LSRs.

Armillaria root rot and others

Armillaria root rot (*Armillaria* spp., basidiomycete fungi), Annosus root disease (*Heterobasidion annosum*), dwarf mistletoe (*Arceuthobium* spp.: parasitic angiosperms in the family Viscaceae), and other fungal diseases are present within the analysis area and are expected to cause minor infections on their host species within the LSRs.

VEGETATION PATTERNS

Vegetation composition, structure, and pattern all influence the diversity of plants and animals that inhabit landscapes. Disturbance processes, distribution of plant series and subseries, and successional trends determine the types and patterns of vegetation over space and time. Our knowledge of vegetation types and distribution across the landscape allows us to evaluate and prioritize future management direction.

CURRENT SERAL STAGE DISTRIBUTION

Methods
We designated seral stages using vegetation series/subseries and dominant stand size class information (or stand age if size class unavailable) from BLM and FS coverages. Appendix C documents the process we used to determine seral stages and Map 2 displays the seral stages in the assessment area.

General stand characteristics of seral stages are listed below:
- Early – young single layered stands (plantations) dominated by seedlings and trees less than 5 inches dbh.
- Early-mid – young single layered stands (mostly plantations) dominated by pole size trees 5-9 inches dbh.
- Mid-natural or managed (mostly post-commercially thinned) stands with varied dominant size classes (see Appendix C), often single layered but may be transitioning into understory reinitiation or late-mature stage.
- Mature – natural stands in the stem reinitiation phase beginning to develop layered canopies. Dominant size class varies by subseries (Appendix C)
- Old growth – natural stands with multi-layered canopies.

Results
Table II-12 and Figure II-1 display the current distribution of seral stages in the LSRA area. Each LSR in the LSRA area currently contains several seral stages, ranging from early to old growth. The old growth stage describes the highest quality late-successional habitat in the LSRs, and area ranges from 16 percent (Thomas Creek) to 70 percent (Wiley). Mature habitat ranges from 0 percent (Hagan) to 27 percent (Whitcomb, Waldo West).

Table II-12. Current seral stage acre distribution by LSR

Seral Stage		Non-forest	Early	Early-mid	Mid	Mature	Old growth
Whitcomb	RO212	110	735	406	429	1,036	1,164
Quartzville	RO213	2,660	18,732	7,886	9,791	5,291	39,306
Jefferson	RO214	1,643	9,394	2,097	8,030	5,233	13,619
South Santiam	RO215	1,104	3,232	2,794	11,199	1,687	7,706
Wiley	RO216	0	98	24	62	0	424
Hagan	RO217	27	261	21	8,143	26	684
Horse Creek	RO218	987	3,852	581	4,722	1,571	15,198
Fall Creek	RO219	314	14,828	9,196	10,211	6,515	24,864
Waldo West	RO220	2,470	15,889	376	5,235	13,970	13,842
Hills Creek	RO221	520	4,630	207	1,368	2,900	6,967
Thomas Creek	RO246	138	216	359	936	349	391
Total		9,973	71,867	23,947	60,126	38,578	124,165

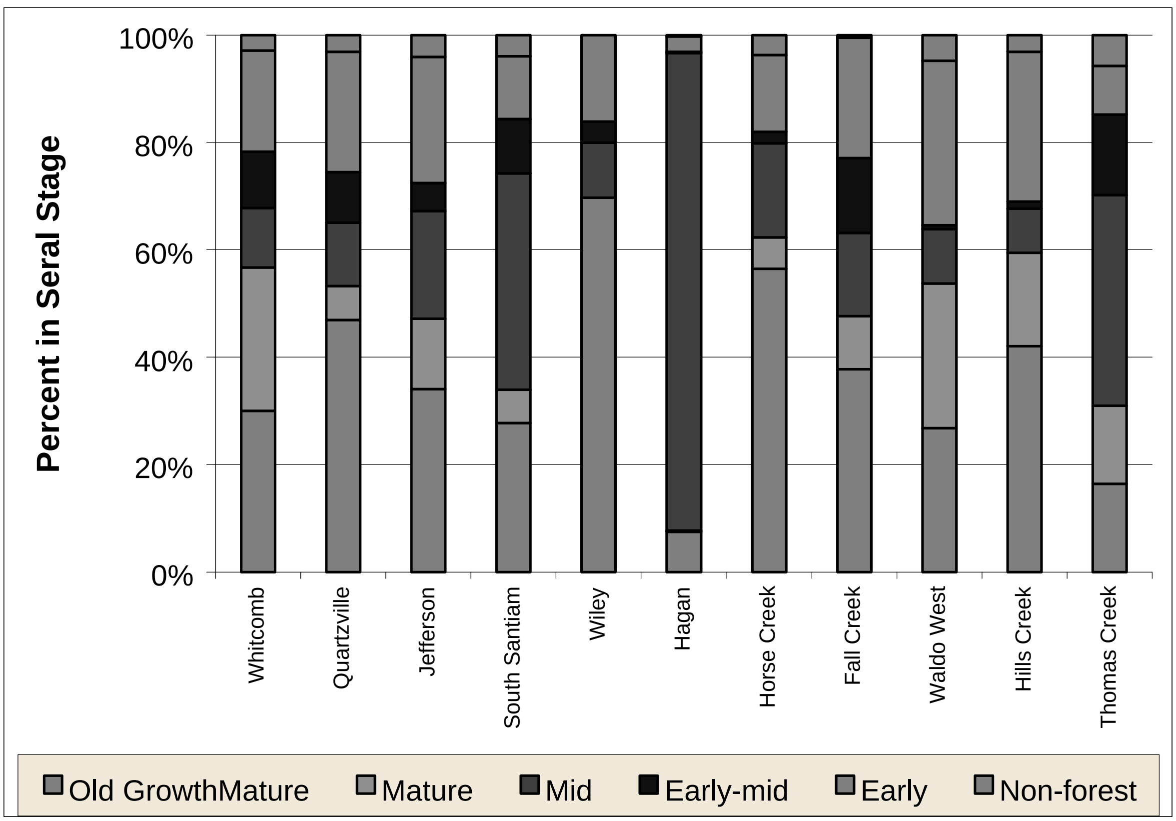


Figure II-1. Current seral stage distribution by LSR.

CURRENT LATE SERAL INTERIOR FOREST CONDITIONS

Interior portions of late-successional forests provide habitat conditions for species of fungi, lichens, invertebrates and amphibians associated with interior forest conditions of higher humidity, moderated temperatures and reduced solar radiation.

Late-successional forests can be adversely impacted by the effect of edges created by roads, timber harvest and other disturbance events. Edge effects include desiccation of moisture sensitive species, increases in understory vegetation, invasion by unwanted nonnative species, and windthrow. Recent studies by Harris (1984), Chen (1991) Chen et al. (1993), Chen et al. (1995), and Chen et al. (1996) measured some of the physical and biological changes to late-successional forests associated with edges.

In general, larger patches of late-successional forest have a higher acreage of interior forest meeting each functional condition, and have a higher likelihood of maintaining a reproducing population of species with larger home ranges. Smaller or irregularly shaped patches of forest may suffer the synergistic effects of multiple edges. Forest canopy removal adjacent to riparian vegetation affects the microclimatic conditions of the riparian forest, as well as forest structural characteristics (Brosofske et al. 1997). Removing upland forest from both sides of the riparian zone creates two edges, and the effects on microclimatic conditions may be synergistic. For large streams (where the canopy is naturally open over the stream due to the width of the channel), this additive effect may occur when only one edge is created, as the river channel may provide the second “edge”.

The current knowledge of edge effects on late-successional forests does not allow a precise evaluation of those effects on individual species. However, existing analyses indicate that the physical and associated biological functions of interior forest improve with increasing distance from edges, with corresponding increases in habitat quality for many species.

In this LSR assessment we have chosen to estimate the extent of some of these effects, and their implications for management of late-successional forests within LSRs, based primarily on the results presented in Chen et al. (1993, 1995, and 1996). The following discussion summarizes the results of an analysis of this issue; management recommendations are presented in Chapter IV. A more detailed discussion of the analysis, including methodology and results, can be found in Appendix F of this document.

We have deliberately avoided specifying any one distance as interior forest. Instead, we have defined interior forest by bands of functional conditions and species responses that vary in their relevance and function depending upon the distance from interior points to the forest edge. These functional bands should not be considered as absolutes, but rather as guidelines that could be modified by local consideration of aspect, topography, prevailing wind speed and direction, elevation and stand condition. Table II-13 summarizes those physical and biological parameters that are affected at various distances from the edge of early-successional forest stands. Generally, changes in biological parameters (e.g., sun scald, windthrow, understory response by shade intolerant species) can be measured up to 120 m from edges, whereas physical parameters (e.g., air temperature, wind speed, humidity) can have detectable changes up to 400 m from edges. However, at least one interior forest species, rattle snake plantain, *Gordyera oblongifolia,* has been shown to be affected by edges up to 225 meters distant (Chen et al. 1996).

Table II-13. Effects of early seral edges on physical and biological parameters of late-successional forests that reduce their suitability as interior late-successional habitat adapted from (Chen 1991, Chen et al. 1993, Chen et al. 1995).

Distance within late-successional forest stand from edge of early seral	Effects of edge on physical and biological parameters of late-successional forest stands that reduce their suitability as interior forest stands.
0 - 60 meters	Direct solar radiation into stand; higher air temperature and consequent lower humidity; significant drying of understory and increases in soil temperature; increased growth of understory vegetation, significant blowdown, some tree death due to sun scald.
61 - 120 meters	Significant wind effects; increased temperature and lower humidity; significant blowdown occurs, resulting in fewer overstory trees and less canopy closure within this and previous band width.
121 - 180 meters	Measurable increases in wind speed and air temperature, and decreases in humidity, in forest stand as compared to optimal interior conditions.
181 - 240 meters	Limit of humidity and air temperature effects of edges.
241 - 400 meters	Slight differences in wind speed.
More than 400 meters	No detectable biological or physical conditions affecting late-successional functions.

[1] Note: These values and effects descriptions represent a generalization of the results presented in the cited literature consistent with our attempt to create a reasonable GIS model to analyze this issue. The reader is encouraged to consult the cited literature for a full discussion of this subject.

Methods

To assess the significance of interior forest conditions and the effects of forest fragmentation within the Mid Willamette LSRA analysis area, forest stands meeting late-successional structural conditions (see the previous section in this chapter - 'Vegetation Patterns' for specific definitions of seral stages by Plant Association Group) were buffered with specific band widths in a GIS model. The specific bandwidths are > 400 m, >240 m, >180 m, >120 m, and >60 m from edges of early seral stage vegetation. This method selected early seral stage stands greater than 4 acres in the analysis area and buffered into all nearby late-successional stands (defined as mature or old growth). Effects due to roads, early seral stands less than 4 acres, large stream channels, and edges of nonforest special habitats were necessarily excluded from this quantitative analysis, but should be considered during any site-specific evaluation of this issue.

We produced a map (Map 12) and tabular data for each LSR to compare the relative amounts of interior forest within each functional band, and to compare the function of interior forest across LSRs.

Results

We estimated the portion of each LSR that likely retains interior forest functions by calculating the acreage of forest functional bands in which that function is not likely to be adversely impacted. As an example, to estimate the acreage of interior forest in which blowdown due to edge effects is minimal, we calculated the acreage in the >120 m band. For South Santiam LSR (RO215), a total of 7,067 acres (or 75.9% of interior forests) meets this criteria. Table II-14 provides an estimate of acreage and percent composition for interior forest functional conditions within each of the LSRs. For visual comparison purposes, Figures II-2 and II-3 graphically illustrate the acreage and percentages of interior forest functional bands within the LSRs (ranked from relative "best" to "worst" condition.

Table II-14. Total acreage and percent of total acres of mature/old-growth late-successional habitat that are considered to provide various functional levels of interior forest habitat (>60, >120, >180, >240, and >400 meter functional bands, after Chen 1993). For a description of interior forest functional bands, see text.

Late-Successional Reserve Name	LSR Number	Total acres Late-Successional	Interior >60 m Late-Successional	%	Interior >120 m Late-Successional	%	Interior >180 m Late-Successional	%	Interior > 240 m Late-Successional	%	Interior > 400 m Late-Successional	%
Whitcomb	RO212	2,203	1,788	81.2	1,405	63.8	1,089	49.4	815	37.0	357	16.2
Quartzville	RO213	44,582	34,892	78.3	26,849	60.2	20,889	46.9	16,517	37.0	9,175	20.6
Jefferson	RO214	18,839	14,649	77.8	11,240	59.7	8,630	45.8	6,534	34.7	2,984	15.8
South Santiam	RO215	9,310	8,000	86.9	7,069	75.0	6,257	67.2	5,617	60.3	4,261	45.8
Wiley	RO216	421	360	85.5	283	67.2	204	48.5	139	33.0	19	4.5
Hagan	RO217	704	664	94.3	614	87.2	568	80.7	528	75.0	466	66.2
Horse Creek	RO218	16,752	14,350	85.7	12,251	73.1	10,449	62.4	8,876	53.0	5,756	34.4
Fall Creek	RO219	31,416	24,010	76.4	18,077	57.5	13,762	43.8	10,690	34.0	5,639	17.9
Waldo West	RO220	27,788	19,929	71.7	14,016	50.4	9,944	35.8	7,190	25.9	3,846	13.8
Hills Creek	RO221	9,814	7,232	73.7	5,197	53.0	3,762	38.3	2,677	27.3	1,150	11.7
Thomas Creek	RO246	801	675	84.3	610	76.2	550	68.7	499	62.3	375	46.8
Totals (All LSRs)		162,629	126,640	77.9	97,611	60.0	76,104	46.8	60,081	36.9	34,027	**20.9**

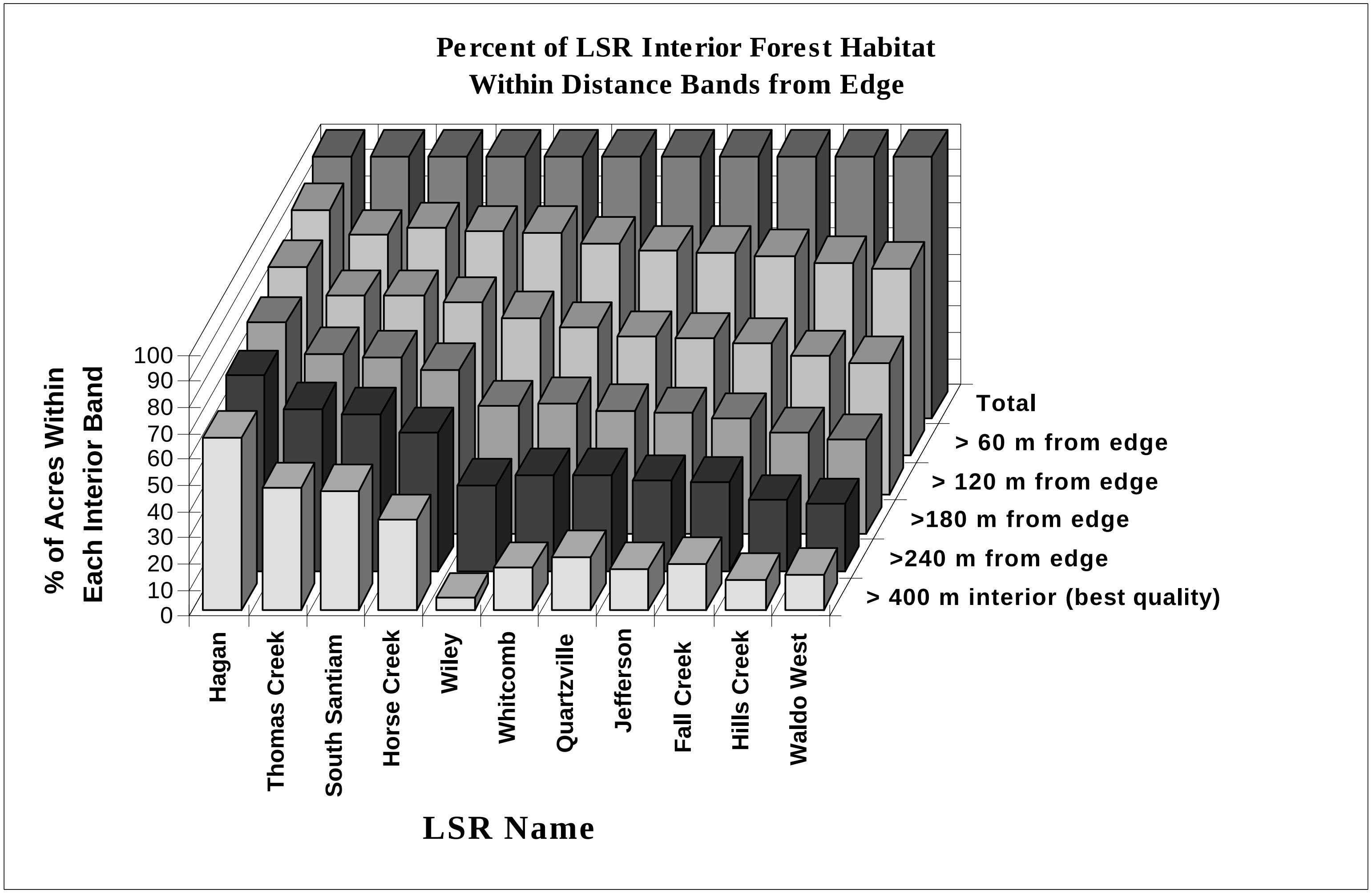


Figure II-2 Percent of acres within different interior forest functional band by LSR.

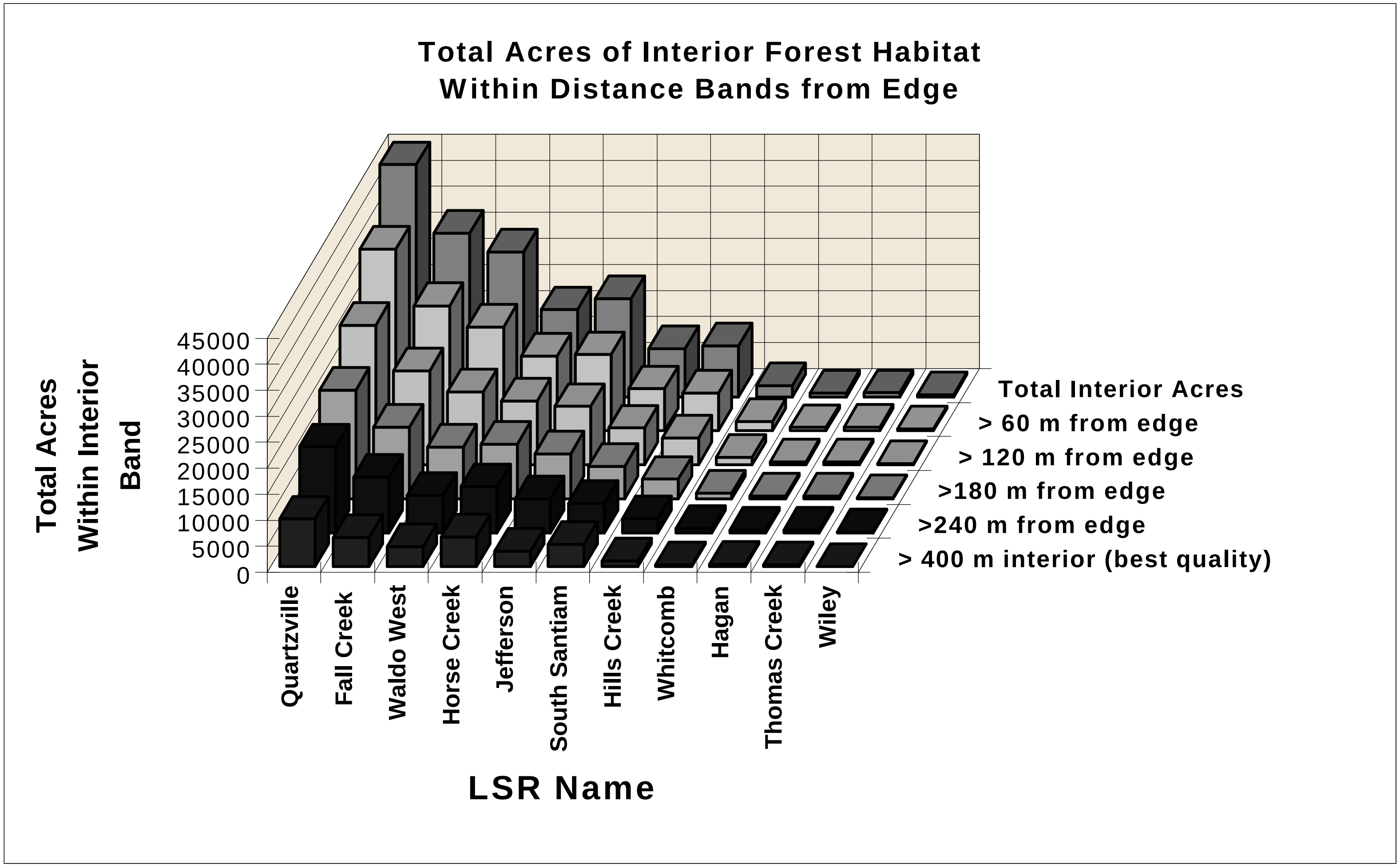


Figure II-3. Acres within different interior forest functional bands by LSR.

On average, all of the LSRs contain relatively low amounts of the best interior forest. Of all LSR interior forest, only about 20.9 percent is in the best interior condition (> 400 meters from an edge) and only about 36.9 percent is >240 meters from an edge. This indicates that habitat for species that require late-successional forest in which most physical and biological effects of edge are eliminated is restricted. About 60 percent of interior forest occurs in the zone where most biological factors are not measurably affected by edge (generally >120 meters), indicating that approximately 40 percent of existing late-successional forest acres in LSRs may have suffered adverse edge effects to biological functions related to stand structural characteristics. This effect is especially acute in the smallest LSRs (Thomas Creek, Whitcomb Creek, Wiley), where the low percentage of interior forest in highly functional bands is exacerbated by low total acreage in those LSRs.

As indicated in Table II-14 and Figure 11-2, substantial variation exists among the LSRs in the percent of late-successional forest within individual interior bands. Hagan has the highest percentage of total late-successional forest in 120 m and greater bands, indicating that the majority of late-successional forest in this LSR has good quality interior conditions (notwithstanding the relatively low total acreage of late-successional forest, discussed below). On the opposite end of the spectrum are Hills Creek and Waldo West, with high percents of late-successional forest in poorer interior condition (<120 m). Assessment of the overall quality of interior forest within these 11 LSRs must consider the cumulative benefits or drawbacks to these two measures of interior forest function. LSRs containing both a large acreage of interior forest as well as a high percentage in the best functional bands are considered to be overall in better condition than those LSRs that contain either a low total acreage of interior forest or a low percent of the best functional bands, or both. None of these LSRs contain both large acreage and percent of best interior functional conditions. Quartzville, Fall Creek, and Waldo West contain relatively high amounts of interior forest, but have below average percent of interior forest when compared to other LSRs in this network. By comparison, Hagan and South Santiam have a high percent of interior forest in the best functional bands, but suffer from a relative low total amount. Hills Creek is likely in the poorest condition of the eight large LSRs due to the cumulative effects of relatively few acres in interior forest and the relatively lower proportion of interior forest in the best functional bands. The three small LSRs are especially susceptible to these cumulative effects due to their size and the functional limitations due to their high proportion off boundary edge to nonfederal lands.

Management Implications

Substantial variation exists among the LSRs in the total acreage of interior late-successional forest. Despite its relatively low percent of late-successional forest in the best interior forest bands, Quartzville ranks high overall due to its large acreage of late-successional forest. Conversely, Hagan contributes relatively little interior forest to the network, despite the good quality of interior that it does have. Of the “large” LSRs, Hagan, Hills Creek, and South Santiam suffer from relatively few total acres in good interior condition.

At this time, no data are available to predict the rate of recovery of interior forest functions and associated species that have suffered adverse impacts from edge effects. It is therefore impossible to precisely predict the actual recovery rate of affected stands and associated species. This lack of certainty suggests caution when designing forest treatment prescriptions in stands adjacent to existing late-successional forests. Recommendations related to silvicultural prescriptions and interior forest are presented in Chapter IV.

Where interior forest conditions currently exist up to the edge of the LSR, future harvest in adjacent nonLSR stands can result in the degradation of interior forest functional conditions in the remaining late-successional forest stand. These effects could be severe in smaller LSRs (e.g., Hagan, Thomas Creek, Wiley, and Whitcomb) and in LSRs, but will be less significant in larger LSRs.

COMPARISON OF LATE-SUCCESSIONAL AND INTERIOR FOREST CONDITIONS BETWEEN THE MID-1900S AND CURRENT CONDITIONS

Comparisons in vegetation pattern should be made at many points in time over a period of several hundred years to get a complete picture of the range of natural conditions. It is rarely possible to get accurate landscape pattern information for pre-1900’s conditions. We can make assumptions about historic landscape patterns based on what we know about historical disturbance regimes and management history. This analysis uses a comparison of mid-1900’s vegetation pattern (available digitally) and current condition to assess management impacts.

Methods

We used available spatial information on the distribution of seral stages for a mid-1900s time period compared to current condition of vegetation to assess vegetation pattern changes. We grouped interior forest patches into four patch classes: small (<125 acres); medium (126-1,000 acres); large (1,001-10,000 acres) and giant (> 10,000 acres). These classes were selected to match patch types characterized in wildlife habitat models (HABSCAPES), and knowledge of home range sizes for key species (Mellen et al. 1995). We calculated patch size for all patches located within LSRs. Patch boundaries, especially for giant patches, could be located outside of the LSR boundary, thus some LSRs may have patch sizes greater than the LSR itself.

Information on the distribution of seral stages was available for two points in time. A mid-1900s seral class map was derived from county mapping efforts completed between 1947 and 1956 (Map 4). This seral stage distribution map contains the best information available on the vegetation pattern prior to intensive forest management. It also gives some insight into pre-fire suppression pattern. Appendix E shows how the mid-1900s seral stages were classified The mid-1900s map is not meant to serve as the desired future condition, but used in conjunction with disturbance regimes, provides us with a comparative context for current conditions.

We describe the classification of current conditions in the previous section and in Appendix C. To align the two data sources, we lumped current seral stages early-mid with mid and mature with old growth.

We also examined interior forest conditions at these two time periods. The previous "Interior Forest Late-Succesional Habitat" describes the method for buffering late-successional patches to arrive at functioning interior habitat. We selected the 120 meter band for comparison, as it delineates an area where most biological factors are not measurably affected by edge (Chen 1991, Chen et al. 1993).

Mapping standards are unknown for the mid-1900s seral distribution layer. Some forest classes were very general., making seral stage designations difficult. Interpretations of results are confined to noting general trends in late-successional and interior forest area, patch numbers and sizes over time.

Results

The results of area occupied by late seral and interior forest are displayed in Figures II-4 and II-5 and Table II-15. Comparison of mid 1900s and current condition:

Amount of late seral and interior forest

- In the mid-1900s, six LSRs had more than 70 % late seral habitat. Currently, no LSRs contain greater than 70% habitat.
- Only Whitcomb and Wiley displayed increases in late seral forest.
- Interior forest habitat decreased in 10 of 11 LSRs, with 6 LSRs displaying decreases greater than 50%.
- Wiley was the sole LSR displaying an increase in interior forest area.
- The proportion of late-successional forest in interior forest conditions has decreased in all LSRs.

Number of late seral and interior forest patches

- Late seral and interior forest patches have increased in number.

Late seral and interior forest patch sizes

- Late seral giant patches have decreased in all LSRs and adjacent landscapes.
- A shift to smaller late seral patches occurs in all LSRs.
- Giant patches of interior forest remain in only Quartzville and Horse Creek LSRs and adjacent landscapes.
- Interior forest patches show a dramatic decrease in patch size in all LSRs.

Table II-15. Acres of late seral habitat and acres of late-successional forest in interior forest habitat in the mid-1900s and currently.

		Late-successional Habitat		Late-successional Interior Habitat[1]	
LSR		Mid-1900s[2] Acres	Current Acres	Mid-1900's[2] Acres	Current Acres
Whitcomb	RO212	1,417	2,200	1,300	1,300
Quartzville	RO213	71,029	44,597	70,103	24,685
Jefferson	RO214	34,391	18,852	32,375	10,315
South Santiam	RO215	12,212	9,393	10,770	6,804
Wiley	RO216	81	424	60	294
Hagan	RO217	2,848	710	2,620	604
Horse Creek	RO218	19,255	16,769	19,089	11,635
Fall Creek	RO219	57,302	31,379	52,362	16,475
Waldo West	RO220	41,122	27,812	39,417	12,497
Hills Creek	R0221	15,405	9,867	15,388	4,671
Thomas Creek	RO246	962	740	909	589

[1] Interior forest is defined as that portion of a late seral patch after buffering in 120 meters from adjacent early seral patches

[2] Refers to the 1947-56 countywide vegetation surveys used to develop seral stages.

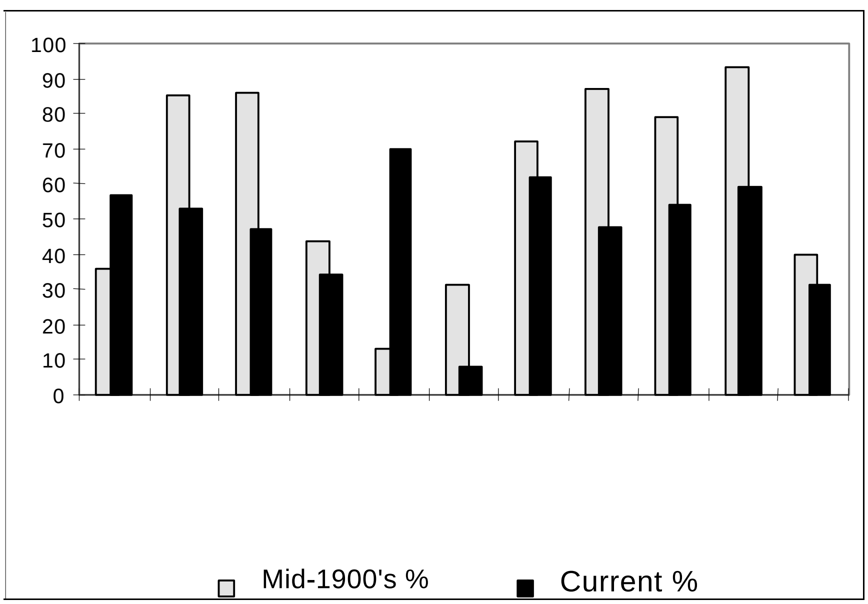


Figure II-4. Comparison of mid 1900's and current late-successional forest.

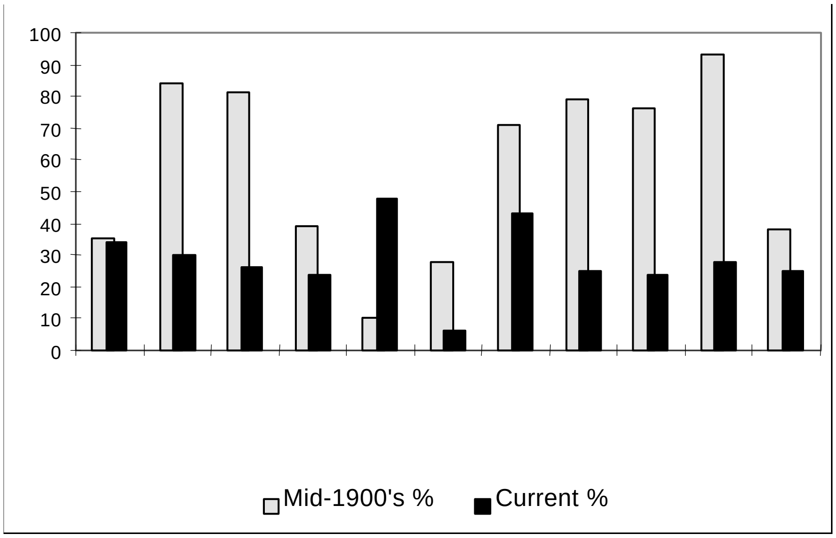


Figure II-5. Comparison of mid-1900's and current interior forest.

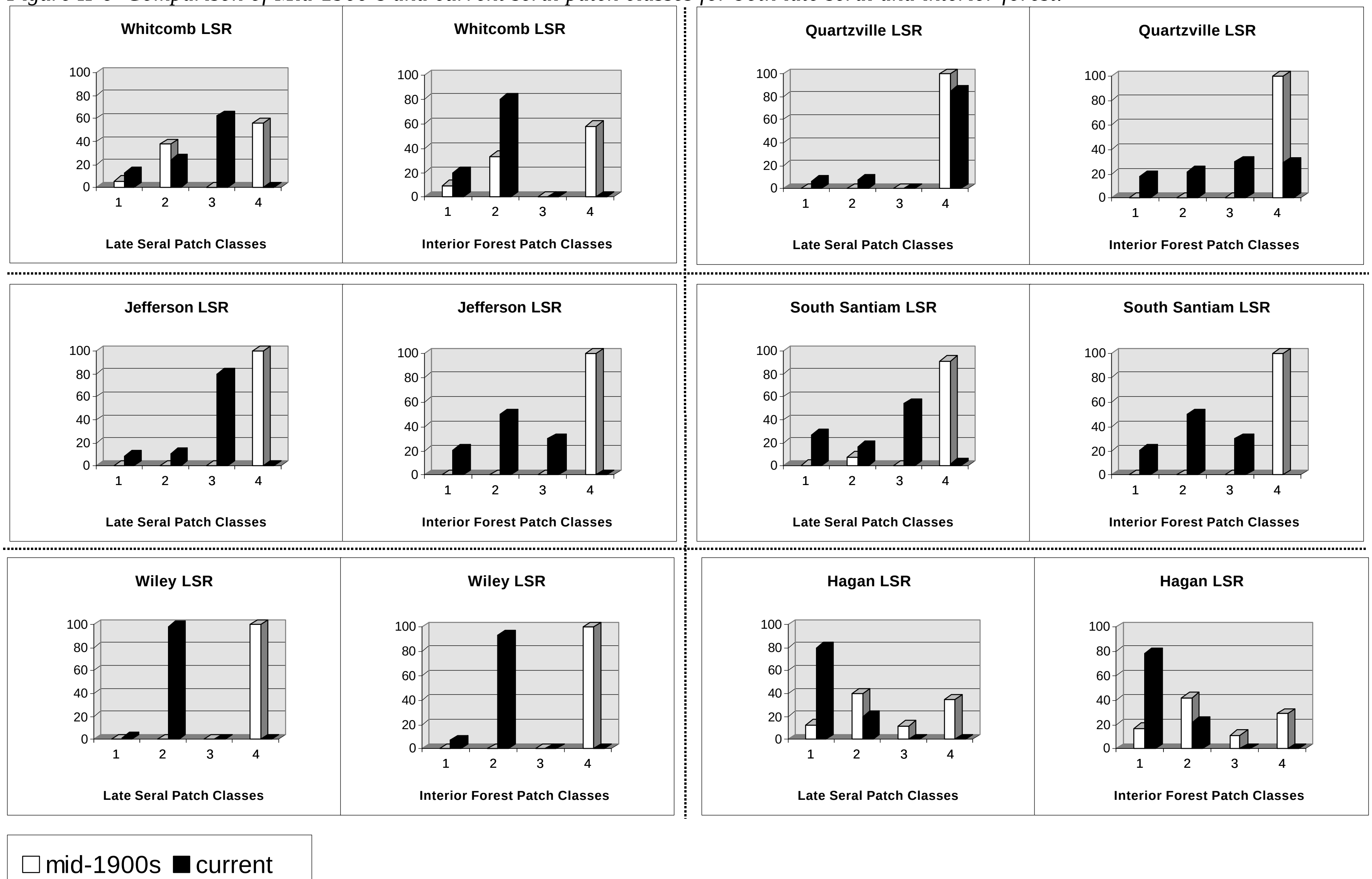
Table II-16. Number of late seral and interior forest patches in the mid-1900s and under current condition.

LSR		Number of late seral patches		Number of interior forest[1] patches	
		mid-1900s[2]	Current	mid-1900s[2]	Current
Whitcomb	RO212	6	17	6	11
Quartzville	RO213	2	389	2	280
Jefferson	RO214	1	314	3	287
South Santiam	RO215	8	345	11	318
Wiley	RO216	1	2	1	5
Hagan	RO217	15	28	19	24
Horse Creek	RO218	6	179	7	135
Fall Creek	RO219	3	152	9	272
Waldo West	RO220	6	223	10	274
Hills Creek	R0221	1	56	1	70
Thomas Creek	RO246	4	11	4	9

[1] Interior forest is defined here as that portion of a late seral patch after buffering in 120 meters from adjacent early seral patches

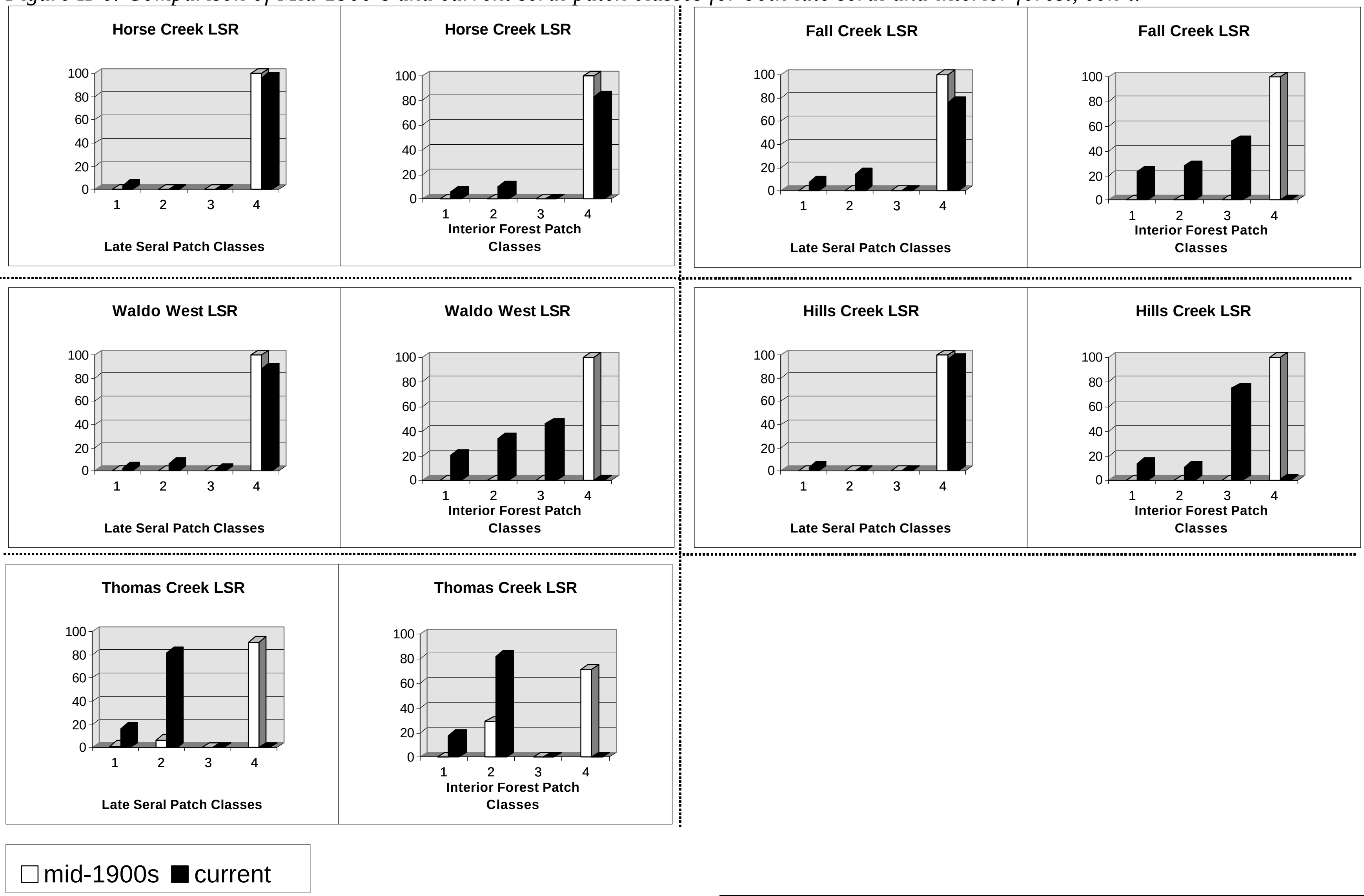
[2] Mid-1900s refers to the 1947-56 countywide vegetation surveys used to develop seral stage coverage

Figure II-6 Comparison of Mid-1900's and current seral patch classes for both late seral and interior forest.



Patch Classes: 1 = <125 acres; 2 = 126-1,000 acres;
3 = 1,001-10,000 acres; 4 = > 10,000 acres

Figure II-6. Comparison of Mid-1900's and current seral patch classes for both late seral and interior forest, con't.



Patch Classes: 1 = <125 acres; 2 = 126-1,000 acres;
3 = 1,001-10,000 acres; 4 = > 10,000 acres

Summary
A decrease in area, increase in patch numbers, and decrease in patch sizes contribute to the LSRs fragmentation.. Adding up the percent change in late seral and interior forest area, the increase in number of patches in late seral and interior forest, and the percent difference in mean interior forest patch size between the mid-1900s and current conditions, reveals that:

- Jefferson and Quartzville LSRs are the most fragmented when comparing the mid-1900s and current condition. In Quartzville, this is due to logging activities within the LSR and in adjacent lands. Fragmentation in Jefferson LSR could be the result of logging activity and fire activity in the area.

- Fall Creek, Hagan, Hills, Horse, South Santiam, Thomas Creek, and Waldo West LSRs have had a moderate level of change due to fragmentation. Most of this is due to logging activity. Hagan and South Santiam lie within large fire areas that burned in the early 1900s, which affected late seral distribution.

- Wiley and Whitcomb LSRs exhibited the least amount of fragmentation from the mid-1900s through today. The fact that these are some of the smallest LSRs may have affected this outcome.

ROAD DENSITY

Roads can negatively impact the function the successional forest, including CWD and interior forest function. Physical effects of roads resulting from the opening of the overstory canopy include increase in solar radiation, reduction of humidity, increase in wind speed, and potential windthrow. Biological impacts include road surfaces limiting the dispersal capability of some species (e.g., mollusks); reduction in habitat suitability due to human disturbance (e.g., elk); creation of pathways and sites for the spread of nonnative species associated with soil disturbance; erosion and associated sedimentation of streams; and reduction of snags and down wood adjacent to roads due to safety concerns or unauthorized removal. Local areas of high road density can suffer from the synergistic effects of closely spaced road openings. Roads also provide access to the LSRs for recreation, fire protection, and other administrative activities that are consistent with LSR objectives. All of the physical, biological and social impacts of roads will be addressed on a local, more site-specific basis by project designers and ID Teams at local administrative units.

Methods
We assessed road density based upon existing roads as identified in the agencies' GIS. Lack of knowledge of the road systems on nonfederal lands precluded a detailed consideration of roads outside of federal ownership. The results from this analysis are limited to roads in or immediately adjacent to the LSRs.

A method was developed that estimates the overall effects of roads. For each point within an LSR, we calculated the number of road miles within a 1 square mile circle (radius approximately 9/16 mi.) "moving window" around the point. To avoid an edge bias, roads immediately adjacent to the LSR boundaries are included in the sampling universe. Thus, each point is assigned a road density value, measured in miles per square mile, based on a 1 square mile circular window around the point. We then calculated the percent of points in each LSR that fell within 0, 0-2, 2-4, 4-6 and >6 mi./sq. mi. density ranges, and summary statistics.

Results

Table II-16 summarizes the results of these calculations of road density. The mean road density in these 11 LSRs ranges from 0.91 mi./sq. mi. for Wiley to 4.48 mi./sq. mi. for Thomas Creek. The range for the 8 largest LSRs is narrower (1.21 for Hagan to 3.75 for Fall Creek), but is still a threefold difference.

Table II-17. Percent of moving window sample points in each LSR for which calculated road densities fall within indicated density ranges (columns 2 through 6). Last 5 columns present summary statistics of road mileage within each LSR.

LSR Name		Road Density Ranges (miles/sq. mile)					Mean Road Density	Standard Deviation	Minimum Density	Maximum Density	Total Road Miles
		0	>0-2	2-4	4-6	>6					
Whitcomb	RO212	2	20	38	38	2	3.30	1.57	0.00	6.56	20
Quartzville	RO213	3	20	44	29	4	3.30	1.60	0.00	7.92	431
Jefferson	RO214	1	27	56	15	1	2.72	1.28	0.00	6.78	170
South Santiam	RO215	16	31	30	20	3	2.47	1.90	0.00	7.72	107
Wiley	RO216	2	92	6	0	0	0.91	0.64	0.00	2.72	1
Hagan	RO217	17	62	17	3	0	1.21	1.20	0.00	7.78	17
Horse Creek	RO218	6	41	47	5	0	2.10	1.22	0.00	5.86	88
Fall Creek	RO219	2	9	43	43	3	3.75	1.39	0.00	7.28	386
Waldo West	RO220	7	33	47	13	0	2.40	1.36	0.00	6.28	194
Hills Creek	RO221	0	14	68	18	0	3.09	1.02	0.00	6.20	80
Thomas Creek	RO246	0	4	30	47	18	4.48	1.40	0.60	7.43	17

Greater road density implies higher road impacts. Wiley and Hagan are the least impacted from roads since the majority of sample points in these LSRs have road densities of less than 2 miles per square mile. Horse Creek, Waldo West and South Santiam are moderately impacted from roads: the road densities greater than 2 miles per square mile fall mostly in the 2-4 mile per square mile range. Jefferson and Hills Creek show significant adverse impacts due to roads by their high proportion of acres (samples) in the 2-4 and 4-6 miles per square mile categories. Finally, Quartzville, Whitcomb, Fall Creek, and Thomas Creek suffer very high to extremely adverse effects due to roads, with greater than 75 percent of the area of each LSR having road densities greater than 2 miles per square mile, and greater than 33 percent of each LSR with road densities greater than 4 miles per square mile. Figure II-7 presents a graphic representation of road density groups by LSR, ranked from relatively least to greatest impacts. These data and the implications of their analysis corroborate the results based solely on the mean density as reported above.

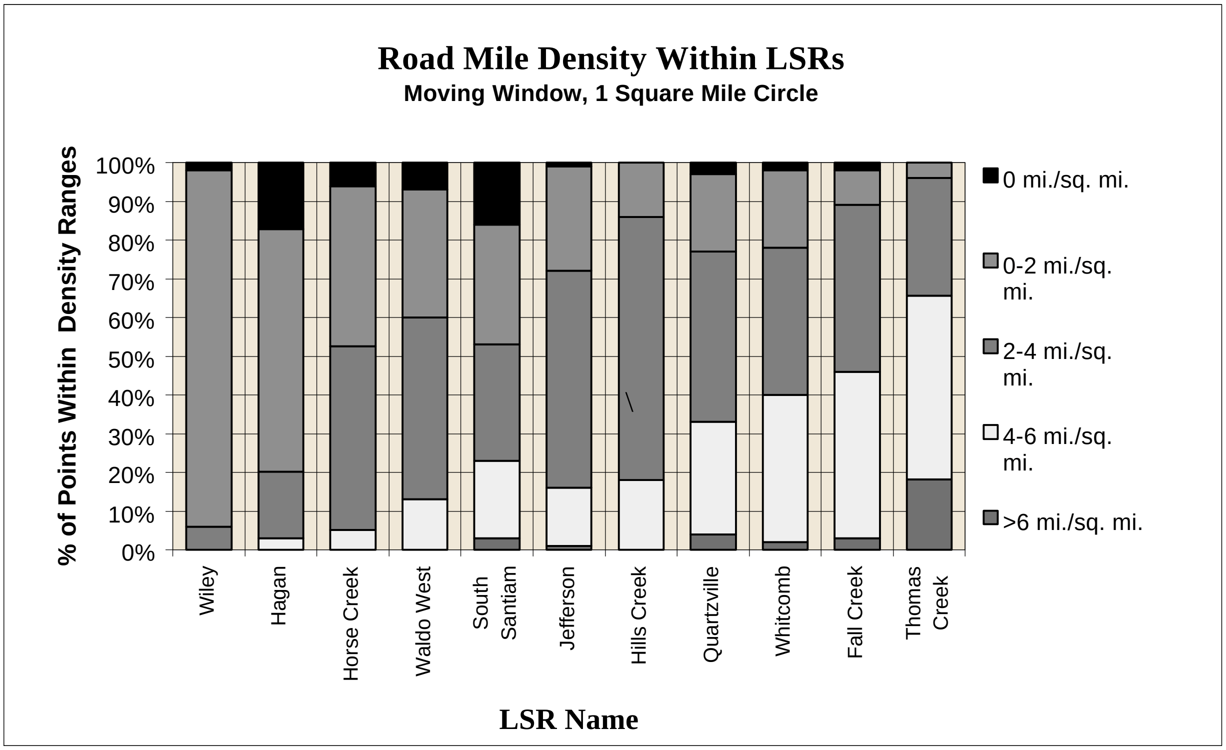


Figure II-7. Percent of moving window sample points in each LSR for which calculated road densities fall within indicated density ranges.

Management Implications

Much restoration of late-successional forest conditions from past effects of roads may be needed in Quartzville and Fall Creek, due to their relatively large size and high overall road density. Conversely, LSRs such as Horse Creek and Hagan require relatively little restoration, due to relatively lower road density and smaller acreage. While not universally true at all scales, these data may be used to establish relative priorities for addressing road maintenance and closure issues across this LSR network.

However, there is a message that should not be lost from these data: site-specific circumstances may justify road treatment in any of the LSRs to meet high priority, site-specific objectives. These data indicate that while there are significant differences in the mean road density between LSRs, there is little difference in the minimum density, maximum density (possible exception: Wiley), or standard deviation across the 11 LSRs (Table II-17). This suggests that each LSR has local sites that are heavily impacted by roads, and would benefit from appropriate treatment as determined from a consideration of site-specific circumstances by knowledgeable local specialists.

LSR COMPARATIVE ANALYSIS

To help us interpret current LSR conditions and to provide guidance for setting management priorities we summarized current LSR conditions by completing a comparative analysis of LSRs relative to one another using six attributes that reflect the overall function and suitability of the LSRs as late-successional refugia. The attributes were primarily based on concepts and LSR characteristics assessed in this chapter and on the connectivity assessment in Chapter III. We 1) assessed the comparative values of individual attributes by LSR, and 2) compiled the attribute values by LSR to attain a composite value for each LSR. All variables were reported proportionate to total LSR acres or total LSR late-successional acres, whichever was applicable to the assessment, to compensate for size difference between LSRs. A variable "Size" was developed for each LSR proportional to total acres in the LSR network as a weighting variable in the composite analysis. We used this information as an indication of management priorities by LSR (See recommendations in Chapter IV and Individual LSRs, Chapter VI).

SELECTED ATTRIBUTES

- **Size** (LSR acres/Total acres for large LSRs in the analysis area)
- **Late-successional Habitat** (LSR acres of late-successional habitat/Total individual LSR acres). This variable reflects the proportion of an LSR that is late-successional habitat.
- **Interior habitat** (LSR acres of interior habitat/LSR acres of late-successional habitat). This variable reflects the amount of late-successional interior habitat proportionate to total late-successional habitat in an LSR.
- **Road Density** (LSR acres with ≤ 2 mi/mi^2 /Total Individual LSR Acres). This variable reflects the proportion of the LSR with relatively low road density based watershed effects (McCammon 1993).
- **Effective Habitat** (Acres of reserve[1] late-successional habitat adjacent to each LSR/Acres late-successional habitat within the LSR + reserve late-successional habitat adjacent to each LSR). This variable reflects the amount of reserve status late-successional habitat associated with each LSR beyond the LSR boundary.
- **Connectivity** (Acres of late-Successional habitat buffered by 3 cells/Total LSR acres). See Connectivity section for more details.

For each LSR, the value of the above variables were displayed from highest (best condition) to lowest (worst condition). The value for individual LSRs was divided into the highest value among all LSRs to reflect the relative difference (**Relative Value**) across LSRs. To obtain a composite of all variables, we summed the values for all variables by LSR and designated them 1(best) to 11(worst).

RESULTS

Tables II-18 through II-24 summarize the results of these analyses and Map 16 displays the composite rankings of LSRs grouped by quartiles. Each variable is reported as described above. "Relative value" reports the relative value of an LSR to the other LSRs by reporting the quotient of the variable value for that LSR divided into the variable value of the LSR with the highest value. For instance, Table II-17 shows that Quartzville is the largest LSR, comprising 26 percent

[1] Reserve habitat includes LSRs, riparian reserves, administratively and congressionally reserved lands

of the total LSR network acres and that Wiley is the smallest LSR comprising less than one percent of the total LSR network acres and 135 times smaller than Quartzville.

Table II-18. LSR comparative analysis by Size (median = 0.082, 25% quartile = 0.012, 75% quartile = 0.158)

LSR		Size	Relative Value
Quartzville	RO213	0.255	1.0
Fall Creek	RO219	0.201	1.3
Waldo West	RO220	0.158	1.6
Jefferson	RO214	0.122	2.1
South Santiam	RO215	0.084	3.0
Horse Creek	RO218	0.082	3.1
Hills Creek.	RO221	0.051	5.0
Hagan	RO217	0.028	9.0
Whitcomb	RO212	0.012	21.2
Thomas Creek	RO246	0.007	34.4
Wiley	RO216	0.002	135.1

Table II-19. LSR comparative analysis by late-successional habitat (median = 0.53, 25% quartile = 0.34, 75% quartile = 0.60)

LSR		L-S Habitat	Relative Value
Wiley	RO216	0.70	1.0
Horse Creek	RO218	0.62	1.1
Hills Creek.	RO221	0.60	1.2
Whitcomb	RO212	0.57	1.2
Waldo West	RO220	0.54	1.3
Quartzville	RO213	0.53	1.5
Fall Creek	RO219	0.48	1.5
Jefferson	RO214	0.47	1.5
South Santiam	RO215	0.34	2.1
Thomas Creek	RO246	0.31	2.3
Hagan	RO217	0.08	9.0

Table II-20. LSR comparative analysis by interior habitat (median = 0.59, 25% quartile = 0.47, 75% quartile = 0.72)

LSR		Interior Habitat	Relative Value
Hagan	RO217	0.85	1
Thomas Creek	RO246	0.80	1.1
South Santiam	RO215	0.72	1.2
Horse Creek	RO218	0.69	1.2
Wiley	RO216	0.69	1.2
Whitcomb	RO212	0.59	1.4
Quartzville	RO213	0.55	1.5
Jefferson	RO214	0.55	1.6
Fall Creek	RO219	0.53	1.6
Hills Creek	RO221	0.47	1.8
Waldo West	RO220	0.45	1.9

Table II-21. LSR comparative analysis by road density (median = 0.28, 25% quartile = 0.47, 75% quartile = 0.15)

LSR		Road Density	Relative Value
Wiley	RO216	0.94	1.0
Hagan	RO217	0.79	1.2
South Santiam	RO215	0.47	2.0
Horse Creek	RO218	0.47	2.0
Waldo West	RO220	0.40	2.4
Jefferson	RO214	0.28	3.4
Quartzville	RO213	0.23	4.1
Whitcomb	RO212	0.22	4.3
Hills Creek	RO221	0.15	6.7
Fall Creek	RO219	0.11	8.6
Thomas Creek	RO246	0.04	23.5

Table II-22. LSR comparative analysis by effective habitat (median = 0.46, 25% quartile = 0.04, 75% quartile = 0.54)

LSR		Effective Habitat	Relative Value
Horse Creek	RO218	0.87	1
Hills Creek	RO221	0.55	1.6
Quartzville	RO213	0.54	1.6
Waldo West	RO220	0.48	1.8
South Santiam	RO215	0.46	1.9
Jefferson	RO214	0.46	1.9
Hagan	RO217	0.16	5.4
Thomas Creek	RO246	0.13	6.7
Fall Creek	RO219	0.04	21.8
Wiley	RO216	0.02	43.5
Whitcomb	RO212	0.01	87.0

Table II-23. LSR comparative analysis of within LSR connectivity (median = 0.92, 25% quartile = 0.80, 75% quartile =0.96)

LSR		Connectivity	Relative Value
Horse Creek	RO218	0.97	1
Hills Creek.	RO221	0.97	1.0
Wiley	RO216	0.96	1.0
Waldo West	RO220	0.96	1.0
Quartzville	RO213	0.95	1.0
Fall Creek	RO219	0.92	1.1
Jefferson	RO214	0.91	1.1
Whitcomb	RO212	0.91	1.1
South Santiam	RO215	0.80	1.2
Thomas Creek	RO246	0.60	1.6
Hagan	RO217	0.26	3.7

The composite analysis of LSR condition (Table II-24) indicates that Horse Creek , Wiley, and Waldo West represent the upper 25 percent, while Hagan and Thomas Creek represent the lower 25 percent when all LSRs were compared. The composite values can be used to weight decisions about management activities in LSRs that would otherwise be based solely on values of the individual variables. For example, Fall Creek has a relatively low value for Interior Habitat, reflecting fragmentation of existing late-successional habitat within the LSR. If we were to treat non-late-successional stands to accelerate stand growth to improve interior habitat conditions in Fall Creek, the composite value indicates that the treatment should not be done at the cost of other variables such as increasing road density, because Fall Creek cannot afford to be compromised further.

Table II-24. LSR composite analysis (median = 2.8, 25% quartile = 2.3, 75% quartile = 3.0 for Total Value)

LSR		Relative Size	L-S Habitat	Interior Habitat	Road Density	Effective Habitat	Connect -ivity	Composite Value	Relative Value
Horse Creek	RO218	0.082	0.62	0.69	0.47	0.87	0.97	3.7	1
Wiley	RO216	0.002	0.70	0.69	0.94	0.02	0.96	3.3	2
Quartzville	RO213	0.255	0.53	0.55	0.23	0.54	0.95	3.1	3
Waldo West	RO220	0.158	0.54	0.45	0.40	0.48	0.96	3.0	4
South Santiam	RO215	0.084	0.34	0.72	0.47	0.46	0.80	2.9	5
Jefferson	RO214	0.122	0.47	0.55	0.28	0.46	0.91	2.8	6
Hills Creek	RO221	0.051	0.60	0.47	0.14	0.55	0.97	2.8	7
Whitcomb	RO212	0.012	0.57	0.59	0.22	0.01	0.91	2.3	8
Fall Creek	RO219	0.201	0.48	0.53	0.11	0.04	0.92	2.3	9
Hagan	RO217	0.028	0.08	0.85	0.79	0.16	0.26	2.2	10
Thomas Creek	RO246	0.007	0.31	0.80	0.04	0.13	0.60	1.9	11

III. CONDITIONS OF LSRS FOR WILDLIFE AND PLANT SPECIES

CONNECTIVITY

The abilities of a species to disperse, survive, and reproduce are interrelated and elemental to its persistence. Our ability to assess the effect of connectivity habitat on the persistence of a terrestrial species is rudimentary, limited by the lack of viability population models that are sensitive to changes in connectivity habitat and limited by incomplete information for most wildlife species on dispersal capabilities, genetic interactions, and demographic parameters that influence successful dispersal of a species. We recommend reading Mellen (1996) for an in-depth review of current connectivity issues, hypotheses, theories, and discussion.

Despite lack of definitions and the limitations of tools and data to assess connectivity, the ability of a landscape to provide for species movement between refugia is a nagging component in addressing the function of a reserve system. While it may not be feasible to address connectivity for all species in great detail, it is reasonable to assess connectivity in broader terms to identify obvious connectivity breaks and outstanding areas of connection. We approached our coarse scale analysis of connectivity by identifying relevant limitations and assumptions and addressing connectivity within and between LSRs at a landscape scale to estimate where connectivity was most likely to be an issue for some wildlife species associated with late-successional habitat.

BETWEEN LSR CONNECTIVITY

Addressing connectivity between large LSRs (including connectivity to the South Cascades LSR, RO222 and Opal Creek LSR, RO209C on adjacent National Forests) represents a scale of analysis associated with potential wildlife and plant species dispersal and genetic exchange and is related to the capability of the reserve system to support interactions between populations over time. Connectivity is important to any habitat reserve system because it insures that the potential for dispersal and genetic exchange can occur between reserves, reducing the risk of inbreeding or extinction (Harris 1984). Elevating the function of separate reserves to that of an interactive network of reserves can help to insure viability of species for which the reserve system was designated.

We focused our assessment of connectivity in association with reserve lands[1] and gave specific attention to riparian reserves because of their standing in the ROD as connectivity habitat and because of the interest to manage these habitats.

[1] Reserve lands include LSRs, riparian reserves, administratively and congressionally reserved lands

Methods

Because of the many species-related variables that influence connectivity, it is ideal to assess connectivity relative to an individual species. Given the large scale, limited time, and lack of dispersal data for this assessment this was not practical and we designed our analysis as an indicator identifying the most obvious and important areas for connectivity at a landscape scale. We modeled connectivity using a dispersal distance that represented terrestrial wildlife species with limited dispersal capabilities. Small-bodied, low-mobility species such as small mammals are limited in their ability to disperse relatively far and are generally exposed to an increased likelihood of predation the farther they disperse. Other than very low mobility species such as nonvascular plants and invertebrates, amphibians probably represent the most limiting dispersers associated with the LSRs (Mellen 1996). In particular, we were concerned with the Oregon slender salamander (*Batrachoseps wrightii*) in association with the LSR network, including and north of Fall Creek LSR. This species is endemic to Oregon, associated to some degree with late-successional habitat, (large logs, the duff layer, and possibly soil condition) and has a patchy distribution primarily within the northwestern Oregon Cascades that is not well known or understood. While we know it is capable of subterranean travel, the types of soil and other habitat conditions that it will travel through have not been studied (Olson, pers comm., Vesely and Hagar 1998). We have so little information on the dispersal capabilities of this species, it is not realistic to model connectivity between LSRs based on this species and we have addressed habitat concerns for this species in other portions of this document. Since we could not find reliable data on amphibian dispersal, we used dispersal information on the red tree vole (*Arborimus longicaudus*) which indicates that this species will travel 350 m through most types of habitat (B. Biswell pers. comm.). Although it is likely the red tree vole is more mobile and uses different habitat components than amphibians we were confident in the dispersal data available for this species which was derived using radiotelemetry methods.

We used GIS and Arc View (Version 3.0, Environmental Systems Research Inst., Inc. Redlands, CA.) to denote all reserve habitat between LSRs (exclusive of 1 acre patches to reduce the influence of error in the data layer) buffered by 3 cells (191m) on all sides. Three cells roughly corresponds to half the distance a red tree vole is capable of dispersing within the limits of the cell size for the GIS data layers and was the most limiting dispersal distance we estimated. Each habitat patch was buffered by ½ the target dispersal distance so that the actual dispersal distance would be represented when any 2 patches were assessed. There after, we increased the estimated dispersal distances until connectivity between LSRs was obtained. We addressed potential and current connectivity.

Our connectivity assessment is not applicable to most portions of the AMA and HJA between South Santiam, Horse Creek, and Hagan LSRs. The Blue River Landscape Project, which includes the HJA, addressed connectivity at a more detailed ecological scale than our assessment. The Blue River Landscape Project included re-allocation of riparian reserves and matrix lands to mimic a patch distribution within a natural range of variability based on historic disturbance regimes such as fire. The re-allocations included elimination of some riparian reserves and designation of small-basin reserves intended for contiguous blocks of undisturbed habitat. We did not have data on the re-allocations to include in our analysis. Although the Blue River Project did not address LSR connectivity specifically, we assume the Plan provides for LSR connectivity because:

"Spatial and temporal connectivity of habitats will be retained and restored across the landscape. Biological diversity of habitats in the form of seral stages, vertical and horizontal structures, habitat types, and species richness including rare species, will generally be greater under the Landscape Plan than the Interim Plan."

Additionally our connectivity assessment did not account for the HJA's uniqueness in functioning as additional reserve habitat regardless of land management allocations.

Using GIS to denote all reserve lands between LSRs (large), we identified breaks in reserve connectivity between LSRs from a progression or combination of GIS coverages to answer specific questions associated with connectivity. The GIS coverages and associated questions were:

1. All reserve lands regardless of seral condition buffered by 3 (191 m), 6 (382 m), 7 (445 m), 13 (832 m), 15 (960 m), and 38 cells (2.4 km) to address the questions: What is the potential of reserve lands to provide connectivity between large LSRs starting with a dispersal distance reflective of small-bodied, low-mobility species (382 m, patches buffered by 3 cells) and increasing that distance until connectivity is met between each pair of large LSRs?
2. All reserve land in late-successional habitat buffered by 3, 6, 7, 13, 15, and 38 cells to address the question: What is the current condition of reserve lands for providing connectivity between large LSRs given the limitations of potential connectivity described in #1 above?
3. Distinguish riparian reserves in late-successional condition from other reserve lands in late-successional habitat buffered by 3, 6, 7, 13, 15, and 38 cells to address the question: Where are riparian reserves currently providing late-successional habitat for connectivity and small refugia between LSRs?
4. Number 3 above overlaid with core-area LSRs: How well are core-area LSRs connected to the larger LSR network?
5. For potential and current habitat coverages, we identified the most direct route between LSRs (Where within LSR connectivity was an issue, LSRs were divided into blocks reflecting within LSR breaks in connectivity and this phase of the assessment was done between blocks) and through contiguous habitat of each coverage to address the questions: What is the percentage of difference between the closest direct-line distance in potential habitat and the closest direct-line distance in current habitat between LSRs? Where are the LSR network potential and current pathways of shortest distance between LSRs?
6. The conglomerate of potential and current connectivity results in #5 above with a layer showing areas of high elevation (> 1219 m/4,000 ft) and/or cool silver-fir zones to address the question: Where are areas critical to potential and current connectivity of low elevation habitat.

We assessed connectivity to identify key areas of concern using the following criteria.

1) Potential connectivity distance between 2 LSRs, long distances being of greater concern over short distances, recognizing that the longer the distance the greater the chance that connectivity habitat, especially midway between LSRs, also serves as refugia.

2) Real and percent change between current and potential connectivity, the greater the difference the less direct the current connection is between LSRs.

3) Differences in #2 above resulting in shifts across landscape features, such as shifts across drainages.

4) Proportion of pathway (current or potential) within high elevation and/or cool silver-fir zones. Although high elevation connections are important, low elevation connections are at higher risk and are more representative of species associated with the reserve system.

5) Congestion of connectivity (nodes) for several LSRs, where multiple connections converge repeatedly at 1 point or pass through the same area.

6) Unique importance of a drainage to potential connectivity, where adjacent ownership or habitat conditions reduce options for connectivity in other drainages.

We made the following assumptions in completing this analysis:

- 382 m is a reasonably restrictive distance representing dispersal capabilities of small-bodied, low-mobility species and represents the most limiting dispersal capabilities for the species we addressed and that we had data for.
- Species with less limiting dispersal capabilities would be accounted for by the other distances we addressed.
- Connectivity within LSRs was a separate issue and could be dealt with independently of connectivity between LSRs.
- We assume late-successional species which are very poor dispersers such as some representatives of non-vascular plants and invertebrates will benefit from this analysis but are reliant on full recovery of LSRs and riparian reserves regardless of the location to benefit their persistence. We assume analysis for these species will be conducted at a finer scale.
- While it is unrealistic to expect all stands are equal in value as connectivity habitat, given the coarse scale and objectives of this analysis, all habitat analyzed for connectivity was assumed equal in dispersal value, regardless of patch size, juxtaposition, amount of stand edge, or stand characteristics.
- The baseline vegetation data used for the analysis was a reasonable representation of what exists on the ground.

Results for Potential Connectivity

The majority of LSRs have potential for connectivity given a dispersal distance of 382 m (Map 13). Currently (Map 14), connectivity does not equal potential connectivity between LSRs and there are varying differences between the most direct connections between LSRs for current and potential connectivity in some areas (Table III-1, Appendix L).

Table III-1. The distance of the most direct routes between LSRs through current and potential connectivity habitat and their differences for select connections.

LSR Connection	Best Potential Dispersal Dist. Buffer	Current (mi)	Potential (mi)	Difference (mi)	% Difference
Wiley - S.Santiam W.	4.8 km (38 cells)	6.7	6.7	0	0
Whitcomb-lg - Quartzville W.	891m (7 cells)	3	2.9	0.1	3
Horse Cr. - Waldo W.	382 m (3 cells)	13.5	13.3	0.2	1
Whitcomb lg - Quartzville E.	891 m (7 cells)	8.3	8.1	0.2	2
Waldo W. - 222 N	382 m (3 cells)	7.8	7.2	0.6	8
Quartzville E. - S. Santiam E.	382 m (3 cells)	7.9	7.3	0.6	8
Whitcomb-sm - Quartzville W.	891 m (7 cells)	3.2	2.5	0.7	22
Whitcomb sm - Quartzville E.	891 m (7 cells)	8.5	7.5	1	12
Fall Cr. E. - 222 N	382 m (3 cells)	11	9.8	1.2	11
Horse Cr. Lg - Fall Cr. E.	382 m (3 cells)	9.6	8.4	1.2	12
S. Santiam C. - Hagan E.	763 m (6 cells)	11.1	9.8	1.3	12
Hills Cr. - 222 S	382 m (3 cells)	8.8	7.5	1.3	15
Thomas N. - Quartzville W.	1.7 km (13 cells)	11.2	9.1	2.1	19
Waldo W. - 222 mid	382 m (3 cells)	17.7	15.3	2.4	14
Fall Cr. E. - Waldo W.	382 m (3 cells)	8.2	5.8	2.4	29
Fall Cr. W. - Waldo W.	382 m (3 cells)	16.8	13.4	3.4	20
Jeff N. - S. Santiam E.	382 m (3 cells)	24.6	20.9	3.7	15
Quartzville E. - S. Santiam C.	382 m (3 cells)	11.2	7.4	3.8	34
Waldo W. - Hills Cr.	382 m (3 cells)	6.7	2.7	4	60
Waldo W. - 222 S	382 m (3 cells)	20.3	16.2	4.1	20
S. Santiam W. - Hagan E.	763 m (6 cells)	15.5	11.3	4.2	27
Quartzville E. - S. Santiam W.	382 m (3 cells)	14.8	10.4	4.4	30
Jeff N. - S. Santiam C.	382 m (3 cells)	26.4	21.8	4.6	17
Jeff S. - S. Santiam E.	382 m (3 cells)	22.1	17.4	4.7	21
Quartzville W. - S. Santiam E.	382 m (3 cells)	21.2	16	5.2	25
Hills Cr. - 222 mid	382 m (3 cells)	13.7	8.4	5.3	39
Jeff S. - S. Santiam C.	382 m (3 cells)	24	18.3	5.7	24
S. Santiam C. - Hagan W.	1.9 km (15 cells)	18.7	12.6	6.1	33
Fall Cr. W. - 222 N	382 m (3 cells)	16.2	9.5	6.7	41
Jeff N. - S. Santiam W.	382 m (3 cells)	31.9	24.8	7.1	22
Quartzville E. - Jeff N.	382 m (3 cells)	16.6	9.2	7.4	45
S. Santiam W. - Hagan W.	1.9 km (15 cells)	21.1	13.1	8	38
Jeff S. - S. Santiam W.	382 m (3 cells)	29.5	21.3	8.2	28
Hills Cr. - 222 N	382 m (3 cells)	16.3	8.1	8.2	50
Quartzville W. - S. Santiam C.	382 m (3 cells)	24.5	16	8.5	35
Quartzville E. - Jeff S.	382 m (3 cells)	14	5.3	8.7	62
Quartzville W. - S. Santiam W.	382 m (3 cells)	28.1	19	9.1	32
Fall Cr E. - Hills Cr.	382 m (3 cells)	27.5	18.4	9.1	33
S. Santiam E. - Horse Cr. Lg.	382 m (3 cells)	25.9	16.2	9.7	37
S. Santiam C. - Horse Cr. Lg.	382 m (3 cells)	25.3	15.6	9.7	38
Jeff S. - Horse Cr. Lg.	382 m (3 cells)	42	32.3	9.7	23
Hagan E. - Horse Cr. Lg	763 m (6 cells)	18.5	7.9	10.6	57
Fall Cr. E. - 222 mid	382 m (3 cells)	35	24.4	10.6	30
Fall Cr. E. - 222 S.	382 m (3 cells)	40.2	29.4	10.8	27
Fall Cr. W. - Hills Cr.	382 m (3 cells)	36.1	24.3	11.8	33
Fall Cr. W. - 222 mid	382 m (3 cells)	41.9	29.7	12.2	29
S. Santiam W. – Horse Cr. Lg.	382 m (3 cells)	33.8	21.5	12.3	36
Fall Cr. W. - 222 S	382 m (3 cells)	47.1	34.5	12.6	27
Quartzville W. - Jeff N.	382 m (3 cells)	31.3	18.2	13.1	42
Quartzville W. - Jeff S.	382 m (3 cells)	28.9	15	13.9	48
Hagan E. - Fall Cr E.	763 m (6 cells)	33.4	14.6	18.8	56

SUMMARY OF MAJOR CONNECTIONS FOR THE LSR NETWORK

Areas of currently unconnected late-successional reserve habitat between LSRs (Map 15) are important to address in project or watershed planning, especially where there is potential for improving LSR connectivity (Map 14). Table III-1 provides some site specific information for setting priorities in addressing connectivity and a summary of some major areas associated with LSR connectivity is provided below. We expect this information and the management recommendations in Chapter IV will be applied in balance with local knowledge and understanding of an area or project. The lines of connection addressed in Table III-1 are not meant to be static pathways, but are expected to be guideposts for determining the most obvious areas to address LSR connectivity overtime at a drainage or watershed scale. Application of information from Map 14 and 15, local knowledge, and site specific assessments will be necessary to determine the best ways to improve or retain connectivity of late-successional reserve habitat.

Whitcomb - Quartzville

Best case connectivity is achieved at a 891 m (7 cells) dispersal distance.
Potential and current connectivity between big Whitcomb and Quartzville (Table III-1 and Appendix L) represent relatively short and small differences, yet connectivity between Whitcomb and Quartzville is essential to avoid isolation of Whitcomb. High elevation/cool silver-fir zones are not a problem.

Quartzville - Jefferson

Direct, relatively short connections between Quartzville and Jefferson (approximately 5.3-9.2 mi.) through low elevation/western hemlock, Douglas-fir plant associations are possible with a dispersal distance of 382 m. Currently the most direct connectivity is achieved (approximately 14-16.6 mi.) to the south of the LSRs. The difference between current and potential connectivity represents a 42 - 62 percent change and represents a major shift across several drainages. A major proportion of the current connection is in high elevation and/or cool silver-fir zone.

Currently, Upper North Santiam/Big Meadows watershed is providing the majority of low elevation connectivity habitat. Potentially, Twin Meadows, Bugaboo, Middle Blowout, and Idanha watersheds will provide the most direct, low elevation connections between Quartzville and Jefferson LSRs.

Reserve habitat between LSRs in the southern portion of this area may be important as refugia because of the connectivity distance between LSRs (18 - 32 mi.).

Upper North Santiam/Big Meadows and Twin Meadows watersheds also provide potential low elevation connectivity to South Santiam and Horse Creek LSRs.

Quartzville - South Santiam

Direct, relatively short connections between Quartzville and South Santiam (approximately 7.3 mi.) through low elevation/western hemlock, Douglas-fir plant associations are possible given a dispersal distance of 382 m. Currently connectivity is achieved relatively directly and over a short distance (approximately 7.9 mi.) between the eastern portions of the LSRs. The difference between current and potential connectivity represents a 7.6 percent shift and reflects a shift between drainages. The current pathway is almost entirely in high elevation and/or cool silver fir zone.

Currently, only a small portion of Upper Mid Santiam and Parks watersheds provide low elevation/western hemlock, Douglas-fir plant associations. Potentially, Upper Mid-Santiam, Sheep, and Donaca watersheds will provide more direct connectivity within low elevation/western hemlock, Douglas-fir plant associations. Because of the checkerboard ownership in this area, options for connectivity are limited and federal lands within these watersheds are essential to providing LSR connectivity.

Mid-Santiam and Sheep watersheds also provide potential direct low elevation/western hemlock, Douglas-fir plant associations connectivity to Jefferson.

South Santiam - Horse Creek

We assume LSR connectivity will be provided via the Blue River Project and the HJA. The area south and southwest of the Experimental Forest will be important for insuring connectivity to Horse Creek LSR. Landownership and habitat conditions in this area may preclude direct connectivity for some species.

Direct, moderately long connections between South Santiam (East) and Horse Creek, to the east of HJA and Blue River Project are possible (approximately 16.2 mi.) primarily through low elevation/western hemlock, Douglas-fir plant associations given a dispersal distance of 382 m. Currently connectivity is achieved indirectly (approximately 25.9 mi.) to the east of the LSRs. The difference between current and potential connectivity represents a 37 percent change and represents a shift between drainages. A small proportion of current connectivity is in high elevation and/or cool silver-fir zone.

Currently, the west portions of Boulder/Frissel and Lost Creek/White Branch watersheds provide the majority of connectivity in low elevation/western hemlock, Douglas-fir plant associations. Potentially, these same areas, Deer Creek, and the eastern portion of Lower Horse Creek will provide the most direct, low elevation connections between South Santiam and Horse Creek LSRs.

Specifically, Spring Creek drainage in the East portion of Lower Horse Creek is a key potential connection, and functions as a node for several potential connectivity routes between LSRs.

South Santiam West - Hagan

We assume connectivity is primarily achieved through the Blue River Project, additionally, connectivity to the west of this project may be important.

The current connectivity between central and west South Santiam and Hagan LSRs range from 9.8 -13 mi. and potentially from 11-21 mi., representing a 12-38 percent change, given a dispersal distance of 763 m (6 cells). Currently in Upper Blue River, Tidbits, Calapooia, and

Blue River Reservoir watersheds over 50 percent of the connectivity is high elevation and/or cool silver-fir zone.

Important watersheds for potential connectivity are Upper Canyon Creek and Calapooia watersheds. Blue River Reservoir watershed is important as a node for all connections through low elevation habitat and currently connections are forced to circumvent Hagan through the area south of the LSR because of habitat conditions of reserves along Hagan's north boundary.

Horse Creek - Fall Creek

Current connectivity is 9.6 mi. and potential is 8.4 mi., representing a difference of 1.2 mi. (12%). Watersheds associated with current and potential connectivity are the same, with the biggest potential for improvement along the west slope of Cougar Reservoir, along Lytle Creek, Indian Creek, Starr, and Hardy Creek

The highest area of congestion for the entire LSR network is including and between Lower South Fork McKenzie, Cougar Res. (especially west of Cougar Reservoir), Hardy Ridge/Rebel Creek, and Upper Christy Watersheds. Also Homestead Camp, Augusta, French Pete, Quartz Creek Devil's Canyon, Fisher Creek watersheds are essential for connectivity with the southern portion of Horse Creek LSR. Potential and current connectivity for 382 - 891 m dispersal distance from the northern portion of the LSR network to the southern portion of the LSR network is reliant on this area. The sensitivity of this area for LSR connectivity is compounded by a predominant high elevation/silver-fir band running southeast from Fall Creek LSR, with Augusta Drainage providing the only low elevation/non silver fir connection north and south. Lower elevation connectivity habitat in the above watersheds may serve as refugia in this area because of the elevation/vegetation bottleneck to the south.

Horse Creek - Waldo West

Direct, moderately long connections between Horse Creek and Waldo West (approximately 13.3 mi.) primarily through a mix of high and low elevation are possible with a dispersal distance of 382 m. Currently connectivity is achieved relatively directly (approximately 13.5 mi.) through areas slightly higher in high elevation/ cool silver-fir habitat. The difference between current and potential connectivity represents a 1.5 percent change and represents a shift between watersheds.

Potential and current connectivity for several LSRs are important especially in Fisher and Devil's Canyon Watersheds. See above under Horse Creek - Fall Creek

Fall Cr - Waldo West

Potential connectivity through low elevation habitat over a relatively short distance (5.8 mi.) is possible. Currently connectivity is achieved indirectly (8.2 mi.) representing a 29.3 percent difference from potential and approximately 30 percent of the distance is in high elevation/cool silver-fir zones.

Currently Upper Christy and the eastern portion of Devil's Canyon watersheds are important to connectivity. Potentially, lower elevation habitat in Upper Christy, Lower Christy and the eastern portion of Devil's Canyon watersheds between Fall Creek and Waldo West LSRs are important connectors. Lower elevation connectivity habitat may serve as important refugia in this area because of the elevation/vegetation bottleneck to the northeast.

The southeast portion of Fall Creek LSR provides direct current and potential connectivity between several LSRs.

Fall Creek - 222

The potential for connectivity between the eastern portion of Fall Creek and 222 is a relatively short distance (9.5 mi.) but connectivity is currently indirect and several watersheds away (16.2 mi.) representing a 41.4 percent difference. High elevation/cool silver-fir zones are a minor component of this area.

Because of the size and shape of watersheds in this area related to connectivity, listing them would not be beneficial. See Appendix L for more detailed locations of connectivity.

Fall Creek - Hills Creek

Potential connectivity is relatively long (18.4 mi.) with little to no effect from high elevation/cool silver-fir habitat. Currently connectivity is achieved indirectly (27.5 mi.) representing a 33 percent difference. Lower Salmon, Lower Salt, and Hills Creek watersheds are important for achieving potential connectivity.

Because of the long span between these LSRs, connectivity habitat may serve as refugia.

Waldo West - Hills Creek

Potentially, these LSRs could be connected over a short distance (2.7 mi.) of low elevation habitat. Currently connectivity is achieved indirectly (6.7 mi.) representing a 59.7percent difference. Current connectivity passes through roughly 50percent high elevation/cool silver-fir habitat. Potential connectivity is possible through the eastern portion of Lower Salt Creek and the western portion of Middle Salt Creek Watersheds.

The area in these two watersheds is a key node for connectivity to LSRs to the north.

Hills Creek - 222

Connectivity between Hills Creek and 222 north is currently 16.3 mi. and is potentially 8.1 mi. reflecting an 8.2 mi. difference and a 50 percent change. Potential connectivity improves low elevation habitat connection over current connectivity. Watersheds important to improving connectivity are Hills Creek and Middle Fork Willamette (Hills Creek res.).

Hills Creek - 222 mid and 222 south connectivity also shows improvement between current and potential, but is compounded by high elevation/cool-silver fir zone adjacent to Hills Creek LSR.

Hills Creek and Middle Fork Willamette (Hills Creek Res. and Pine) are important watersheds for connecting the LSR network to the southern portion of 222.

Waldo West - 222 mid

Currently, connectivity is achieved at 17.7 mi. and could potentially be achieved at 15.3 mi., representing a 2.4 mi. (13.5%) difference, given a 382-m dispersal distance. The shift is not large but the distances are relatively long and connectivity habitat may also be especially important as refugia. Hills Creek and Middle Fork Willamette (Hills Creek Res. And Pine) are important watersheds for addressing connectivity.

Core LSRs

The core LSRs are important additions in providing connectivity and refugia between the large LSRs. There are 414, core LSRs and 376 of these are connected to some portion of the network of late-successional reserve habitat given a dispersal distance of 382 m. Thirty-eight of these core LSRs are not connected to the network given a dispersal distance of 382 m, and are primarily in isolated BLM blocks or on Forest Service land between Quartzville and Jefferson LSRs. The potential for connectivity to the network for most of the 38 core LSRs is possible once riparian reserves have recovered to late-successional conditions.

WITHIN LSR CONNECTIVITY

Allocating an area as a LSR does not automatically transform the area into functional habitat for the array of plant and animal species associated with the habitat for which the reserve was designated. Addressing connectivity within LSRs (large LSRs only) represents a scale of analysis that is primarily concerned with movement and dispersal activities assumed within a self-sustaining population, and is related to the capability of the reserve to support an interactive population over time. Fragmentation of late-successional habitat within LSRs has produced breaks in habitat that can be larger than some species are willing to negotiate. It was our objective to identify the most outstanding breaks within LSRs to help prioritize and prescribe treatments and protective measures to correct or compensate for the habitat breaks quickly. We identified areas where gaps in connectivity were obvious. While fragmentation and connectivity are related issues, we have dealt with overall fragmentation within LSRs in other sections of this document.

Methods

We used GIS and Arc View (Version 3.0, Environmental Systems Research Inst., Inc. Redlands, CA.) to denote all late-successional habitat within each LSR (exclusive of 1 acre patches to reduce the influence of error in the data layer) buffered by three cells (191m, ½ 382 m dispersal distance) on all sides. Three cells roughly correspond to half the distance a red tree vole is capable of dispersing within the limits of the cell size for the GIS data layers.

Areas within an LSR that fell outside connected habitat described above were identified as unconnected habitat and as having a lower likelihood of providing late-successional connectivity than connected areas within the LSR. We calculated the percentage of unconnected habitat acres on Federal and on non-Federal lands in each LSR as a percentage of the total acres (Federal and non-Federal) within an LSR.

We made the following assumptions in completing this analysis:

- 382 meters is a reasonably restrictive distance representing the dispersal capabilities of small-bodied, low-mobility species and represents the most limiting dispersal capabilities for the species we addressed and had dispersal data to apply to the analysis.
- We assume late-successional associated species that are very poor dispersers such as some representatives of non-vascular plants and invertebrates will benefit to some degree from this assessment. We assume it is likely that their persistence within an LSR will depend on the extent of late-successional habitat, especially where interior habitat occurs, and an indicator of how well representatives of these species will interact can be derived from the LSR Comparative Analysis concerning acres of late-successional and interior habitat.

- While it may be unrealistic to expect all stands are equal in value as connectivity habitat, given the scale, available data, and objectives of this analysis, all habitat analyzed for connectivity was assumed equal in dispersal value, regardless of patch size, juxtaposition, amount of stand edge, or stand characteristics.
- The baseline vegetation data used for the analysis was a fair representation of what exists on the ground.

Results

The GIS layer we created from our assessment reflected areas where connectivity of late-successional habitat was deficit within each LSR (Map 13) given a dispersal distance of 382 meters. All LSRs showed areas lacking connectivity, some more severe than others. We reported lack of connectivity as the percent Public land within an LSR outside of late-successional habitat and associated 191 meter (0.5 x 382 m) buffer. Within LSR connectivity also is affected by non-federal lands (Table III-2).

Table III-2. Percentage of unconnected late-successional habitat for federal and private land within LSRs (listed in descending order).

LSR Name	LSR Number	% unconnected habitat – federal land	% unconnected habitat - private land
Hagan	RO217	74	-
Thomas Creek	RO246	40	-
South Santiam	RO215	20	6
Whitcomb	RO212	9	-
Jefferson	RO214	9	5
Fall Creek	RO219	8	1
Quartzville	RO213	5	4
Waldo West	RO220	4	-
Wiley	RO216	4	-
Hills Creek	RO221	3	-
Horse Creek	RO218	3	1

SUMMARY

Within LSR connectivity of late-successional habitat is important to address through habitat mitigation. Hagan and Thomas Creeks have the least connected habitat of the LSRs. This can be attributed to the overall absence of late-successional habitat within these LSRs. Hagan is currently transitioning from mid- to late-seral condition and there is probably little we can do to accelerate its development as an LSR. In the case of Thomas Creek, increasing late-successional habitat wherever it is reasonable to do so even if connectivity does not benefit would be an outstanding priority.

Connectivity within Whitcomb, Fall Creek, South Santiam, Jefferson, and Quartzville is negatively impacted by the amount and juxtaposition of non-connected late-successional habitat on federal lands. In the cases of South Santiam, Jefferson, and Quartzville connectivity is further impacted by private in-holdings. These conditions result in isolated blocks of habitat or blocks of habitat that are connected by relatively narrow causeways. Enhancing connectivity and avoiding further degradation of connectivity on federal lands within these LSRs is a priority in improving the function of these LSRs.

LATE-SUCCESSIONAL SPECIES

FEDERALLY LISTED SPECIES

NORTHERN SPOTTED OWL (*STRIX OCCIDENTALIS*)

The LSR land allocation of the NFP was established, in part, as a means of achieving the conservation and recovery of the northern spotted owl, a species listed as threatened under the Endangered Species Act of 1973, as amended (ESA). Several previously proposed management strategies have indicated the need to maintain clusters of owls well distributed across the landscape, so as to provide both demographic and genetic interchange among owls throughout their range. Detailed analyses of reserve networks as a strategy to conserve and recover populations of the northern spotted owl have been accomplished as part of the Interagency Scientific Committee Report (Thomas, et al. 1990), the Draft Recovery Plan for the Northern Spotted Owl (USDI, 1992b), and the NFP FSEIS. It should be noted that neither the ISC report nor the draft recovery plan have been adopted as official policy, although many of the ecological concepts and principles and management objectives upon which these strategies are based have been incorporated into the NFP. Substantial analysis of the ecological principles and management implications of these strategies, including the reserves upon which they are based, are available in these cited documents and will not be repeated here.

Critical habitat for the northern spotted owl was officially designated on January 15, 1992 (USDI, 1992a) and provides regulatory requirements to federal agencies related to conserving the primary constituent elements of spotted owl habitat.

We summarize existing spotted owl habitat conditions within the LSR network in the Mid Willamette LSRA area, and provide recommendations related to spotted owl conservation, so that activities within these LSRs will be beneficial to the northern spotted owl, a late-successional forest associated species. We also provide a summary of spotted owl Critical Habitat Units (CHUs) in order to assess the role of these LSRs in meeting legal requirements for maintaining the primary constituent elements of critical habitat. The purpose of this is to provide baseline information on the degree of overlap of CHUs with LSRs and non-LSR allocations in the analysis area.

The ecological premise for using reserved landscapes such as LSRs for conservation of rare species reflects current theory of island biogeography, which requires that each “island” of habitat support a group of interacting, reproductive pairs such that the probability of local extinction is low, and that concurrent extinction on all ‘islands’ within a province is very low.

The FSEIS reported the number of owl sites known to exist within each reserve at the time of that analysis. The number of owl sites is based on data from surveys conducted in suitable owl habitat across the landscape, with the determination of actual sites based upon protocol procedures for resolving the status of resident singles or pairs of owls. The FSEIS also reported the acreage of suitable habitat within each LSR. The details and assumptions of those analyses can be found in that document. Table III-3 reports these estimates of suitable habitat and numbers of sites based on either pairs or territorial singles, differentiated for each LSR within the analysis area.

Table III-3. Previously reported estimates of suitable habitat and owl sites likely to be occupied within Mid Willamette LSRs [1.]

Late-Successional Reserve Name	LSR Number	Total Acres in LSR	Acres of Suitable Habitat	Owl Sites Reported in FSEIS		
				Pairs	Singles	Total
Thomas Creek	RO246	2,095	1,344	2	0	2
Whitcomb	RO212	3,598	2,412	2	0	2
Quartzville	RO213	83,700	53,217	23	3	26
Jefferson	RO214	39,735	20,836	18	3	21
South Santiam	RO215	26,687	20,164	7	2	9
Wiley	RO216	514	356	0	0	0
Hagan	RO217	8,975	8,382	1	0	1
Horse Creek	RO218	27,162	19,057	8	3	11
Fall Creek	RO219	66,501	32,895	20	9	29
Waldo West	RO220	51,793	25,145	9	9	18
Hills Creek	RO221	16,724	10,121	7	3	10
Totals (All LSRs)		**327,484**	**193,929**	**97**	**32**	**129**

[1] Data reported here are from Table G-3, page G-16, of the Final Supplemental Environmental Impact Statement (FSEIS), February 1994.

Current habitat conditions within LSRs

Our analysis of existing habitat conditions within the LSRs uses existing data on categories of suitable habitat, based upon a classification system in place within each administrative unit. Forest Service and BLM biologists classified forest stands into several categories of nesting, roosting, foraging and nonsuitable habitats, based upon objective assessments of stand structural conditions, stand age, and owl occupancy status. These criteria were supplemented by somewhat more subjective standards when professional experience and/or aerial photo interpretation indicated that a change in classification was warranted. This final interpretation provides a basis for an evaluation of existing conditions of habitat for spotted owls within the analysis area. Table III-4 summarizes the current suitable habitat conditions within each of the LSRs in the analysis area, based upon GIS data.

These data document substantial differences among the LSRs in their current ability to support reproductive pairs of spotted owls. A wide range exists in both the amount and percentage of currently suitable habitat within LSRs in the analysis area. Approximately 178,664 acres of currently suitable habitat exists within the 11 LSRs, ranging (for the 8 large LSRs) from a high of 50,083 acres in Quartzville to a low of 8,238 acres in Hagan. The three small LSRs contain substantially fewer acres, due to their overall small size. The percent of each LSR that is currently suitable owl habitat also has a wide variation, ranging from 91 percent (Hagan) down to 44 percent (Fall Creek).

Table III-4. Acres classified as capable and/or suitable[1] northern spotted owl habitat within each of the LSRs, based upon GIS data. (Note: In the existing data some acres of currently suitable habitat are misclassified as 'Not Capable', resulting in small errors in reported acreage and percentages. Recommendations to correct this misclassification are provided in Chapter IV.)

Late-Successional Reserve Name	LSR Number	Acres of Capable and Currently Suitable NSO Habitat [2]	% [3]	Acres Capable but Not Currently Suitable [4]	%	Total Acres of Capable NSO Habitat[5]	Acres of Non-Capable NSO Habitat [6]	Total Acres of Classified NSO Habitat
Thomas Creek	**RO246**	1603	70.4	674	29.6	2278	126	2404
Whitcomb	**RO212**	3335	71.3	1341	28.7	4676	115	4791
Quartzville	**RO213**	50,083	61.5	29,877	36.7	81,384	2,338	83,722
Jefferson	**RO214**	19,476	51.8	16,758	44.6	37,579	2,719	40,298
South Santiam	**RO215**	18,844	75.0	5,382	21.4	25,122	1,345	26,467
Wiley	**RO216**	458	76.0	143	23.7	603	0	603
Hagan	**RO217**	8,238	90.5	740	8.1	9,103	61	9,164
Horse Creek	**RO218**	17,026	68.1	6,588	26.3	25,005	1,971	26,976
Fall Creek	**RO219**	28,510	43.7	36,376	55.8	65,170	800	65,971
Waldo West	**RO220**	22,385	47.0	23,690	49.8	47,610	3,749	51,359
Hills Creek	**RO221**	8,706	55.1	6,139	38.9	15,801	792	16,593
Totals (all LSRs)		**178,664**	**56.8**	**127,708**	**40.6**	**314,331**	**14,016**	**328,348**

[1]For this analysis, suitable habitat is defined as the sum of acres of nesting/roosting/foraging and roosting/foraging habitat.
[2]Acres classified as capable of becoming suitable habitat that are currently suitable.
[3]Percent of the total capable spotted owl habitat acres that are currently within the respective classification.
[4]Acres of capable spotted owl habitat that are not currently suitable.
[5]Total number of acres of forest stands capable of becoming suitable spotted owl habitat.
[6]Acres of forest and nonforest habitat not capable of becoming suitable for spotted owl nesting, roosting and foraging.

Complementary to these numbers are the acreage and percent of total acres within each LSR that are composed of habitat that is capable of becoming owl suitable habitat, but is not currently suitable. LSRs such as Fall Creek, Quartzville, Waldo West and Jefferson contain large areas (36,376 acres; 29,877 acres; 23,690 acres; and 16,758 acres, respectively) that might benefit from silvicultural prescriptions aimed at promoting specific habitat structural and functional conditions for restoring owl suitable habitat.

In general, the analysis indicates that there are no large differences between the data reported in the FSEIS and the data as reported in the LSRA when suitable habitat is defined as the sum of nesting/roosting/foraging (NRF) plus roosting/foraging (RF) habitat. With the exception of the Wiley LSR, most differences reported for both the acres of suitable and proportion of suitable are minor, accountable as minor changes to the data during updates, or rounding errors in the computations.

In order to compare the analysis of the more detailed and updated data from this LSR assessment to those conditions assumed to exist under the FSEIS, data from Appendix G, Table G-3 of the FSEIS is included in this analysis along with current data. Suitable habitat from the LSRA data is subdivided into NRF and RF habitat. For purposes of this analysis, NRF habitat is assumed to contain all habitat elements necessary for spotted owls to feed, breed and shelter. RF habitat provides some of those habitat elements, but is not considered to be able to provide for all of those elements, or may provide them in lower quality. This subdivision of the data into 2 categories establishes sideboards to account for a range of potential conditions. The NRF definition of suitable habitat provides a more conservative estimate of suitable habitat. The inclusive NRF + RF definition provides a more liberal, or higher, estimate of suitable habitat. Table III-5 provides an estimate of the total acreage, the acreage of suitable habitat and the proportion of suitable habitat for each LSR in the analysis area.

A difference among the results is observed when the definition of suitable habitat is changed from “NRF + RF” to just “NRF.” This eliminates the habitat that may conflict with the definition of suitable habitat as described in the final rule for critical habitat as well as the final rule for the species listing under ESA. On the extreme is Hagan, where the amount of suitable habitat changes from 8,387 to 942 acres (91% to 10%). Virtually all LSRs show a significant drop in suitable habitat based upon this change of definition.

Owl sites were identified over a period of several years, during which owl pairs changed, home ranges shifted on the landscape, and habitat modification occurred. It also must be acknowledged that for some landscapes owl surveys have not been completed for all potential habitat, indicating that additional sites may have existed but were not located. Since all sites identified in the FSEIS were reviewed to ensure that their designation met applicable protocol, each site does represent a location where an owl pair or territorial single has existed and/or currently exists.

Table III-5. Current acreage of suitable habitat within the LSRs in the assessment area.

Late-Successional Reserve Name	LSR Number	Acres of suitable spotted owl habitat in LSR				Proportions of suitable habitat within LSR		
		FSEIS data [1]		LSRA data [2]		FSEIS	LSRA data [2]	
		Total acres	Suitable	NRF	NRF+RF	Data [1]	NRF	NRF+RF
Thomas Creek	RO246	2,095	1,344	742	1603	0.64	0.31	0.67
Whitcomb	RO212	3,598	2,412	1,929	3,335	0.67	0.50	0.86
Quartzville	RO213	83,700	53,217	40,732	52,526	0.64	0.487	0.628
Jefferson	RO214	39,735	20,836	17,159	21,892	0.52	0.429	0.547
South Santiam	RO215	26,687	20,164	5,655	20,070	0.76	0.214	0.758
Wiley	RO216	514	356	151	466	0.69	0.248	0.766
Hagan	RO217	8,975	8,382	942	8,387	0.93	0.103	0.914
Horse Creek	RO218	27,162	19,057	4,276	18,929	0.70	0.159	0.702
Fall Creek	RO219	66,501	32,895	25,912	33,369	0.49	0.393	0.506
Waldo West	RO220	51,793	25,145	15,974	25,417	0.49	0.311	0.495
Hills Creek	RO221	16,724	10,121	6,374	9,857	0.61	0.384	0.594
Totals (All LSRs)		**327,484**	**193,929**	**119,876**	**195,897**	**0.59**	**0.366**	**0.598**

[1]Data reported here comes from Table G-3, page G-16, of the Final Supplemental Environmental Impact Statement.

[2]Data reported here are: NRF - Habitat reported as occupied and/or nesting/roosting/foraging habitat, typical and atypical; RF - Habitat reported as roosting and/or foraging, typical and atypical; NRF + RF = sum of acres in NRF plus RF categories.

Features of the CHU network as related to the LSR network

The purpose of identifying critical habitat is to provide for those biological and physical attributes that are essential to the species' conservation throughout its range. As defined in the final rule, the primary constituent elements of northern spotted owl critical habitat are nesting, roosting, foraging, and dispersal habitat. Dispersal habitat is not analyzed in detail in the LSRA because it is an issue that is more applicable to non-LSR land allocations and is best addressed in greater detail through watershed analysis and landscape design.

We describe primary constituent elements (specifically, nesting, roosting and foraging habitat) within the network of CHUs. We make recommendations related to the role of LSRs in meeting legal requirements for management of critical habitat within the analysis area, so as to avoid adverse modification of the identified primary constituent elements. These recommendations will attempt to alleviate some of the perceived conflicts that currently exist between LSR and CHU management.

The seven CHUs in the Mid Willamette LSRA analysis area encompass a total of 573,112 acres, ranging in size from 38,460 acres (Middle Santiam) to 113,076 acres (Waldo West). CHUs contain more acres of currently suitable habitat than do LSRs (287,335 vs. 178,664 acres). CHUs have less variability in the amount of currently suitable habitat, expressed as a percent of capable habitat, than do LSRs. More acres of capable habitat exist in CHUs (534,580) as compared to LSRs (314,331 acres). Table III-6 summarizes the current suitable habitat conditions within each of the CHUs in the analysis area. (Note: numbers reported here are slightly different than reported elsewhere due to use of different data sets in the analysis). `

The percentage of each CHU that currently consists of forest stands that are capable but not currently suitable ranges from a high of 54 percent (Fall Creek) to a low of 32 percent (Horse Creek). Acreage within this classification ranges from a high of 56,996 acres in Fall Creek to a low of 11,997 acres in Horse Creek.

Approximately 84 percent (275,122 of a total of 326,423 acres) of forested habitat within these LSRs is overlaid by critical habitat for the spotted owl (Table III-7). In five of the eight large LSRs, critical habitat overlays 90 percent or more of the LSR. Only South Santiam contains less than 50percent critical habitat. Management of LSRs plays an important role in the conservation of primary constituent elements of critical habitat for this species.

Seral stages of forested habitats within LSRs and CHUs

We looked at seral stages within LSRs and CHUs based on the seral stage distribution information presented in this document. The purpose of this is to establish the environmental baseline for seral stages within LSR and CHUs, and to compare the relative acreage of seral stages in LSRs (both within and outside of CHUs) and CHUs (both within and outside of LSRs). Table III-6 presents the results of that comparison.

For LSRs, these data indicate that a higher proportion of old growth seral stage is found in portions of LSRs overlain by CHU (40%) than are found in the portions of LSR not overlain by CHU (29%). This difference is even higher when comparing late-successional forests (old growth plus mature) in LSRs overlain with CHU (52%) vs. not overlain with CHU (38%). These results imply that those portions of LSR in which critical habitat occur are likely to provide better quality and quantity of habitat for spotted owls than are those portions of LSRs that lie outside of CHUs.

Table III-6. Acres classified as capable and/or suitable northern spotted owl nesting/roosting/foraging habitat within each of the northern spotted owl Critical Habitat Units, based on GIS data.

Critical Habitat Unit Name	CHU Number	Acres of Capable and Currently Suitable [1]	% [2]	Acres Currently Suitable but not Capable [3]	%	Acres Capable but Not Currently Suitable [4]	%	Total Acres of Capable NSO Habitat [5]	Acres of Non-Capable NSO Habitat [6]	Total Acres of Classified NSO Habitat
Jefferson	OR-13	31,645	48.4	1,896	2.9	31,834	48.7	65,375	7,047	72,422
Quartzville	OR-14	53,631	56.8	1,343	1.4	39,368	41.7	94,342	3,385	97,727
Middle Santiam	OR-15	17,858	54.6	2,467	7.5	12,389	37.9	32,714	5,746	38,460
Santiam-Blue River-Hagan	OR-16	58,923	63.3	3,268	3.5	30,858	33.2	93,049	10,075	103,124
Horse Creek	OR-17	24,166	63.8	1,735	4.6	11,997	31.7	37,898	2,984	40,882
Fall Creek	OR-18	48,278	45.5	726	0.7	56,996	53.8	106,000	1,421	107,421
Waldo West	OR-19	52,856	50.2	3,975	3.8	48,371	46.0	105,202	7,874	113,076
Totals (all CHUs)		287,357	53.8	15,410	2.9	231,813	43.4	534,580	38,532	573,112

1 Acres of forest stands classified as capable of becoming suitable habitat that are currently suitable.
2 Percent of the total capable spotted owl habitat acres that are currently within the respective classification.
3 Acres of currently suitable habitat that are misclassified as 'Not Capable'.
4 Acres of capable spotted owl habitat that is not currently suitable.
5 Total number of acres of forest stands capable of becoming suitable spotted owl habitat.
6 Acres of forest and nonforest habitat not capable of becoming suitable for spotted owl nesting, roosting and foraging.

Table III-7. Forested habitat acres in LSRs within and not within spotted owl Critical Habitat Units (CHUs) within the Mid Willamette LSRA analysis area.

LSR Name	LSR Number	Total acres of LSR within CHU	% of Total Acres	Total Acres of LSR not within CHU	% of Total Acres	Total Acres in LSR
Whitcomb	**RO212**	3,711	98.4%	62	1.6%	3,773
Quartzville	**RO213**	68,893	81.2%	15,980	18.8%	84,873
Jefferson	**RO214**	36,926	91.4%	3,491	8.6%	40,417
South Santiam	**RO215**	13,734	48.9%	14,369	51.1%	28,103
Wiley	**RO216**	0	0.0%	607	100.0%	607
Hagan	**RO217**	8,966	98.2%	168	1.8%	9,134
Horse Creek	**RO218**	24,147	92.0%	2,098	8.0%	26,245
Fall Creek	**RO219**	60,811	92.6%	4,881	7.4%	65,692
Waldo West	**RO220**	46,985	95.3%	2,316	4.7%	49,301
Hills Creek	**RO221**	10,949	68.2%	5,115	31.8%	16,064
Thomas Creek	**RO246**	0	0.0%	2,254	100.0%	2,254
Total Acres		**275,122**	**84.3%**	**51,341**	**15.7%**	**326,463**

Table III-8. Acres by forest seral stage within LSRs and northern spotted owl CHUs within the Mid Willamette LSRA analysis area. Includes only those CHUs that lie within the analysis area that are significantly overlain with LSRs in this analysis.

LSR/CHU Overlap	Forested Seral Stage	Total Acres In LSR And in CHU	% of Total Acres	Total Acres in LSR but not in CHU	% of Total Acres	Total Acres In LSR	% of Total By Seral
Total Acres For CHU Included In LSR	**Early**	63,542	23.1%	10,140	19.8%	73,682	22.6%
	Early-Mid	21,346	7.8%	6,779	13.2%	28,125	8.6%
	Mid	47,031	17.1%	14,711	28.7%	61,742	18.9%
	Mature	33,895	12.3%	4,741	9.2%	38,636	11.8%
	Old-Growth	109,308	39.7%	14,970	29.2%	124,278	38.1%
	Totals	275,122	100.0%	51,341	100.0%	326,463	100.0%
Total Acres For CHU Not Included In LSR							
	Early	67,315	24.3%				
	Early-Mid	20,945	7.6%				
	Mid	55,081	19.9%				
	Mature	43,235	15.6%				
	Old-Growth	90,476	32.7%			Total Acres in All CHUs & LSRs Within Assessment Area	
	Totals	277,052	100.0%				
Total Acres For CHU						Acres	Pct.
	Early	130,857	23.7%			140,997	23.4%
	Early-Mid	42,291	7.7%			49,070	8.1%
	Mid	102,112	18.5%			116,823	19.4%
	Mature	77,130	14.0%			81,871	13.6%
	Old-Growth	199,784	36.2%			214,754	35.6%
	Totals	552,174	100.0%			603,515	100.0%

For CHUs, these data indicate that a somewhat higher proportion of old growth seral stage is found in portions of CHUs overlain by LSR (40%) than are found in the portions of CHUs not overlain by LSR (33%). This difference is less significant when comparing late-successional forests in CHUs overlain with LSR (52%) vs. not overlain with LSR (48%). These results imply that those portions of CHU that lie outside of LSR are slightly less functional for spotted owls, based on the better quality of habitat (i.e., proportion of old growth forest).

Management Implications

Critical habitat within LSRs is an important consideration when making management decisions related to restoration of late-successional habitats and associated species. Appropriate silvicultural measures to apply to these stands in CHUs that overlay Matrix, AMAs, riparian reserves, Congressionally Withdrawn and Administratively Withdrawn land allocations is not addressed in this LSRA, but is an issue that should be addressed in watershed analysis and provincial level planning.

An essential consideration is the definition of suitable habitat; using the more restrictive definition of just NRF habitat results in significant decreases in the estimated amount of suitable habitat in CHUs. Two CHUs are likely to currently be receiving substantial demographic support from low elevation wilderness (Horse Creek), or was established substantially to support intra- and inter-province dispersal (Middle Santiam).

A substantial portion of the Santiam-Blue River-Hagan CHU is included in the Central Cascades AMA. Although management of the Central Cascades AMA has significant implications for critical habitat in the province, this issue will not be substantially addressed here, other than a presentation of the environmental baseline.

LSRs play an essential role in meeting legal requirements for managing CHUs and the primary constituent elements of critical habitat. CHUs within this analysis area are likely to have sufficient habitat to maintain pairs of owls at a level at which they function as an interacting metapopulation. Activities within LSRs that maintain or improve the suitability of habitat for spotted owls are not likely to have significant adverse effects on CHUs.

BALD EAGLE (HALIAEETUS HISTRIONICUS)

The bald eagle is a federally threatened species in Oregon and is associated with late-successional habitat primarily because it uses large trees for nest and roost sites (FEMAT 1994a). Bald eagle management plans are written for individual sites to reflect site specific considerations (Willamette NF Plan). Management objectives for LSRs and bald eagle sites are likely to be consistent. Where the areas overlap, protection of bald eagle sites must be considered when treatments are proposed. Proposed treatments in LSRs where bald eagles are present may require consultation with USFWS, seasonal restriction, special closures, or other site-specific criteria outlined in the bald eagle management plan or identified by a qualified biologist. Management recommendations also can be found in the Pacific Bald Eagle Recovery Plan (USDI 1989).

PEREGRINE FALCON (*Falco peregrinus*)

The peregrine falcon is a federally threatened species in Oregon and although it is not closely associated with late-successional habitat, it nests on cliffs within and forages over forest habitat in all seral stages. Peregrine falcon management plans are written for individual sites to reflect site specific considerations (Willamette NF Plan). Management objectives for LSRs and peregrine falcon sites may not always be consistent. Where the areas overlap, protection of peregrine falcon sites must be considered when treatments are proposed. Proposed treatments in LSRs where peregrine falcons are present may require consultation with USFWS, seasonal restriction, special closures, or other site-specific criteria outlined in the peregrine falcon management plan or identified by a qualified biologist. Management recommendations also can be found in the Recovery Plan for the Peregrine Falcon (USDI 1982).

TERRESTRIAL WILDLIFE SPECIES

We identified terrestrial wildlife species associated with late-successional habitat that occur or are suspected to occur on the Willamette NF and Salem District BLM by compiling late-successional associated species from the FEMAT report that also appeared in the Habscapes (Mellon et.al. 1995) wildlife species data base for the Willamette NF (Table III-9). Species presence was determined using Wildobs (Cite) wildlife sitings database and review by Forest Service and BLM wildlife biologists familiar with the area or species. While we recognize that some of these species may be found in other than late-successional habitat we used this system for determining late-successional species because of the formal reviews associated with FEMAT and HABSCAPES.

Table III-9. The occurrence and management status of terrestrial vertebrate species designated by FEMAT as strongly associated with late-successional forest habitat within LSRs in the Mid-Willamette assessment area.

	Species' Occurrence by LSR [2]										
Species' Common Name [1]	Whitcomb R0212	Quartzville R0213	Jefferson R0214	S. Santiam R0215	Wiley R0216	Hagan R0217	Horse Creek R0218	Fall Creek R0219	Waldo West R0220	Hills Creek R0221	Thomas Creek R0246
AMPHIBIANS											
Northwestern salamander	S	S	S	D	S	S	S	D	S	S	S
Pacific giant salamander	S	D	S	D	S	S	D	D	S	S	S
Cascade torrent salamander	S	S	S	S	S	S	S	D	-	-	S
Clouded salamander	S	S	S	S	S	S	D	D	S	S	S
Oregon slender salamander	S	S	S	S	S	S	D	D	S	S	S
Dunn's salamander	S	S	-	D	S	S	-	D	-	-	S
Rough-skinned newt	S	S	S	S	S	S	D	D	D	S	S
Tailed frog	S	S	S	S	S	S	D	D	S	S	S
Cascades frog	-	D	S	D	-	S	S	S	S	S	-
Spotted frog	-	-	-	-	-	-	-	-	-	-	-
BIRDS											
Wood duck	S	D	S	D	S	S	S	D	S	S	S
Harlequin duck	S	D	D	D	S	S	S	D	D	S	S
Barrow's goldeneye	-	-	-	-	-	-	S	-	S	D	-
Bufflehead	-	-	-	-	-	-	S	S	S	D	-
Hooded merganser	S	S	S	D	S	S	S	S	S	D	S
Common merganser	S	S	S	D	S	S	S	D	D	D	S
Bald eagle	-	D	-	D	-	-	-	D	-	D	-
Northern goshawk	-	D	S	D	-	-	S	D	D	D	-
Peregrine falcon	S	S	S	S	S	S	D	D	D	D	S

Table III-9. The occurrence and management status of terrestrial vertebrate species designated by FEMAT as strongly associated with late-successional forest habitat within LSRs in the Mid-Willamette assessment area con't.

	Species' Occurrence by LSR [2]										
Species' Common Name [1]	Whitcomb R0212	Quartzville R0213	Jefferson R0214	S. Santiam R0215	Wiley R0216	Hagan R0217	Horse Creek R0218	Fall Creek R0219	Waldo West R0220	Hills Creek R0221	Thomas Creek R0246
Flammulated owl	-	-	-	-	-	-	-	-	-	S	-
Northern pygmy-owl	S	D	S	S	S	S	D	D	D	D	S
Northern spotted owl	D	D	D	D	H	D	D	D	D	D	D
Barred owl	S	D	S	D	D	S	S	D	D	D	S
Great gray owl	-	-	-	-	-	-	S	D	D	D	-
Vaux's swift	S	D	S	D	S	S	S	S	S	S	S
Red-breasted sapsucker	S	S	S	S	S	S	S	S	S	S	S
Williamson's sapsucker	-	-	-	-	-	-	-	-	-	-	-
Hairy woodpecker	S	S	S	D	S	S	S	S	D	S	S
Three-toed woodpecker	-	-	-	-	-	-	-	-	D	-	-
Black-backed woodpecker	-	D	-	-	-	-	-	-	-	-	-
Northern flicker	S	S	S	S	S	S	S	D	D	D	S
Pileated woodpecker	S	D	S	D	S	S	D	D	D	D	S
Hammond's flycatcher	S	S	S	S	S	S	S	S	S	S	S
Pacific-slope flycatcher	S	D	S	S	S	S	S	S	S	S	S
American crow	S	S	S	S	S	S	S	D	S	S	S
Common raven	S	S	S	S	S	S	S	D	D	D	S
Chestnut-backed chickadee	S	S	S	S	S	S	S	S	D	D	S
Red-breasted nuthatch	S	D	S	S	S	S	S	S	D	D	S
White-breasted nuthatch	S	S	S	S	S	S	S	S	S	S	S
Pygmy nuthatch	-	-	-	-	-	-	-	-	-	-	-
Brown creeper	S	S	S	S	S	S	S	S	D	D	S
Winter wren	S	S	S	S	S	S	S	D	D	D	S

Table III-9. The occurrence and management status of terrestrial vertebrate species designated by FEMAT as strongly associated with late-successional forest habitat within LSRs in the Mid-Willamette assessment area con't.

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Golden-crowned kinglet	S	S	S	S	S	S	S	S	D	S	S
Hermit thrush	S	S	S	D	S	S	S	D	D	S	S
Varied thrush	S	D	S	S	S	S	S	D	D	D	S
Warbling vireo	S	S	S	S	S	S	S	S	S	S	S
Hermit warbler	S	S	S	S	S	S	S	S	S	S	S
Wilson's warbler	S	S	S	S	S	S	S	S	S	S	S
Red crossbill	S	D	S	S	S	S	S	S	S	S	S
MAMMALS											
Vagrant shrew	S	S	S	S	S	S	S	S	S	S	S
Baird's shrew	S	S	S	S	S	S	S	S	S	S	S
Dusky shrew	S	S	S	S	S	S	S	S	S	S	S
Fog shrew	S	S	S	S	S	S	S	S	S	S	S
Shrew-mole	S	S	S	S	S	S	S	S	S	S	S
Little brown myotis	S	S	S	S	S	S	S	S	S	S	S
Yuma myotis	S	S	S	S	S	S	S	S	S	S	S
Long-eared myotis	S	S	S	S	S	S	S	S	S	S	S
Fringed myotis	S	S	S	S	S	S	S	S	S	S	S
Long-legged myotis	S	S	S	S	S	S	S	D	S	S	S
Silver-haired bat	S	S	S	S	S	S	S	S	S	S	S
Big brown bat	S	S	S	S	S	S	S	S	S	S	S
Hoary bat	S	S	S	S	S	S	S	S	S	S	S
Townsend's chipmunk	S	S	S	S	S	S	S	S	D	S	S
Siskiyou chipmunk	-	-	-	-	-	-	-	-	-	-	-

Table III-9. The occurrence and management status of terrestrial vertebrate species designated by FEMAT as strongly associated with late-successional forest habitat within LSRs in the Mid-Willamette assessment area con't.

	Species' Occurrence by LSR [2]										
Species' Common Name [1]	Whitcomb R0212	Quartzville R0213	Jefferson R0214	S. Santiam R0215	Wiley R0216	Hagan R0217	Horse Creek R0218	Fall Creek R0219	Waldo West R0220	Hills Creek R0221	Thomas Creek R0246
Douglas' squirrel	S	S	S	S	S	S	S	S	D	S	S
Northern flying squirrel	S	S	S	D	S	S	S	D	S	S	S
Deer mouse	S	S	S	S	S	S	S	S	S	S	S
Western red-backed vole	S	S	S	S	S	S	S	S	S	S	S
Red tree vole	S	S	S	S	S	S	S	D	S	S	S
Marten	S	D	S	D	S	S	D	S	D	D	S
Fisher	-	-	-	-	-	S	S	S	S	S	-
Elk	-	-	-	-	-	-	D	D	D	D	-
REPTILES											
Northern alligator lizard	S	S	S	S	S	S	S	S	S	S	S

1 Species associated with late-successional forest, from the FEMAT report, pages IV-39 and 40 (USDA, 1993).

2 Occurrence by LSR: **D** = documented occurrence; **S** = suspected to occur there, but no written records; **H** = historical range, but not recently documented, may be extirpated; **-** = not likely to occur, outside of reported range, or unknown.

3 Management Status:
FSS = Forest Service Sensitive
J2 = species undergoing further analysis for mitigation adopted in the Northwest Forest Plan
PB = Protection buffer species
S&M = Survey & manage species identified in the Northwest Forest Plan
T&E = Federally listed as threatened or endangered under the Endangered Species Act

SENSITIVE SPECIES

TERRESTRIAL VERTEBRATES AND INVERTEBRATES

Mechanisms to address sensitive species such as biological evaluations are not superseded by this document. In cases where sensitive species are late-successional associates, it is prudent to ensure optimal habitat conditions overtime within the LSRs.

BOTANICAL SPECIES

No plant species listed as Threatened or Endangered by the USFWS occur on the Willamette NF. The forest has a list of sensitive plant species designated by the regional forester. The region's Sensitive Species Program is designed to manage rare species and their habitats to prevent a need for federal listing at a future date. Sensitive species are vulnerable due to low population levels or significant threats to habitat (USFS, R-6 FSM). One species, *Sidalcea nelsoniana*, listed as Threatened by the USFWS, is on Salem District BLM land. The BLM has a program similar to USFS for rare plants. They are termed special status rather than sensitive. Table III-10 lists sensitive and rare plants in LSRs in the planning area.

Table III-10. Rare plants in Late-Successional Reserves on Willamette NF and BLM Lands

Species	Common Name	LSR	No. Populations
Aster gormanii	Gorman's aster	Jefferson	7
Botrychium minganense	Gray moonwort	South Santiam	1
Botrychium montanum	Mountain moonwort	Quartzville	1
Cimicifuga elata	Tall bugbane	South Santiam	2
		Fall Creek	1
Huperzia occidentalis	Fir clubmoss	Quartzville	3
Lycopodiella inundata	Bog clubmoss	South Santiam	2
Ophioglossum pusillum	Common adder's tongue	Quartzville Horse Creek	1 1
Romanzoffia thompsonii	Thompson's mistmaiden	Quartzville Jefferson Waldo West	1 3 3
		Fall Creek	3
Scheuchzeria palustris	Scheuchzeria	Quartzville	1

Gorman's aster is a white perennial daisy that prefers to grow in gravelly scree slopes with low to moderate soil development. The species is montane to alpine in distribution and is most commonly associated with a manzanita/juniper plant association (*Arctostaphylos nevadensis*/*Juniperus communis*) with buckwheats, lupines and bentgrass. Habitat enhancement for this species may include removal of trees on the edge of the habitat if encroachment on populations is documented.

The moonworts, *Botrychium minganense* and *Botrychium montanum,* are species found under the coniferous canopy associated with water. Common associates are an overstory of western red cedar and understory of vine maple, wood sorrel and other moonwort species. Not a lot is known about the needs of these species. We do know they need a mycorrhizal symbiont (fungi) for survival and germination. This may have implications for prescribed burning around populations. Making sure fires in these areas are moderate would be mandatory for fungal survival. A stable hydrologic regime is also important, as is maintenance of canopy closure to maintain humidity.

Tall bugbane is located in several LSRs. This species also grows under the canopy but, in this case, prefers a mixed coniferous/bigleaf maple overstory with a common swordfern understory. Many years of monitoring this species has shown that plants need sunlight (canopy gaps) to reproduce. If left alone, populations with no gaps remain vegetative. Most populations suffer from a lack of diversity of age classes. Habitat enhancement for this species might include limbing or topping of trees in adjacent areas to create canopy gaps.

Fir clubmoss is a species associated with riparian areas in coniferous forest. Bog clubmoss and scheuchzeria are acid-tolerant species that grow with Sphagnum moss, sundews and bog huckleberry. Common adder's tongue is found at the edges of ephemeral ponds and wetlands. *Romanzoffia thompsonii* is an annual mistmaiden, residing in rock garden and rock outcrop habitats. Sites always have an abundance of water in the springtime. Soil development is minimal and is usually composed of gravel or scree. A stable hydrologic regime is important for all of these species. Habitat enhancement may include control of weedy species, exclosures from browsing ungulates and management of competing vegetation (pruning alder or spiraea).

FISH

The Northwest Forest Plan Role

When the President visited the Northwest for the Forest Conference in 1993 fish were specifically mentioned several times. The charge of the resulting Forest Ecosystem Management Assessment Team (FEMAT) was to incorporate fish habitat protection as a major component of a plan that yielded a predictable and sustainable timber harvest (Sedell et al. 1997). As a result, large patches of habitat for threatened and endangered animals were set aside on federal lands so that the burden of conserving these species would be reduced for state and private landowners. While various factors outside federal lands impact anadromous fish life cycles, the FS and BLM recognized an obligation to manage watersheds for productive fish habitat (Sedell et al. 1997). The resulting Aquatic Conservation Strategy included not only riparian reserves, watershed analysis, and habitat restoration, but also a system of Key Watersheds to protect at-risk anadromous and resident salmonids (Map 8). Protection of aquatic habitat, while conducting other land uses, is a primary emphasis in the Key Watersheds. Together with LSRs and Wilderness, the resulting landscape pattern provides a refuge system for anadromous and resident fishes. While the wilderness primarily plays a role in providing high quality water, the Key Watersheds and LSRs within the assessment area provide significant habitat for anadromous and resident salmonids.

Anadromous Fishes

Anadromous species native to the Willamette River Basin include the Pacific lamprey-*Entosphenus tridentatus*, winter steelhead, *Oncorhynchus mykiss*, and spring chinook salmon *Oncorhynchus tshawytscha*. Without exception, each LSR provided habitat for one or more of these species prior to human impacts of the period 1940-present. Introduced summer steelhead may currently utilize portions of LSRs 218 and 219. Considering the mainstem streams which originate or flow through the LSRs, only two streams (Thomas Creek and Wiley Creek) are currently unimpeded by major flood control or hydroelectric dams. Both of these streams have been impacted by agricultural and forest practices. Although little is known about lamprey trends, these fish spend about six years in fresh water and then migrate to the ocean. Their return as adults once provided a commercial fishery in the Willamette River. From 1943-1949 an annual harvest of some 233,000 pounds occurred and was thought to represent 10-20 percent of the run (Wydoski and Whitney 1979). Lampreys have traditionally been an important tribal food source, a practice which continues in the present at such locations as Willamette Falls (ODFW 1995).

Within the LSR assessment area winter steelhead and spring chinook have been impacted primarily by habitat loss. Habitat has been reduced by federal, state, and private forestry; private agriculture; dams used for flood control, hydroelectric generation; and ditches/canals used for irrigation or power. The occurrence in each LSR for native species and the associated dam(s) are displayed as Table III-11.

Table III-11. Steelhead and Spring Chinook Passage Status by LSR

LSR (number/name)		Anadromous fish(es)	Resident Salmonids	Associated dam(s)	Fish passage status at dam(s)
Whitcomb	RO212	None	Cutthroat	Foster Greenpeter	N.A.
Quartzville	RO213	w. steelhead, sp. Chinook	Rainbow, Cutthroat	Foster Greenpeter	No action
Jefferson	RO214	w. steelhead, sp. Chinook	Rainbow, cutthroat	Big Cliff, Detroit	No action -
South Santiam	RO215	w. steelhead, sp. Chinook	Rainbow, cutthroat	Foster	Action - adult truck & release
Wiley	RO216	w. steelhead, sp. Chinook	Rainbow, Cutthroat	None	N.A.
Hagan	RO217	None	Cutthroat	Leaburg	ladder
Horse Creek	RO218	sp. Chinook	Rainbow, bull trout, cutthroat	Leaburg	ladder
Fall Creek	RO219	w. steelhead, sp. Chinook	Rainbow, Cutthroat	Fall Creek	Action - adult truck & release
Waldo West	RO220	sp. Chinook	Rainbow, brook trout, cutthroat	Dexter, Lookout	No action - no funding
Hills Creek	RO221	sp. Chinook	Rainbow, Cutthroat	Dexter, Lookout, Hills Creek	Action - adult truck & release
Thomas Creek	RO246	w. steelhead, sp. Chinook	Rainbow, Cutthroat	None	N.A.

Bull trout were historically distributed in areas comprised of LSRs 214, 215, 218, and 220. Bull trout are now dependent on a few streams in the McKenzie River Basin. Horse Creek (RO218) is the only LSR that currently has bull trout. Horse Creek, Walker Creek and the East Fork of the South Fork of the McKenzie River all provide adult foraging habitats. Spawning has not been documented in these streams (Bickford, pers. comm.). Native cutthroat trout, rainbow trout, and sculpin species compromise the majority of the resident fish biomass in streams within these LSRs.

Habitat Condition Within LSRs

The individual watershed assessments provide the most comprehensive information on stream habitat quality, including many streams within the LSRs. Of primary concern are those parameters within LSR stream segments that are considered to be outside a range of natural variability or indicate a high risk to aquatic resources. These parameters include 1) stream temperature; 2) road densities; and 3) stream habitat condition as represented by pool quality (depth and frequency).

Stream temperature information from the USFS and the 1996 Oregon DEQ 303d list indicate Horse Creek as the only “water quality limited” stream within the LSRs. Horse Creek did not meet the stringent bull trout spawning temperature range, although spawning use of the stream has not been documented. It is likely that other streams within certain of the LSRs may not meet State temperature requirements; however, data is lacking (e.g., Whitcomb, Wiley, Thomas Creek, Quartzville, South Santiam, and Fall Creek LSRs).

Road densities are discussed elsewhere in this assessment. All LSRs except Quartzville, Hagen, and Wiley have greater than 50 percent of their acres in a road density >2 miles/square mile. This could be a factor in cumulative impacts to watershed condition.

Loss of large pool habitat has been documented by comparison of 1934-1946 stream surveys to 1988-present surveys in many anadromous streams in the Columbia Basin (Sedell and Everest 1991). Most mainstem reaches of streams within the LSRs (e.g., North Santiam, Quartzville Creek, South Santiam, Fall Creek, and Salmon Creek) have been impacted by loss of large pool habitat.

LATE-SUCCESSIONAL SPECIES ADDRESSED IN THE FEMAT REPORT

TERRESTRIAL VERTEBRATES AND INVERTEBRATES

Specific direction for survey and manage species is addressed in separate documents from this assessment. In some cases the survey and manage strategies for specified taxa may be directed at land management designations other than LSRs such as Matrix, AMA, or Riparian Reserves lands. The late-successional species, including survey and manage addressed in the FEMAT Report, were a primary influence on the development and direction associated with managing LSRs. The basic assumption underlying the LSR strategy is that they will serve as primary habitat refugia for these species. If this assumption is compromised, the integrity of the NFP also is weakened. The current and future condition of the LSRs that characterize them as late-successional refugia for plants and animals is what sets them apart from matrix land. All projects within LSRs must be designed and implemented with this in mind. While we have identified some specific habitats and species to address or protect when planning and implementing treatments and projects within LSRs, we expect the following steps to be taken for late-successional species as integral components of project design and implementation:

- Identify late-successional species (Refer to species occurrence tables) with the potential to occur within the project area.
- Surveys will be implemented for late-successional species where there is indication survey information is needed to give special consideration to a species for treatment design or implementation (habitat present, historical presence, etc.).
- If site-specific surveys are not feasible, seasonal restrictions or special treatments will be implemented to protect late-successional species or their habitat when needed.
- Treatments will be designed for long-term beneficial or no impact to late-successional species and when it is a concern in the project area, specifically address Oregon Slender salamander and other terrestrial amphibians, pond breeders, northern goshawk, and unique or special habitats such as seeps or hollow trees.

BOTANICAL SPECIES

The ROD (USDA et al. 1994) contains a list of species, called survey and manage species that must be considered when planning projects. A large list of old-growth dependent species was created and effects of alternatives on each species were analyzed during the EIS process. Those species found to be at risk even under the preferred alternative are survey and manage species. Appendix I lists those old growth associated species not considered at risk under the NFP. The FEIS for the Northwest Forest Plan includes standards and guidelines (S&G's) to be followed in all land allocations for survey and manage species. There are four survey strategies that may be assigned to species:

1. Manage known sites. This may include a range of actions from creation of a preserve for the species to a buffer in a timber sale unit. To manage one must use of knowledge of the species and its distribution and its habitat needs. Management guidelines are being distributed.
2. Survey Prior to Ground-Disturbing Activities. For botanical elements (see discussion below), surveys must be conducted for projects initiated or sold in fiscal year 1999. Survey protocols are being developed.
3. Extensive Surveys. Surveys are to find high priority sites for species management. Surveys will be conducted when elements are identifiable (for example surveys for fungi will be completed in the fall when fruiting bodies are visible). Survey protocols are being developed.
4. General Regional Surveys. Surveys are to acquire additional information on species distribution to determine necessary levels of protection. Survey protocols are being developed

Botanical survey and manage elements include lichens, bryophytes (mosses and liverworts), fungi, and vascular plants. Information on species distribution is incomplete or unavailable. The biological importance of these species is just being discovered. Fungi provide food for flying squirrels, the prey base of spotted owls, as well as voles, squirrels, mice, and other small mammals (Maser et al. 1978). Lichens provide a food source for deer and elk during winter when grass and shrubs are unpalatable or buried by snow (USDA et al. 1993). They are also used by flying squirrels, red-backed voles,and woodrats (Maser, et al. 1985). Lichens, which contain cyanobacteria as their "algal" symbiont, make nitrogen available in forests where it is a limiting nutrient. Bryophytes are important reservoirs of water and nutrients and account for approximately 20 percent of the total biomass and 95 percent of the photosynthetic biomass in the forest understory. Bryophytes are important food sources for invertebrates and are used as nesting materials for mammals (USDA et al. 1993).

Lichens (Table III-12) are organisms composed of both a fungus and an alga or a cyanobacterium. A number of nitrogen-fixing lichens, including two rare species, are found in LSRs (Pike et al. 1975; Lesica, et al. 1991). Locations of these old-growth dependent species are being slowly added to our knowledge base with the air quality monitoring efforts pioneered on the Willamette NF by Dr. Linda Geiser. Examples are *Lobaria, Fuscopannaria, Nephroma, Pseudocyphellaria* and *Sticta.* These species most assuredly occur within Salem BLM LSRs, too. These species are epiphytes; they require retention of aggregates of standing trees to maintain a suitable microclimate and to provide for dispersal (USDA et al. 1994a). Diversity of nitrogen-fixing lichens increases with stand age, so maintenance of late-succession habitat will favor these species, (Lesica et al. 1991).

Six lichens are rare enough to warrant inclusion as survey strategy 1 components. Populations of these species, *Hydrothyria venosa*, *Hypogymnea oceanica*, *Nephroma occultum*, *Philophorus nigricaulis*, *Pseudocyphellaria rainierensis* and *Usnea hesperina*, are so unique that they should be protected from any management action in LSRs. Broadcast burning should be low intensity as high intensities may affect epiphytic species (USDA et al. 1994a, p. 234). Habitat for the rock-dwelling lichen, *Philophorus*, is perfect for management actions such as building of roads using native rock from forest quarries. Other potential adverse effects to this species could come from yarding through rock outcrop or rock garden habitat. (USDA et al. 1994a, p. 238). Management recommendations for survey strategy 1 species were unavailable at printing but are forthcoming from the Regional Ecosystem Office.

Table III-12. Survey and manage lichens located in Willamette and Salem BLM LSRs

Species	Type	Survey Strategy	LSR	No. Sites
Chaenotheca furfuracea	Pin Lichen	4	Fall Creek	1
Fuscopannaria species	N-fixing	4	all	
Hydrothyria venosa	Aquatic Lichen	1,3	Fall Creek	1
Hypogymnia oceanica	Rare oceanic-influenced	1,3	Quartzville	1
Lobaria species	N-fixing	4	all	
Nephroma occultum	Rare n-fixing	1,3	South Santiam Hagan Fall Creek	1 1 1
Peltigera species	N-fixing	4	all	
Philophorus nigricaulis	Rock lichen	1,3	Quartzville	3
Pseudocyphellaria rainierensis	Rare n-fixing	1,2,3	Quartzville South Santiam	4 1
Pseudocyphellaria species	Rare n-fixing	4	all	
Ramalina thrausta	Riparian Lichen	4	Fall Creek	1
Sticta species	N-fixing	All		
Usnea hesperina	Rare oceanic-influenced	1,3	South Santiam	1

One survey and manage bryophyte is located within LSRs: *Rhacomotrium aquaticum*. This species is a survey strategy 1 and 3 species. It is located in South Santiam LSR. Habitat is shaded moist rocks and cliffs along shady streams or in forests. Care should be taken if aquatic restoration projects are planned in the vicinity of this known site. Draft Management Recommendations (REO, USDA, 1996) include:

(1) Minimize disturbance of known sites from boating, mining, and recreation.
(2) Maintain riparian buffers prescribed in ROD.
(3) Maintain overstory for microclimate.
(4) Maintain low sediment in streams with aquatic populations.

Two protection buffer bryophytes are located in LSRs: *Buxbaumia viridis* and *Ulota megalospora*. These species are to be treated as survey strategy 1 and 3 species. *Buxbaumia* is a species that prefers rotting logs, in decay class 3 and 4. Draft Management Recommendations (REO, USDA, 1996) for Buxloaumia include (a) input of large woody debris in various decay classes; (b) leave windfalls in place to provide structurally diverse habitat; and (c) maintain a dense overstory to maintain humidity (>70 percent closed canopy). If prescribed burning is part of the plan for the LSR, one should take extreme caution in the Buxbaumia sites. Ulota is associated with hardwood species such as red alder, ocean spray, vine maple and bigleaf maple. DMRs for *Ulota* (REO, USDA, 1996) note the species may not require protection buffers "if continuity of habitat over time is provided within the watershed." This means riparian reserves, LSRs, and administratively withdrawn areas.

A number of fungi have been documented in LSRs. Management considerations should include avoiding hot prescribed burns to ensure mycorrhizae are able to survive, maintenance or enhancement of course woody debris for mycorrhizal habitats and summer water reservoirs. Standards and guidelines for mushroom harvest in the Willamette Forest Plan state there should be no commercial mushroom harvest in LSRs; only poachers would be of concern for the rare fungi.

Table III-13. Survey and manage fungi located in Willamette and Salem BLM LSRs

Species	Organism	Survey Strategy	LSR	No. Sites
Chroogomphus loculatus	Rare gilled	1,3	Horse Creek	1
Gastroboletus imbellus	Rare bolete	1,3	Horse Creek	1
Gastroboletus ruber	Rare bolete	1,3	Horse Creek	1
Glomus radiatum	Rare zygomycete	1,3	Horse Creek	1
Gymnomyces sp. Nov.	Rare truffle	1,3	Quartzville	1
Leucogaster citrinus	Rare false truffle	1,3	Quartzville	1
Leucogaster microsporus	Rare false truffle	1,3	South Santiam Horse Creek	1 1
Martellia idahoensis	Rare false truffle	1,3	Horse Creek	1
Neournula pouchettii	Rare cup fungus	1,3	South Santiam	1
Octavinia sp. Nov.	Rare false truffle	1,3	Horse Creek	1
Pithya vulgaris	Rare cup fungus	1,3	South Santiam	1
Rhizopogon evadens ssp. Evadens	Truffle	1,3	Horse Creek	1
Rhizopogon inquinatus	Truffle	1,3	South Santiam	1
Rhizopogon sp. Nov.	Truffle	1,3	Horse Creek	1

A complete listing of all survey and managed species known or suspected to occur on the Willamette NF and the southern portion of the Cascades Resource Area, Salem BLM can be found in Appendix I.

Management recommendations (USDA, 1996b) for all survey strategy 1 fungi are to maintain populations by retaining forest structure and soil conditions. Avoid disturbance, including modification of the overstory canopy. Prescribed burns should take these species into consideration.

SPECIAL HABITATS

Special habitats contribute to the overall biodiversity across the landscape and are important for plants and wildlife. For the most part, these areas are non-forested including meadows, rock outcrops, ponds and talus slopes. Some special habitats (e.g., swamps and mineral deposits) are forested.

The Willamette NF has recognized the significance of these sites in its standard and guideline FW-211 (USDA, 1990). This S&G states that these sites will be maintained or enhanced (repaired), and their ecotones buffered from management activities.

Data for this analysis was collected via aerial photo interpretation. Some LSRs have extensive inventories (e.g., Waldo West), where habitat types have been identified. Other LSRs have only general habitats outlined. Habitats listed include only those greater then one acre. Habitat types have been combined in the following table (see Appendix J for key of habitats combined by agency) because attributed GIS layers differ in naming conventions as well as intensity of inventory. Ground-truthing of general types is necessary for a realistic interpretation of biodiversity within the LSR (data need).

Table III-14 depicts location and acreage of special habitats. Maintaining or “reclaiming” special habitats is crucial to maintaining biodiversity across the landscape in the Pacific Northwest. Various wildlife species have evolved over time to be either partially or totally dependent on these habitat types for a portion or all of their life histories. Some land slugs are suspected to be dependent on rock slides or talus slopes for a major portion of their life histories. Perennial or intermittent ponds are crucial to the reproduction and larval development of many frogs and salamanders. These ponds also provide a source of insect forage for many species of bats and passerine birds. Dry meadow complexes are important foraging areas for kestrels and great gray owls because they support small mammal prey species such as gophers and voles. Snags and coarse woody debris are important for a long list of wildlife species. They serve as homes for many primary and secondary cavity-nesting birds. Insects and fungi are decomposers of dead wood that eventually contributes to long-term site productivity. Marten use dead and downed wood for foraging, denning and resting.

It is evident that past management activities have affected special habitats. Until the early 1900s, fire played an active role in maintaining the dry and mesic meadow complexes. Part of the natural successional process has been a repeated burning of these sites by fire. Near the Willamette Valley these sites were burned by Native Americans. Near ridgetops, these sites were burned through lightning strikes and subsequent natural wildfires. This disturbance shifts the successional age of the site by killing trees that naturally move in to the site. Because these sites are important for wildlife cover, forage, nesting and a host of other habitat features, active management may be necessary to maintain the current successional stage of these sites. Management could come in the form of prescribed burning and/or pruning of young trees. These habitats will become more important over time as young plantations in the LSRs grow and are no longer good sources of forage and edge habitat for wildlife species.

Functions of each type of special habitat delineated previously, and the wildlife species which use them, are outlined in the Special Habitat Management Guide (Dimling and McCain, 1996). The 1990 Willamette NF LRMP directs the Forest to “maintain or enhance” special habitats. The management guide outlines a methodology for analysis of the environmental factors necessary for maintenance of each habitat and aids in formulating site-specific prescriptions for these areas (Dimling and McCain, 1996).

Table III-14. Special Habitats in LSRs

Habitat Type	Number /LSR	Acres	LSR
Dry Meadow	2	4	Whitcomb
	125	1303	Quartzville
	38	370	Waldo West
Rock	19	41	Whitcomb
	336	2857	Quartzville
	18	68	Thomas Creek
	4	20	Fall Creek
	43	691	Waldo West
Shrub	19	27	Quartzville
	3	21	Fall Creek
	90	408	Jefferson
	29	385	Waldo West
Talus	7	7	Whitcomb
	83	507	Quartzville
	252	1103	Jefferson
	25	99	Fall Creek
	22	168	South Santiam
	3	18	Hagan
	19	182	Horse Creek
	9	23	Hills Creek
	40	410	Waldo West
Wet Meadow	9	68	Whitcomb
	35	102	Quartzville
	9	26	Thomas Creek
	4	38	
	8	132	Waldo West
Mesic Meadow	3	7	Whitcomb
	16	62	Quartzville
	15	109	Fall Creek
	23	114	Jefferson
	82	615	South Santiam
	70	862	Horse Creek
	16	241	Hills Creek
	2	12	Waldo West
Pond	7	78	Whitcomb
	18	159	Quartzville
	1	3	Fall Creek
	13	113	Jefferson
	2	17	South Santiam
	1	3	Thomas Creek
	3	29	Waldo West
Dry Rock Garden	1	5	Hills Creek
	3	36	Waldo West

NOXIOUS WEEDS

The Willamette NF initiated an Integrated Weed Management Program in 1993. The Forest Plan S&G directs that sites be identified and analyzed for the most effective control methods based on site-specific analysis of weed populations (USDA, 1993).

The highest priority species for treatment are “new invaders” which are defined as those weeds in early stages of invasion which have not naturalized to the point of resource damage. Spotted knapweed, *Centaurea maculosa*, is located in three LSRs: Jefferson, South Santiam and Horse Creek. All of these sites are along major highways that intersect the LSRs: U.S. Highway 22, 20 and 126. Meadow knapweed, *Centaurea pratensis*, is documented in two sites in the Thomas Creek LSR on Salem BLM.

Treatment of these populations is dependent on their abundance and where they are located. The Willamette NF has a form it fills out for all new infestations, considering soil type, closeness to water, number of plants, accompanying vegetation and many other variables. From the site-specific data, treatment methods that could include manual, chemical, prescribed fire, mechanical and competitive plantings are chosen.

Other species found within LSRs are termed “established infestations.” These weeds have spread to the point where eradication is impossible and resource damage is unacceptable. Established weeds include Canada thistle, bull thistle, tansy ragwort, Scotch broom, and common St. John's-wort. These species may be found in any disturbed site but are most commonly associated with clearcut logging units, landings and logging roads. All are generally outcompeted, due to lack of sunlight, in moderately young forest plantations. St. John's-wort can be found in these sites, but is also common in meadow habitats which often harbor natural soil disturbers such as groundhogs and mountain beavers. St. John's-wort, once established, has the ability to outcompete native species, causing a severe reduction in the biological diversity of the site, especially in the rock garden habitats found in the watershed.

Due to the sheer amount of acreage these infestations cover, treatment methods are limited primarily to biological control over most of the land area. This type of control involves the use of insects that naturally feed on the plant or its seeds, eventually causing an equilibrium in population numbers. Some experimentation with controlled burning as a method for control of Scotch broom and St. John’s-wort may also occur.

IV. TREATMENT CRITERIA AND NEEDS

INTRODUCTION

The objective of forest management in LSRs is to protect and enhance conditions of late-successional forest ecosystems for the benefit of associated species. This assessment relies on teams looking at areas from the LSR network to the LSR to the site scale to maintain landscape diversity when determining if a stand needs treatment. A decision to not treat a site should always be a viable option for an area that could then serve as a control. If it is determined that a stand could be treated to meet objectives, following successional pathways for the appropriate subseries environment with silvicultural prescriptions or projects that focus on desired structural characteristics and processes would be appropriate. When acceptable other treatments may follow more accelerated pathways to attain late-successional characteristics both spatially and temporally across the landscape.

PROCESS

We recommend that proposed activities in LSRs follow a similar process of evaluation to determine if the action or treatment meets LSR objectives and associated criteria designed to ensure consistency among implemented actions. In addition to considering the recommendations that follow in this chapter, all activities will need to be reviewed for consistency with the following guidance.

1. Land and Resource Management Plans (as amended by the NFP). All proposed actions will be evaluated to ensure they are consistent with the goals, objectives, and standards and guidelines in these Plans.

2. Late-Successional Reserve Assessment. This assessment identifies conditions within the LSRs that should be considered for treatment in order to meet the desired objectives of late-successional and old growth forest ecosystems. This assessment also provides specific criteria that shall be applied to the proposed action or treatment to ensure that the LSR objectives are met. In this assessment, treatment needs and criteria are identified at the **landscape level**, **LSR network, individual LSR** and at the **condition-specific or stand level**. All levels shall be considered during the identification, design, and evaluation of treatments.

3. Watershed Analyses. Most of the LSRs in this assessment are covered by a watershed analysis following the analytical steps in the Federal Guide to Ecosystem Analysis at the Watershed Scale (Refer to Table I-3). These analyses contain significant information regarding local conditions, especially watershed, riparian, aquatic species, and fisheries that shall be integrated into all proposed actions and treatments. Recommendations resulting from the watershed analyses will be reviewed for any inconsistencies with the criteria and recommendations in this assessment. If the information in the watershed analysis would result in an activity or treatment prescription that is not consistent with the criteria and recommendations in this assessment, an interdisciplinary team from the Willamette NF Supervisors Office and Salem BLM District Office will review the inconsistency and provide the appropriate agency line officer with a recommendation. If the recommendation is to

proceed with an activity or treatment that is not consistent with this assessment or the ROD, the proposal will be sent to the REO LSR group for review and approval.

4. NEPA and Interdisciplinary Team Input. All proposed actions and treatments shall meet the applicable level of documentation as required by the Council on Environmental Quality regulations and applicable agency policy. Any issues or concerns arising from the evaluation of a proposed action or treatment will be addressed. Integrated treatment prescription will be developed through an interdisciplinary process utilizing all of the sources of information and direction previously cited. The agency line officer is responsible for approving proposed treatments in the LSR. This is the critical step where the final treatment prescription is evaluated to ensure that it is consistent with the Land and Resource Management Plan direction and objectives, and the logic and the location for the treatment is supported by the analysis and information in this assessment and in the watershed analysis.

5. Implementation and Monitoring. Monitoring will begin immediately following the decision to proceed to ensure that the treatment is carried out according to the integrated prescription. Pre-treatment surveys or other surveys conducted independently of activities can also be an integral part of the monitoring. Monitoring will continue throughout project implementation and post-treatment phase to evaluate the achievement of LSR objectives.

For this assessment, we analyzed the LSRs at the **landscape level** and the **condition specific** or **stand level**. Treatment needs and criteria were identified at both levels and both need to be considered when identifying treatment needs and the criteria that should be applied to the treatment.

LANDSCAPE LEVEL TRIGGERS AND TREATMENT CRITERIA

REGIONAL CONNECTIVITY

RECOMMENDATIONS

- Maintain dispersal conditions at lower elevations east of Jefferson (RO214), Horse Creek, and Waldo West (RO220) for connection with the Deschutes NF.
- Connectivity north and south is important and criteria and recommendations for the South Cascades LSRA (RO222) and the North Willamette LSRA should be referenced along with this assessment to ensure connectivity with Quartzville (RO213), Jefferson (RO214), Fall Creek (RO219), and Hills Creek (RO221).

CONNECTIVITY BETWEEN LSRS

There is potential for the majority of LSRs to be connected by reserve habitat (Administratively Withdrawn, Congressionally Designated, riparian reserves and core LSRs at a dispersal distance of 382 meters (estimated dispersal distance for the red tree vole, see previous section for more detail. In some cases, potential connectivity of reserve habitat between LSRs is only possible at a distance > 382 meters, and it is unreasonable to expect connectivity within reserve lands at a distance less than what the reserve lands provide. Regardless of the minimum distance for potentially achieving connectivity between LSRs, current condition of the reserve habitat precludes achieving potential connectivity in some areas (Maps 14 & 15).

RECOMMENDATIONS, BETWEEN LSRS CONNECTIVITY

- Apply information from Map 14 and 15, and Appendix L for watershed and project planning and prioritizing especially for riparian reserve management.
- Assess the value of land allocations not addressed in this analysis that may add to LSR connectivity, such as scenic allocations managed on an extended rotation.
- Improve late-successional connectivity of reserve habitat between LSRs by establishing long term strategies for stand retention or enhancement in riparian reserves so that connectivity is achieved and maintained overtime within watersheds through which potential connective routes pass. Avoid compromising connectivity within watersheds where current connectivity exists (Appendix L). Reducing widths of riparian reserves in watersheds where there is current or potential connectivity for LSRs (Appendix L) is not recommended if LSR connectivity is compromised. Developing a long-term strategy is especially important in watersheds that are essential to current and potential connectivity for the entire LSR network: Fisher, Devil's Canyon, Upper Christy, Lower Christy Lower S.F. McKenzie, Cougar Reservoir (especially west of Cougar Reservoir), Hardy Ridge/Rebel Creek. Also Homestead Camp, French Pete, Quartz Creek, Upper NORTH Santiam/Big Meadows, Twin Meadows, Sheep, Upper Mid-Santiam, Donaca, and especially Augusta Creek, Spring Creek Drainage in the East portion of Lower Horse Creek, Lower Salt Creek, and the western portion of Middle Salt Creek

- Improve the connectivity between LSRs by planning stand acceleration and structural improvements or protection projects in riparian reserves within the connectivity breaks identified in Map 14. Also, consider projects that are most likely to improve connectivity of reserve habitat between large LSRs and core LSRs.
- Reducing the widths, canopy closure, or stand structure within riparian reserves in the areas where connectivity is absent is not recommended unless it has a neutral or positive effect on connectivity of LSRs.

LSR PRIORITIZATION

COMPARATIVE ANALYSIS OF LSRS

The following recommendations are based on the results of the Comparative Analysis of LSRs. (Chapter II) The recommendations reflect our interpretation of the results as they apply to this analysis and we encourage managers to review the results as they may make additional interpretations for application in concert with site specific information.

Recommendations

- Whitcomb, Fall Creek, Hagan, and Thomas Creek represent overall LSR conditions equal to or below the median for all 11 LSRs. We recommend that these LSRs are a priority for improving LSR conditions if possible without further compromising their current function. The implications of the results are especially important for Whitcomb, Fall Creek and Thomas Creek, because they are lacking adjacent late-successional habitat that falls under some other reserve designation (See Chapter II, Comparative Analysis, effective habitat analysis). In Whitcomb, it would make sense to focus on closing roads and improving interior habitat conditions where within LSR connectivity will be enhanced. In Fall Creek, it would make sense to close roads and treat stands that will enhance late-successional characteristics where interior habitat will benefit and apply treatments so that between LSR connectivity can be improved along the eastern and southeastern portions of the LSR. In the case of Hagan, we don’t expect active management of stands, and road densities appear to be relatively low, so it makes sense to leave the area alone. In Thomas Creek, the high road densities and lack of late-successional habitat, especially where within LSR connectivity is a problem are key issues.
- Hills Creek, Jefferson, South Santiam, Waldo West, Quartzville, Wiley, and Horse Creek are at or above the median for overall LSR conditions relative to all 11 LSRs. Hills Creek ranked relatively high for amount of late-successional habitat, but the lack of interior habitat implies a high level of fragmentation and improving interior habitat where possible and road closures are high priorities. Jefferson and South Santiam indicate an overall lack of late-successional habitat is the key issue in these LSRs. Waldo West shows relative values at or above the median for all variables except interior habitat for which Waldo West shows the worst rating when compared to all other LSRs, thus interior habitat is the highest priority for this LSR. Quartzville reflects just below the median for road density and interior habitat, and represents the median for late-successional habitat. Horse Creek is above the median for all variables measured.

WITHIN LSR TRIGGERS AND TREATMENT CRITERIA

LANDSCAPE BLOCKS

We categorized current landscape patterns within each LSR. Similar patterns were grouped into seven pattern types based on the mixture of seral stages and patch sizes present (Map 17). The objective was to identify and prioritize treatment needs based on coarse-scale ecosystem considerations by comparing the existing landscape patterns to historical and target conditions identified in the NFP. It is important to understand that these landscape blocks characterize broad vegetative patterns. Landscape block boundaries are transitional areas rather than distinct delineations as might be inferred from Map 17. Chapter VI makes individual LSR recommendations using the landscape block concepts outlined below.

Landscape Block A – Late Seral

Current Condition Description – These areas have a high percentage (72-87%) of late-successional forest, mostly old growth, and equal portions of earlier seral stages. The average late seral patch size is 350 acres (300-375 acre range), providing highly functional habitat for interior habitat and connectivity.
Objective – Maximize long-term functioning of late-successional habitat, allowing for localized short-term impacts.

Landscape Blocks B – Mixed Seral dominated by late seral

Current Condition Description – These blocks have a mix of seral stages, but are dominated by late-successional. Fragmentation of late-successional exists, which impacts interior forest condition.
Objective – Maintain the current function of existing interior forest and connectivity. Blocking treatments geographically will promote developing large patches of developing late-successional forest.

Block B1

Description - Late-successional forest occupies 52 to 65 percent (32-48% old growth) of the block with an equal mix of the earlier seral stages.
Objective - Use a mix of activities within an area to develop large patches. Buffering commercial thinning should occur in stands adjacent to existing interior habitat.

Block B2

Current Condition Description – Late-successional forest occupies 32 to 55 percent (24-49% old growth) of the block with early seral dominating the earlier stages (~25-50%).
Objective - The priority in this area is for precommercial thinning in early seral stands. Buffering adjacent interior forest is not a concern when working with this seral stage.

Landscape Block C - Mixed Seral dominated by mid seral

Current Condition Description – Late-successional forests comprise 22 to 52 percent of the area (2-18% old growth) with mid seral stands dominating earlier seral stages (30-40%). Some of the larger patches of mid seral may be transitioning to functioning late seral habitat.
Objective – Protect mid seral stands that are currently functioning or transitioning. Mid seral patches should be evaluated for risk before treating and treatment should be limited to smaller portions of these stands. Priority for treatments would be in the early and early-mid seral stands. Treatments in early and early-mid should be aggregated to promote large patches of developing late seral forest.

Landscape Block D – Mixed Seral dominated by mid seral.

Current Condition Description – Late-successional forests comprise 50 percent of the area (40% old growth) with mid seral dominating earlier seral stages. Fragmentation is not as extreme as in block B with larger late-successional patches and mid seral are often adjacent to these late-successional patches. Some of the mid seral stands may be transitioning to functional late-successional habitat.
Objective – Protect existing late-successional forests. A priority would be to treat non-functioning mid seral stands to create larger patches of late-successional habitat in the short to mid term.

Landscape Block E – small isolated mixed seral.

Current Condition Description – This block describes the small LSRs located near the Willamette Valley with various amounts of each seral stage. Their small size and isolation puts them in a separate landscape block.
Objective. The objective is to maintain and protect existing late-successional forest. Any treatments should follow the successional pathways (pg. 16).

Landscape Block F – Mid Seral

Current Condition Description – Fire regenerated mid seral stage patches averaging 120 acres dominate this landscape block. Late seral stages comprise 7 to 28 percent (7-20% old growth).
Objective - Protect functioning mid- and late-successional habitat. Priority would be to treat earlier seral stands. Evaluation of the current function of mid seral stands is important. Treatments to these stands may be risky because they are often the closest to functioning late seral that is present in these blocks.

RECOMMENDATIONS - LANDSCAPE BLOCKS

Landscape blocks can provide information on prioritization, scheduling, and site level consideration for treating densely stocked, early to mid seral conifer stands.

- Landscape block A represents the best late-successional habitat in these LSRs. Treatments, when needed, within block A should be scheduled in a group to minimize the number of entries and disturbance. Quartzville, Horse Creek, and South Santiam have significant amounts of block A.

- The highest priority for treating densely stocked early and early-mid seral stands is in landscape blocks B1, B2, and C. (Quartzville, Jefferson, Santiam, Fall Creek and Hills Creek). These landscape blocks have the potential to develop a significantly greater number of stands with late-successional structure over the next 20 to 50 years. The highest priority for treating densely stocked mid seral stands is in landscape block D (Jefferson).

- In landscape block E (Wiley, Whitcomb, Thomas Creek), the most important function is to serve as a refuge for late seral species and provide connectivity as stepping stones for larger, more mobile species.

- Landscape block F (Hagan and south Santiam) is a low priority for density treatment, but is a high priority for treatments to accelerate the accumulation of down logs and snags.

CONNECTIVITY WITHIN LSRS

Within LSR connectivity was addressed in the landscape block identification and evaluation and was modeled using the dispersal distance for the red tree vole (382 m) (see previous section for more details). The objective of the latter analysis was to identify the most obvious breaks in late-successional habitat within the LSRs. Management strategies concerning connectivity for individual LSRs can be found in “LSR Specific Treatment Criteria and Needs”.

RECOMMENDATIONS, WITHIN LSR CONNECTIVITY

- Thomas Creek LSR has the least connected habitat, primarily because of an overall absence of late-successional habitat. When reasonable, treatments that enhance and accelerate late-successional habitat is important for these LSRs. The condition of these LSRs can be further improved if treatments can be implemented to improve connectivity.
- Connectivity of federal lands within Whitcomb, Fall Creek, South Santiam, Jefferson, and Quartzville is negatively impacted in some areas. Connectivity within South Santiam, Jefferson, and Quartzville are further impacted by private in-holdings. These conditions result in isolated blocks of habitat or habitat connected by narrow pathways. Restoring and avoiding further degradation of connectivity within these areas should be a priority when developing treatments.

ROAD DENSITY

Analysis results indicate nearly five-fold difference of road impacts among LSRs. These results suggest that, although the LSRs have individual sites that are heavily impacted, the total acreage impacted by roads is highly variable among the LSRs. Within each LSR, there are likely to be specific sites where high road densities cause significant adverse effects to late-successional forests and associated species. These sites should receive special consideration for treatment to reduce or eliminate those adverse effects. Appropriate actions include obliteration, closure (either seasonal or yearlong), or special maintenance guidelines to meet specific objectives (e.g., elk security).

The recommendations that follow are based upon three assumptions. First, allocation of funds and resources to accomplish short- and long-term road management objectives are likely to be substantially contingent upon LSR forest management activities (e.g., timber harvest). Second, whereas the maximum benefits to late-successional species and LSR goals might be achieved by reduction of road mileage to near zero, this strategy would fail to meet other resource goals related to human use of LSRs, such as access to public recreation sites and private inholdings, fire control, and forest administration. Third, these recommendations assume that the most critical site-specific road management activities are likely to be completed during the first few years of NFP implementation, and that activities that address the larger landscape level road issues, such as overall road density, will become increasingly higher in priority as site-specific projects are completed. Watershed Analyses have been completed for most of the LSRs and contain key information and recommendations concerning road impacts and proposed closures.

Based upon our interpretation of the analysis and above-mentioned assumptions, the following management activities are recommended:

- LSR activity planning and scheduling should seek opportunities to remove low priority and high impact roads at the time when funds are generated from forest management activities. The goal is to optimize silvicultural benefits to late-successional forests with exploitation of opportunities to manage the road network.

- Those portions of LSRs above 2 mi./mi^2 should receive special attention for treatment so that they can meet long-term objectives, LSR-wide. This recommendation is especially pertinent to Fall Creek (RO219) and Quartzville (RO213) LSRs. Other information, such as other access rights, recreation objectives, or other unknown road uses, were not incorporated into this analysis. Based upon the 2 mi./mi^2 figure, we estimate the following potential miles of road treatment as a long-term objective:

Table IV-1. Road miles currently in LSRs and long-term road mile objectives.

LSR Name	LSR Number	Total Road Miles	Road System Miles @ 2 mi./mi^2.	Road Miles Recommended for Treatment
Fall Creek	RO219	386	206	180
Quartzville	RO213	431	261	170
Jefferson	RO214	170	125	45
Waldo West	R0220	194	162	32
Hills Creek	RO221	80	52	28
South Santiam	R0215	107	87	20
Thomas Creek	RO246	17	7	10
Whitcomb	RO212	20	12	8
Horse Creek	RO218	88	84	4
Hagan	RO217	17	29	0
Wiley	RO216	1	2	0

- Priority should be given to those LSRs and portions of LSRs that suffer the highest level of adverse impacts due to roads, as estimated by overall road density. Treatment preference should be given to those roads that contribute the most to adverse impacts to sedimentation and risk of mass failure, interior forest, CWD, wildlife security, or fire risk.

- Regardless of mean road density, special site-specific considerations may prompt the need to meet higher priority, short-term LSR objectives. These include risk of road failure near fish-bearing streams, high risk of human-caused fire, protection of archeological and sensitive ecological sites, etc., which are likely to take precedence over more widespread yet less site-sensitive considerations.

STAND LEVEL TRIGGERS AND TREATMENT CRITERIA

STAND DENSITY AND SERAL STAGE

The previous section identified landscape vegetative patterns and conditions that might trigger treatments within the LSRs and the process to determine those areas. At a finer scale, the landscape triggers are the result of a variety of existing or potential individual stand conditions within the LSRs. This is largely a result of past land-use patterns and/or practices. These individual stand or site-specific conditions are also part of the triggering mechanism. Site-specific analysis in conjunction with the landscape level evaluation is essential to determine if an area would require some sort of vegetative manipulation to achieve or accelerate attainment of desired late-successional characteristics.

Studies have shown that accelerated development of many of the structural components of late-successional stands can be achieved (Oliver 1990, Marshall 1991). The effects of accelerated development of structural characteristics on ecosystem processes (i.e. tree growth and maturation, death and decay, disturbances), and functions (i.e. nutrient and hydrologic cycling, buffering of microclimates, storing carbon), however, are not known. Some processes and functions cannot be accelerated and will simply take time to develop. We recommend enough variability in treatments and enough untreated land to provide for any unknown elements, functions and processes. The decision not to treat a site is appropriate when:

- Stands are at the desired condition or on a path to achieve them in a desirable time frame.
- Entry into the area is undesirable or not feasible, due to restrictions such as potential impacts to specific species, access management objectives and others.
- Landscape diversity is an issue.

DENSE UNIFORM CONIFER STANDS

Dense, uniform stands have always been a part of the landscape; however, the amount and distribution of these stands now occurring in these LSRs is inconsistent with the range of natural conditions. These stands will be the primary focus for manipulating vegetation to provide the structural conditions associated with late-successional habitat.

Early through mid seral stands currently occupy about 155,878 acres (47%) of land within the LSR allocation across the landscape. Approximately 71,867 acres (22%) are in early seral stands, while somewhat older early mid seral stands make up approximately 23,947 (7%) acres. Many of these stands may benefit from density management within the next 30 years. Mid seral stands currently on a suitable trajectory for attainment of most late-successional characteristics may benefit from less intensive treatments. These include creating snags and large down wood, planting shade tolerant species which do not have existing seed sources, and road closures or obliteration.

Commercial thinning opportunities are predominately in the "dense uniform conifer stands" of the early mid seral stands. Only a portion of mid seral stands would be treated. Throughout the LSR, federal forest management agencies are predicting that about 7,000 acres per year will be scheduled for manipulation of vegetation to accelerate the attainment of late-successional conditions. Locations of these treatment areas will be based on the priorities described in landscape blocks.

Table IV-2 displays the amount of early seral dense conifer stands available for treatment in the LSRs, the number of acres proposed for treatment in the next 1-5 years and the next 6-10 years. These figures are ranger district and resource area estimates based on the current vegetative condition and out-year planning for silvicultural treatments. The same information is given for the early-mid seral stands and the mid-seral stands. Those seral stages are combined in this table. However, stands older than 80 years that are still in the mid-seral condition may be proposed for treatment, subject to REO review, are displayed for information. The acres proposed for treatment are gross stand acres. The actual treatment areas, especially for the commercial thinnings, will likely be less than the acres shown due to many factors: no-treatment buffers in riparian reserves, inoperable areas due to soil sensitivity or logging systems, site-specific species mitigations, and areas that after on-site visits are determined to be on the right trajectory. All treatments are subject to adequate agency funding for planning and project preparation.

Table IV-2. Acres in LSRs with potential treatment opportunities

LSR		Proposed Precommercial Thin 1998-2002	Proposed Precommercial Thin 2003-2007	Total Acres Early	% Area Treatment	Proposed Commercial Thin <80 1998-2002	Proposed Commercial Thin <80 2003-2007	>80 1998-2007	Total Acres Mid	% Area Treatment
Whitcomb Creek	RO212	163	180	735	**47%**	224	434	0	835	**79%**
Quartzville	RO213 (FS)	2,373	2,708	12,664	**40%**	2,787	1,726	500	12,713	**39%**
Quartzville	RO213 (BLM)	895	1281	6,068	**36%**	567	585	0	4,964	**23%**
Jefferson	RO214	5,000	500	9,394	**59%**	300	700	200	10,127	**12%**
South Santiam	RO215	862	421	3,232	**40%**	1,123	477	1,000	13,993	**19%**
Wiley	RO216	0	0	98	**0%**	0	0	0	24	**0%**
Hagan	RO217	0	0	261	**0%**	0	0		8,164	**0%**
Horse Creek	RO218	869	553	3,852	**37%**	0	900	0	5,303	**17%**
Fall Creek	RO219	2,946	4,894	14,828	**53%**	6,718	5,000	0	19,407	**60%**
Waldo West	RO220	1,800	1,200	15,889	**19%**	800	1,700	0	2,500	**45%**
Hills Creek	RO221	450	300	4,630	**16%**	0	200	0	200	**13%**
Thomas Creek	RO246	50	60	216	**0%**	82	44	0	1,295	**0%**
TOTAL		15,358	12,037	71,867	**38%**	12,519	11,722	1,700	84,011	**31%**

MANAGEMENT CRITERIA, DENSELY STOCKED CONIFER STANDS

Guidelines and criteria for silviculture treatments in densely stocked early seral stands (precommercial thinning and release) and treatments in densely stocked early-mid and mid seral stands (commercial thinning) were developed by the REO and are documented in REO memos of May 9, 1995 and July 9, 1996 (Appendix K). These guidelines and criteria should be applied to landscapes where the objective is to follow accelerated pathways to attain late-successional characteristics both spatially and temporally. Treatment criteria and considerations in these memos include:

- Variable thinning densities,
- Creating small gaps,
- Promoting species diversity,
- Creating structural components (snags and down wood).

The treatment criteria in those memos reflect the landscape in this assessment area. They shall be the desired landscape condition and will be considered when designing silvicultural treatments of densely stocked conifer stands in this assessment area. We anticipate evaluating these criteria at the project area level (approximately 100 to 1000 acres). The exception is the criteria for coarse woody material *(See Coarse Woody Debris section).* In all circumstances, we feel it is critical that the final treatment prescription reflects the specific conditions and needs of each stand as well as the landscape. The memos cited above and the recommendations in this assessment provide the sideboards for treating the densely stocked stands to achieve the LSR objectives. However, each stand and situation is unique and each treatment prescription must be designed with that in mind.

INTERIOR FOREST CONDITIONS

Criteria to consider in the design and location of silvicultural prescriptions is the potential to adversely affect interior forest function in nearby stands. In early-mid and mid seral stands, prescriptions for thinning that substantially open canopies to wind and solar radiation, especially if these openings persist for several years, can have lasting detrimental effects. Therefore, it is essential that prescriptions be designed to protect interior forest functional conditions, yet achieve, as possible, other late-successional forest objectives.

In Chapter II of this assessment, the existing conditions of interior forests were evaluated by comparing different width bands around existing mature and old growth stands. These bands can be interpreted as the area where silvicultural prescriptions that eliminate or significantly reduce forest microclimate stability have potential to affect interior forest functions. Thus, silvicultural activities that significantly open stands within 120 meters of late-successional patches to wind, solar radiation or increased air temperature are likely to adversely impact biological functions in nearby interior forests. Similarly, these same activities within 240 meters may affect measurable physical functions. In extreme cases, interior functions up to 400 meters into a late-successional interior forest could be affected.

Based on the previously defined functional bandwidths used to evaluate the condition of interior forest, a similar GIS analysis creates “effects bands” within early-mid and mid seral stage forests in the analysis area. The effects bands were created by buffering all late-successional forests by bands of 0-60 m, 61-120 m, 121-180 m, 181-240 m, 241-400 m and 400+ m into existing early-mid and mid seral stage stands. Silvicultural prescriptions that eliminate or significantly reduce forest microclimate stability in these bands have potential to adversely affect interior forest functions.

The estimated portion of each LSR that lies within each effects band is shown in Table IV-3 by LSR. A total of about 89,718 acres of mid and early-mid seral stage forest stands are potentially available within LSRs for application of silvicultural prescriptions that would accelerate growth of these stands to late-successional conditions.

In large blocks of early-mid and mid seral stage habitat within LSRs, such as Landscape block B1, these principles could be applied in such a way that heavier thinning would occur greater than 240 m from the edge of existing late-successional forests, with a gradual decrease in intensity of thinning as the prescription area approaches the late-successional forest edge. Within 60 to 120 meters of the edge, thinning would be mostly of single tree or clump selection to meet very specific goals while retaining near optimal canopy closure. This landscape pattern would provide a wide range of densities and canopy retention on the larger landscape in bands around late-successional stands, a pattern not unlike that found following natural disturbance events.

Application of these principles could be modified given due consideration of landscape features that alter the effects of edges (seral stage, aspect, slope, elevation, prevailing wind direction, etc.) and other site-specific management goals for late-successional forests and associated species.

Analyses the range of natural conditions can set a context for the importance and priority of interior forest. This historic level could be used to assess the amount of edge currently existing in each LSR, and the relative priority that recovery of interior forest conditions has among the various resource management issues within each LSR. For LSRs where the existing landscape is highly fragmented as compared to the reference period, such as Quartzville, maintenance and recovery of interior forest would be a high priority, and justify careful consideration of potential effects of proposed silvicultural activities. Where interior forest edge effects are lower, such as Hills Creek or Waldo West, as estimated by the degree of fragmentation of existing late-successional forests, less emphasis of this issue might be warranted.

Table IV-3. Total acres of early-mid and mid seral stage forest stands within each effects distance band (0-60, 61-120, 121-180, 181-240, 241-400, and >400 meters from edge of late-successional forest stands).

Late-Successional Reserve Name		Early-mid & Mid 0-60 meter band	%	Early-mid & Mid 61-120 meter band	%	Early-mid & Mid 121-180 meter band	%	Early-mid & Mid 181-240 meter band	%	Early-mid & Mid 241-400 meter band	%	Early-mid & Mid > 400 meters band	%	Total Acres in Early-mid & Mid seral
Whitcomb	RO212	254	28.6	195	21.9	134	15.1	88	9.9	145	16.3	73	8.2	889
Quartzville	RO213	7,262	34.4	4,610	21.8	3,135	14.9	1,963	9.3	2,703	12.8	1,437	6.8	21,110
Mt. Jefferson	RO214	3,881	32.0	2,257	18.6	1,643	13.6	1,199	9.9	1,948	16.1	1,193	9.8	12,121
South Santiam	RO215	3,467	24.4	2,544	17.9	2,044	14.4	1,598	11.3	2,554	18.0	1,986	14.0	14,193
Wiley	RO216	47	54.7	16	18.6	8	9.3	8	9.3	7	8.1	0	0.0	86
Hagan	RO217	577	7.1	530	6.5	516	6.3	490	6.0	1,183	14.5	4,876	59.7	8,172
Horse Creek	RO218	2,674	48.7	1,299	23.6	681	12.4	358	6.5	375	6.8	108	2.0	5,495
Fall Creek	RO219	6,844	35.3	4,554	23.5	2,975	15.3	1,681	8.7	1,559	8.0	1,771	9.1	19,384
Waldo West	RO220	2,823	50.3	1,283	22.9	778	13.9	423	7.5	300	5.3	4	0.1	5,611
Hills Creek	RO221	734	46.7	321	20.4	174	11.1	121	7.7	179	11.4	44	2.8	1,573
Thomas Creek	RO246	189	17.4	133	12.3	53	4.9	37	3.4	40	3.7	632	58.3	1,084
Totals (all LSRs)		28,752	32.0	17,742	19.8	12,141	13.5	7,966	8.9	10,993	12.3	12,124	13.5	89,718

MANAGEMENT CRITERIA, INTERIOR FORESTS

Early Stands

- Silvicultural activities such as precommercial thinning that are otherwise consistent with recommendations in this document likely will have insignificant effects upon interior forest conditions.
- The greater consideration for these stands is the application of silvicultural treatments that are consistent with mid- and long-term goals for the management of late-successional forests and associated species.
- Silvicultural prescriptions should consider mitigation strategies (e.g., maintaining dense canopy closure to suppress shade-intolerant invasive non-native species) that might be identified during site-specific analysis by local interdisciplinary terms.

Early-mid stands

- Silvicultural activities within stands that lie greater than 240 meters from existing late-successional stands are unlikely to have any measurable effect on the physical or biological functions of interior forest when, otherwise, consistent with recommendations in this LSRA.
- Silvicultural prescriptions that reduce canopy closure in stands that are 120 to 240 meters from existing late-successional stands should aim to achieve rapid growth response of retention trees and consequent canopy recovery. This may occur at a longer time interval than that acceptable in mid seral stands.
- Silvicultural prescriptions in stands that lie less than 120 meters from late-successional stands should strive to avoid increasing solar radiation, wind speed, and windthrow in adjacent late-successional stands. The potential for these effects is lower since the edges are already highly contrasting. However, prescriptions should still aim to retain the maximum canopy closure consistent with achieving goals to improve height growth.
- There is evidence that snags as tall or taller than the surrounding stand are important to many forest dwelling bat species (Betts 1996, Vonhof and Barclay 1996, Waldein 1997, Brigham et al 1998, Ormsbee and McComb 1998). We recommend implementing stand management strategies to insure tall, exposed snags at all stages of stand development.

Mid seral stands

- Silvicultural activities within stands that lie greater than 240 meters from existing late-successional stands are unlikely to have any measurable effect on the physical or biological functions of interior forest when otherwise consistent with recommendations in this LSRA.
- Silvicultural prescriptions that reduce canopy closure in stands that lie in a zone 120-240 meters from existing late-successional stands should aim to achieve rapid growth response of retention trees and consequent canopy recovery.
- Silvicultural prescriptions that allow even short-term increases in solar radiation and wind currents into stands that lie in a zone 0-121 meters from adjacent late-successional stands can have effects lasting for 10-20 years. These include windthrow, occurrence of shade intolerant nonnative species, and desiccation of sensitive lichens and fungi in the adjacent interior habitat. Activities in this zone should aim to ensure maximum canopy closure, or rapid recovery of canopy closure where thinning occurs.
- There is evidence that snags as tall or taller than the surrounding stand are important to many forest dwelling bat species (Betts 1996, Vonhof and Barclay 1996, Waldein 1997,

Brigham et a.l 1998, Ormsbee and McComb 1998). We recommend implementing stand management strategies to insure tall, exposed snags at all stages of stand development.

COARSE WOODY DEBRIS (SNAGS AND DOWN WOOD)

Management options for CWD in LSRs will generally be limited to commercial thinning and salvage following catastrophic disturbances. For thinning activities, we recommend the following process to determine the appropriate CWD levels (Figure IV-1). The resulting strategies and recommendations may also be useful for planning projects designed strictly to restore CWD levels in the LSRs.

Recommendations on CWD ranges do not include values in the highest or lowest quartiles. Habitat needs are generally to be met in the intermediate range. We consider that prescriptions that would result in many acres at the extremes would pose substantial risk to LSRs and late-successional species, whether due to fire or insect risk levels or to large patches of low habitat complexity or availability.

The thinning prescriptions are intended to apply to the early-mid and mid seral stand conditions. Under unmanaged conditions, these stands are in the decay phase of the natural CWD volume curve (Spies 1988 and Spies 1991) where CWD values would naturally be high. Under managed conditions CWD can be dramatically lower. Management strategies in these stands will affect the rate at which they approach the CWD accumulation phase.

For salvage prescriptions we recommend the process outlined in Figure IV-2 under the subsection entitled “Recommendations for CWD following Disturbance”.

EVALUATE LANDSCAPE CONDITIONS
- existing levels of CWD in surrounding areas
- connectivity concerns
- fire risk zone

↓

EVALUATE STAND CONDITIONS
- identify vegetation series
- identify stand seral condition
- existing CWD in stand to be treated
- local fire risk
- species specific concerns, considerations

↓

SELECT STRATEGY 1-4
- determine appropriate strategy based on landscape and stand considerations

↓

REVIEW OVERALL CWD RECOMMENDATIONS

↓

DEVELOP CWD PRESCRIPTION FOR THINNING ACTIVITY
- identify appropriate cover % or volume/acre based on tables
- identify other CWD considerations
- document rationale for prescription
- demonstrate progress in meeting CWD objectives

Figure IV-1. Process for Determining CWD Levels in Early-Mid and Mid Seral Stand Treatments

Strategies for CWD when Thinning Appropriate uses of the strategies below require consideration at the landscape and site specific scale. Site specific considerations involve soil, wildlife refugia, aquatic resources, and operational feasibility in balancing benefits from density management for future live and dead structural components with providing snags and down wood to meet current ecosystem functional needs. CWD ranges for a site were developed from CVS data for mid, mature, and old growth stands. There will be occasions when on-site CWD levels may not be within the ranges, due to high initial legacy levels, operational feasibility, or a species specific habitat needs.

Landscape scale considerations (connectivity for species, fire risk, and range of natural conditions) should be weighed in the development of CWD objectives. The intent of the CWD recommendations is to meet median amounts of coarse wood on a landscape over the long term with the full range of variability. Prescribed amounts of CWD are not intended to be met homogeneously on every acre treated. We have provided volume ranges to allow adaptability to meet natural variability, to balance specific management objectives, and to account for sites where past management or natural events have precluded high levels of coarse wood retention.

The numbers of snags and amount of down wood prescribed within treatment units will be assessed over approximately 10 acre areas to determine compliance with the average trees or pieces per acre or volumes per acre in the prescription.

For early-mid stands, recommendations are given in volumes or percent cover of down wood. The cover recommendations reflect research on small mammals (Carey and Johnson 1995). They are intended to provide a distribution of favorable habitat over a range of percentages of the treatment units, rather than attempting to achieve a lower average cover homogeneously across the area. With the smaller, uniform size classes available in this seral stage, and emphasis on accelerating late seral live structural components, we designed more flexibility in the distribution of CWD. Cover can be assessed over areas up to 40 acres. Connectivity with adjacent habitat can be addressed more effectively, while fuels management may be facilitated over a larger area. Volume ranges are also provided for prescriptions where meeting optimal small mammal habitat (or for species with similar habitat requirements) may not be the primary CWD objective.

Strategy 1: Meet short-term needs for CWD

This strategy only applies under severe conditions over small areas. Landscape and site conditions that may trigger selecting this strategy include:

1) Landscape area around treatment area is low in CWD.
2) Site productivity is an issue.
3) There are species specific needs for refugia and connectivity.
4) Local conditions analysis reveal short term CWD needs.

Benefits from adopting this strategy:

a) Adds an immediate CWD pulse into the ecosystem; adds wood to the soils system for productivity; benefits fungi and invertebrates.
b) Creates some vertebrate habitat quickly to meet management goals of CWD (e.g., small mammal populations near owl sites, expand habitat for Oregon slender salamander near known populations, etc.).

Potential negative impacts from this strategy:

a) Could compromise other objectives such as canopy closure.
b) Habitat quality and persistence of CWD may be limited by size classes available.
c) Could compromise long-term availability of large trees for live stems or snags and logs in the future.
d) Restoration treatment economics and logistics may not be favorable.

Table IV-4. Ranges of snags and logs for Strategy 1:

Series	**Early-mid *down wood only***		**Mid**		
	volume (cu.ft/ac)[1]	10% ground cover	**Large. Snags**[2] **minimum** Tpa	**Total snags protected** Tpa	**Logs** (cu.ft/ac)
ABAM/ABGR	2500-4000	over 50-75% of the area	20	60	1000-3000
PSME	3000-4500		15	45	1500-2500
TSHE	3000-4500		10	50	1500-3000

[1]Volume of down wood of stems >3"diameter and 8' in length
[2]Snags at least 21"dbh or in largest third of stem diameters

Values for treating mid seral stands in Table IV-4 are drawn from the high end (75th quartile) of the range of large snags for natural mid seral stands (see Appendix F). The numbers include a minimum number of large snags (from the largest 1/3 of the diameters in the stands) as well as a total number of snags that are to be protected. Total protected snags reflect the sum of the 75th quartile for numbers of large snags and the low end (25th quartile) of the small snags between 9 and 21" dbh. Down log levels range from the median to 75th quartile volumes for natural mid seral stands. Volume ranges for early-mid seral stands are scaled from data on young stands given in Spies (1991). This strategy is designed to supply a short-term need for CWD components in ranges suitable for late-successional species and is not intended to mimic successional paths of natural stands.

While this strategy may approximate the total amount of CWD within these seral stages, the prescription does not necessarily match the distribution of size or decay classes, due to past management activities. By necessity, these prescriptions replace the lost soft CWD with hard CWD from existing green trees.

Strategy 2: Balance long-term and short-term goals for CWD

Landscape and site conditions that may trigger selecting this strategy include:
1) CWD in landscape is generally low to moderate but on-site CWD loading is not of immediate concern.
2) Species specific needs for refugia and connectivity are important.

Benefits from adopting this strategy:
a) More flexibility than under Strategy 1 in determining amounts, types, and distribution of CWD on site for current treatment and future entries.
b) Improving short-term habitat for some vertebrate species.
c) Improving fungal and invertebrate habitat.
d) Improving economic feasibility of treatment compared to Strategy 1.
e) Provides greater flexibility to develop other structural elements of late seral conditions compared to Strategy 1.

Potential negative impacts of this strategy:
a) CWD quality may not meet optimal condition, especially in the short term.
b) May be outside range of natural conditions for some CWD characteristics.
c) May retard attainment of some elements of late seral conditions over the long term.

Table IV-5. Range of snags and logs for Strategy 2.

Series	**Early-mid-*down wood only*** 10% ground cover[1]	**Mid** **Large snags[2] Minimum** Tpa	**Total snags protected** Tpa	**Logs** (cu.ft/ac)
ABAM/ABGR	over 25-50% of the area	10	50	750-2000
PSME		10	25	1000-2000
TSHE		5	35	1000-2000

[1]Volume of down wood of stems >3"diameter and 8' in length
[2]Snags at least 21"dbh or in largest third of stem diameters

Values for treating mid seral stands in Table IV-5 are drawn from the higher range (median to 75th quartile) of the range of large snags for natural mid stands (see Appendix F). The numbers include minimum number of large snags (from the largest 1/3 of the diameters in the stand) as well as a total number of snags which are to be protected. Total protected snags reflects the sum of the median for numbers of large snags and the low end (25th quartile) of the small snags between 9 and 21" dbh. Down log levels bracket the median volume for natural mid seral stands. This strategy is intended to ensure a moderate supply of CWD components for the short- and mid-term. For early-mid seral stands, volume ranges are not included since available CWD quality (size, persistence) is not as important in the short-term to habitat objectives for Strategies 2 as for Strategy 1.

Strategy 3: Emphasize long-term CWD objectives

Landscape and site conditions that may trigger selecting this strategy include:
1) A high percentage of the landscape is late-successional or optimal CWD levels already exist.
2) Connectivity is not a short-term issue.
3) Site specific risks of disturbance to species of concern are low.

Benefits from adopting this strategy:
a) High likelihood of achieving long-term high quality CWD levels.
b) Maintains future options in managing stand structure.
c) Less likely to be economically constrained than Strategy 1 or 2.
d) Lower short-term risk for species dependent on other structural characteristics (e.g. canopy closure).
e) Ensures more variability at the landscape level within conditions such as Landscape Block A.
f) Lower fire risk.

Potential negative impacts from this strategy:
a) Higher short- and mid-term risk for some species.
b) Random event may preclude achieving long-term goals.

Table IV-6. Range of snags and logs for Strategy 3.

Series	**Early-mid-*down wood only*** 10% ground cover[1]	**Mid** **Large snags**[2] minimum # Tpa	**Total snags protected** Tpa	**Logs** (cu.ft/ac)
ABAM/ABGR	over 15-25% of the area	2	30	500-1000
PSME		5	25	1000-1500
TSHE		2	35	500-1500

[1]Volume of down wood of stems >3"diameter and 8' in length
[2]Snags at least 21"dbh or in largest third of stem diameters

Values for treating mid seral stands in Table IV-6 are drawn from the lower quartile range (25th quartile to median) of the range of large snags for natural mid seral stands (see Appendix F). The numbers include a minimum number of large snags (from the largest 1/3 of the diameters in the stand) as well as a total number of snags that are to be protected. Total protected snags reflects only the low end (25th quartile) of the small snags between 9 and 21" dbh. Another condition for Strategy 3 is when more emphasis is placed on achieving maximum rate of green tree growth to meet long-term objectives. In mid stands, this strategy is intended to mimic successional paths of natural stands while ensuring a moderate level of CWD components for the short- and mid-term. Down log levels range from the 25th quartile to median volumes for natural mid seral stands. For early-mid seral stands, volume ranges are not included since available CWD quality (size, persistence) is not as important in the short-term to habitat objectives for Strategies 3 as for Strategy 1.

The project analysis should include the rationale for the final prescription built on the process and strategies explained above including description of how and when CWD objectives will be achieved.

ADDITIONAL MANAGEMENT RECOMMENDATIONS FOR CWD

Early-mid Seral

Prescriptions for snag and down wood levels in young managed stands need to address accelerating attainment of late seral structure. This means managing densities to promote diameter growth while retaining enough trees to ensure the future complement of large snags and logs. There will be cases where the treatment would not be economically viable if down wood recommendations below were met immediately. In such cases, the loss of down wood function over the short-term should be compared to gains toward other objectives in attaining other late-successional characteristics such as tree size, stocking or other considerations.

The following recommendations for snags apply to early-mid seral stands:

- Protect all existing large snags (greater than 21" dbh) Consider retention of live trees to protect large snags or clumps of smaller snags. Retain logs created from existing snags dropped during treatment for CWD.
- Manage for long-term gain in snag sizes and numbers. Note that under natural conditions, this seral stage has a rich legacy of snags in larger sizes from the pre-disturbance stand. The small snags from the plantation will not persist as long as large snags, nor provide the same wildlife habitat. Thus, small snags are not

generally an effective substitute for large snags, even if they include equivalent volume.

- Leave enough trees to grow and become snags in the future. The largest green trees available may be ones most likely to provide future structural components, becoming the largest dominants or wolf trees, and may be more valuable live than as snags.
- Consider stem inoculation of small trees to initiate heart rot so that cavity nesters can use them earlier.
- Create snags in older stands.

Mid Seral

CWD levels from treating mid stands are intended to provide the quality and quantity of snags and logs associated with successional processes in the transition into the late seral stage. The levels are also intended to provide immediate habitat for CWD associated species.

The following recommendations are supported by CVS data and apply to mid seral stands**:**

- Leave large hard logs, where available, to make up a minimum of 20 percent of the prescribed down wood volume. This will provide for continuity in current habitat and ensure mid- to long-term availability of soft logs. If present, existing soft logs may be counted to make up 60-80 percent of down wood volumes under the prescriptions.
- Protect existing large snags or groups of small snags when possible. Clumping green trees around snags may protect them during thinning operations.
- CVS data shows that generally in late-successional stands, 40 percent of the snags were soft. Where present, up to 40 percent of snags in the prescription can be accounted for from existing soft snags. The remainder should come from the green trees or hard snags on the site.
- Emphasize snags in the 21”+ dbh classes. If live 21”+ trees are not present or where they must be retained to meet green tree objectives, then snags will be created from trees in the top third of the stand’s diameter range. If there are less than the minimum number of large snags, these must be created from the largest third of the stand diameters. The remainder of the total number of snags to be protected can be filled with smaller existing snags (down to 9” dbh). The low end of small snag ranges (up to the 25th quartile) for the mid stands was used because the large numbers of small snags in that seral stage is generally the result of natural thinning. Retaining at least the lower quartile of small snags found in natural stands should provide for the habitat and site productivity functions performed by standing dead trees in those size classes, as well as near to mid-term inputs of down logs in the small diameter range. Creating a higher number could limit the retention of the live trees desirable for the longer-term stand structure, while also having the potential for increasing fire risk or operational feasibility. Only create snags to meet the minimum number of large (>21”, >16’) snags.

  Example 1: (Under Strategy 3) a western hemlock zone stand has 3 large snags/acre and 25 small snags. All existing snags here are to be protected, since the desired protected snag level is 35. Two additional large snags are to be created to meet the minimum level of 5 large snags.

  Example 2: (Under Strategy 3) a western hemlock zone stand has 6 large snags and 10 small snags. Large snag levels are met. All snags would be protected. No further snags would be created during this treatment.

Initial snag and down wood levels may be somewhat lower than overall project objectives when significant additional mortality or snag fall are anticipated immediately following treatment. CWD objectives should generally be met within 5 years of a thinning treatment. Injuries to live trees during harvest, windthrow, breakage, or insect attack may increase new down wood or create new snags. CWD monitoring in year three would allow K-V funds, or other sources such as Jobs-in-the-Woods, to be used to create more CWD if needed.

Where Douglas-fir bark beetle infestation risk is high, down logs can be created in pulses within a 5-year period to decrease the total of fresh logs present in any one period. For example, a third of the logs could be felled during the treatment, a third after monitoring using KV or other funds, and the remainder recruited from girdled trees.

Additional consideration should be given to root rot pockets that will provide down wood in the near future. Snags created by root rot will not last long in the stand. Consider these snags as part of the existing down wood component rather than counting them toward snag objectives.

HOLLOW LOGS AND TREES

Because hollow logs and trees, like snags and down wood, provide a unique habitat niche associated with decay and advantageous to wildlife, they have been included in this section. Although several tree species can become hollow, western redcedar is a tree species found in the west slope of the Cascades that is prone to heart-rot. The hollowing process and the creation of entrance points to the interior chamber can be augmented by fire events when sparks find their way to the rotting interior. Wildlife species that use hollow trees include pileated woodpecker, spotted owl, Vaux's swift, marten, fisher, and several bat species. Hollow trees offer large chambers for roosting and denning and since the trees are still alive, they can provide this unique habitat year round for several decades. Trees with heart-rot are the only source of hollow logs. The following criteria should be considered in treatments that may affect hollow log and tree habitats and as possible triggers to enhance this habitat component in the LSRs.

- Survey stands for hollow trees and logs. Protect these structures and the adjacent microclimate where possible. Retain hollow logs or hollow log candidates where possible.
- Protect western-red cedar groves or individual trees whenever possible as future legacy for hollow trees and logs.
- Create openings into hollow trees and experiment with inoculation when K-V or other funding is available.
- Consider seasonal restrictions for harvest and burning activities affecting hollow trees that are occupied by wildlife during breeding season or when being utilized as a winter roost or den.

MANAGEMENT RECOMMENDATIONS FOR REDUCING FIRE RISK

Fire risk must be considered in prescribing CWD levels, especially for Strategies 1 and 2. Fire risk at the landscape and local scales will determine whether fine fuels must be treated and reduced as part of the prescription. Refer to Map 8 to determine landscape fire risk. Local fire risk is determined by local potential for fire starts (e.g., near high use recreation, heavy traffic, high lightning frequency, etc.), local fuel loading, and local topography that is likely to lead to rapid fire spread which would be difficult to contain. Fine fuels are limbs, twigs and other forest litter less than three inches diameter that dry out quickly and contribute to rapid fire spread.

The following recommendations apply to all CWD prescriptions (See Fire Management Plan Chapter V for discussion of fire management zones):

- Treatment to reduce the amount of fine fuels is a priority in the southern fire zone where landscape fire risk is high or moderate or where local fire risk is high. This is especially true when considering Strategy 1 or Strategy 2.
- Do not prescribe high levels of CWD in the Southern Fire Zone when fine fuels can not be treated.
- Treatment of fine fuels is a priority in the Northwest and Northeast Fire Zones when landscape fire risk is high. This is especially true when considering Strategy 1 or Strategy 2.
- Treatment of fine fuels is a priority in all fire zones where the local fire risk is high.
- Treatment of fine fuels is optional in Strategy 3 or when fire risk is lower than described in the above recommendations.
- In the Southern Fire Zone, the pre-settlement fire regime produced high variability at the landscape scale, so CWD levels are expected to be similarly variable. A good mixture of Strategies 2 and 3 is expected. Outside the Southern Fire Zone, Strategy 2 is expected to be more common.

RECOMMENDATIONS FOR CWD FOLLOWING DISTURBANCE

The ROD defines salvage as the removal of trees from an area following a stand-replacing event such as those caused by wind, fires, insect infestations, volcanic eruptions, or diseases. The ROD recognizes salvage as an acceptable management practice to avoid excessive amounts of coarse woody debris or reduce high risk of future stand replacing events (USFS, 1994b). The priority is to salvage where it would help attain late-successional characteristics, e.g. to speed stand regeneration.

Salvage prescriptions are intended to apply primarily to mature and old growth stands. Under natural conditions, these stands are accumulating or have accumulated CWD. The following process describes how the appropriate CWD levels can be determined for these activities in LSRs.

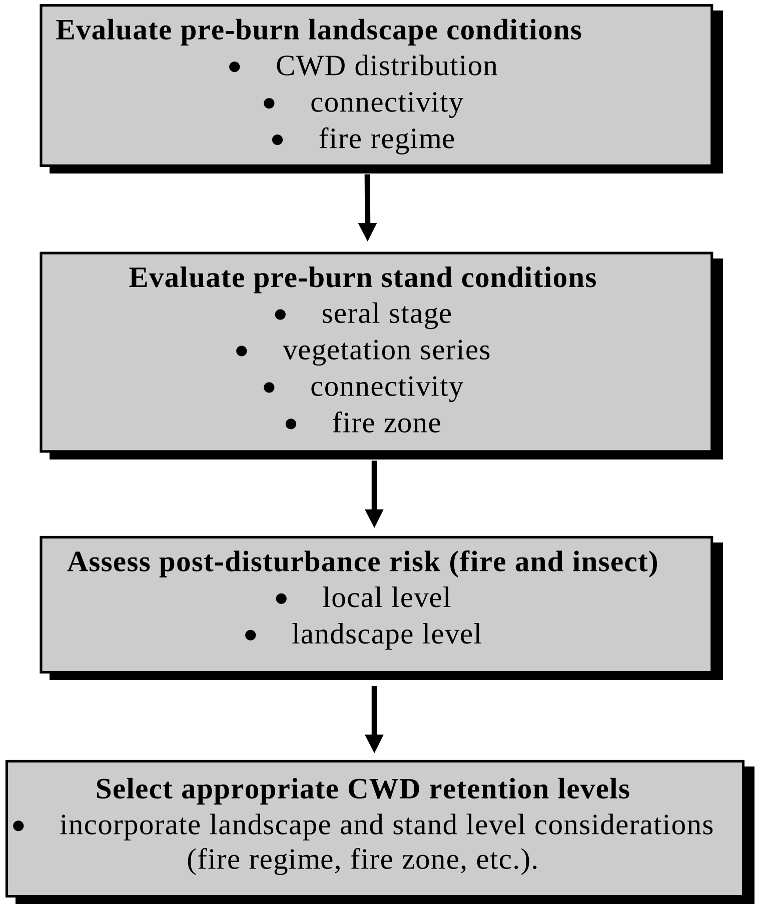


Figure IV-2. Process for Determining CWD Levels in Potential Salvage Situations.

ata are currently not available and the models are not yet validated to provide reliable ranges of CWD necessary to maintain processes and functions for series or subseries by fire regime by seral stage. Where risk levels are low, and both site and landscape objectives for CWD, connectivity, and species specific requirements have been addressed, salvage which maintains CWD levels to at least mid-range in natural late-successional stands may be expected to produce acceptable quantity and quality of related habitat components for species associated with CWD. It is acceptable to exceed the 75th quartile (high range) CWD levels where site-specific conditions warrant. Retention of a higher proportion of snags and logs in hard decay classes is necessary to provide for persistent CWD during stand recovery and the early seral stage.

In stands originally in the mature or old growth stages, leave hard CWD to within the ranges for similar stands. Snags and logs must be in the large size class (for logs, >21" diameter large end; for snags, >21"dbh, >16' height). Fire risk at landscape and local scales will determine which end of the ranges is appropriate. Table IV-7 shows fire risk criteria for CWD in salvage prescriptions. CWD Levels refer to Table IV-8 values. Fine fuels treatment is a priority where landscape and local fire risks are of concern.

Where stands to be salvaged were in mid or early-mid seral stages before disturbance, little of the small size classes of CWD is likely to persist until the new stand can contribute large CWD. In these stands, refer to Table IV-4 in the previous thinning strategies for ranges that may contribute CWD to protect soils and provide some habitat while allowing quickest rate in attainment of overall late-successional characteristics.

Where insect risk is high, recommended CWD Levels of High in Table IV-7 may be decreased to a Low-High range to allow more flexibility in decreasing infestation risk

Table IV-7. Fire risk criteria for CWD in salvage prescription.

Fire zone	Landscape Fire risk	Local Fire risk	CWD Level (in Table IV-8)[1]	Fine fuels Treatment Priority
South	High	High/mod.	Low	Yes
	High	Low	Low-High	Yes
	Moderate	High/mod.	Low	Yes
	Moderate	Low	High	Optional
	Low	High	Low-High	Yes
	Low	Low/Mod.	High	Optional
North	High	High	Low	Yes
	Low/Mod.	High	Low-High	Optional
	Low/Mod.	Low/Mod.	High	Optional

[1]Low-High means that levels from either low or high range of CWD in Table IV-8 are acceptable and can be chosen to respond to landscape and site specific conditions.

Table IV-8. CWD retention levels for mature (MAT) and old growth (OG) salvage where fire and insect risk is low.

Series	Seral stage	Snags		Down wood	
		low range	high range	low range	high range
ABAM/ABGR	MAT	4500-6500	6500-10500	1000-1500	1500-3000
	OG	4500-8500	8500-10000	2000-3500	3500-5000
PSME	MAT	500-1000	1000-1500	500-1500	1500-2000
	OG	2500-3500	3500-4500	1000-1500	1500-2500
TSHE	MAT	1500-3500	3500-6500	1000-2000	2000-4000
	OG	4000-5500	5500-9500	2000-3000	3000-5000

Every effort should be made to employ management practices that are not likely to cause catastrophic disturbances; however, it is likely that catastrophic disturbances (insects, disease, wind or fire) will eventually occur. Such disturbances may be detrimental to the goals and objectives of the LSR. In this situation, it is appropriate to employ management activities that reduce or mitigate the impacts to late-successional habitat. Management responses to disturbance events will follow the guidelines in the ROD.

Management Recommendations for CWD and Salvage

The following recommendations apply to all CWD prescriptions in salvage projects.

- All standing live trees are to be retained. If they are damaged or felled during the salvage operation, they will be retained on the site.
- Snags and down logs must be in size and decay classes likely to persist until the new stand is contributing large CWD.
- Logs in advanced decay classes can not be credited to CWD retention levels after a disturbance event (ROD 1994).
- Retention of all material where it is highly concentrated will not be required (ROD 1994).
- Biomass (cubic volume) left in snags can be credited as part of the total CWD levels.
- The species composition of the original stand will be approximated in CWD left on site.
- Note that for salvage prescriptions, soft CWD should not be removed. Soft CWD may not be counted towards recommended CWD levels for salvage; this differs from recommendations for treating stands under Strategies 1-3 for thinning in early-mid and mid seral stands.
- A mix of clumps and dispersed snags is desirable. If snag levels present following the disturbance do not meet the ranges, equivalent volumes of hard down wood will be added to the down wood retention levels to meet overall CWD needs.

RECOMMENDATIONS FOR SENSITIVE SPECIES OR HABITATS

SPECIES SPECIFIC TREATMENT CRITERIA

Species and habitats influencing management strategies within LSRs

Management activities within LSRs are to be driven by environmental considerations associated with late-successional habitat. The assumption was that many of the terrestrial wildlife species identified by FEMAT would be provided for by the late-successional reserve system. Some of these species have specific habitat needs that must be safeguarded to manage for the persistence of these species. Paying attention to these unique habitats is one of the outstanding features that sets the management of LSRs apart from that of Matrix lands.

Effectively managing LSRs requires us to be responsive to new information on habitat associations for species inhabiting late-successional reserves becomes available. There is important information about these species that was not available or considered during the FEMAT analysis. The following species, habitats, and recommendations reflect some current information relevant to late-successional habitat that we conclude is important drivers for LSR management. We also expect there is other information that can be applied for this purpose and should be incorporated into LSR management as we described in the previous section (Species of management concern).

SPOTTED OWLS

It is prudent to design management strategies within LSRs that implement all means to conserve this species and its habitat, including minimizing the incidental take of the species, avoiding the adverse modification of critical habitat, reducing competition and predation, and conducting activities in LSRs that are beneficial to late-successional forest associated species. Activities that provide long-term gains to late-successional forest conditions yet substantially delay restoration of capable habitat to suitable status may have some serious implications for spotted owl conservation. Prescriptions to treat stands should consider short-term impacts, and be designed to alleviate those impacts whenever possible. Activities in otherwise suitable habitat that rely upon long-term gains to owls to justify their short-term adverse impacts are rarely appropriate.

Silvicultural practices that improve the growth rate of retention trees so as to decrease the time to attainment of late-successional forest structural conditions are to be encouraged, when designed to attain specific forest structural objectives. These objectives should include full consideration of short-term and long-term habitat needs for spotted owls, to not delay or preclude the species' recovery.

Spotted owls are known to be adversely affected by fragmentation of late-successional forests, whereas great horned owls and barred owls respond favorably to fragmentation (Johnson, 1993), at least within the range of forest conditions commonly encountered within these LSRs. Salvage treatments may promote the development of habitat conditions that are more suitable to great horned owls or barred owls and their prey, and increase the risk of predation or competition of these species on spotted owls.

We have incorporated considerations for conservation of the spotted owl into landscape and stand level recommendations, identified elsewhere in this chapter. For example, Landscape Blocks A, B1, and D represent higher quality late-successional and spotted owl habitat conditions. Activities within these blocks are designed to maintain current connectivity and minimize the number of entries into stands, while allowing for activities that benefit this and other late-successional forest associated species. At the stand level, we have developed 3 strategies for meeting CWD objectives, based upon whether priorities are for short-term or long-term gains, or some balance of these options. Consideration of spotted owl conservation needs can be incorporated into decisions to adopt any of these strategies for this essential habitat component.

Within these overall landscape and stand level recommendations, local implementing teams are encouraged to consider the following recommendations to ensure the conservation of the spotted owl within the LSR network.

Suitable Habitat

Habitat modifying activities in LSR suitable habitat would seemingly be inconsistent with NFP standards and guidelines (that require activities to be beneficial to late-successional forest associated species), unless those activities demonstrated *significant short-term* benefits to the spotted owl that outweighed any adverse impacts.

Silvicultural activities that promote development of late-successional forest conditions in other than NRF habitat are encouraged, when consistent with other recommendations in this document.

Within the analysis area, forested acres in LSRs compose approximately 50% of all forested acres in CHUs. Thus, LSRs form the backbone of critical habitat for the spotted owl in this analysis area. Consideration of critical habitat within these LSRs is essential so that conservation of the species can be achieved in the CHU network.

To meet these overall goals for spotted owl management and conservation, we provide the following recommendations:

- Timber harvest and other forest management activities (including density management, thinning or salvage) within LSRs that would remove or downgrade habitat classified as suitable for spotted owls at the time of the activity are inappropriate.

- Timber harvest and other forest management activities that occur within capable but currently nonsuitable habitat that would substantially delay its regrowth into suitable condition may be inappropriate, unless site-specific analysis clearly demonstrates that long-term benefits clearly outweigh short-term adverse impacts to spotted owls.

- Silvicultural activities which rapidly achieve late-successional forest structural development might best be applied adjacent to existing late-successional stands, or where late-successional forest stands currently make up a high proportion of a planning area.

- More intensive silvicultural treatments that have slower responses (but perhaps greater mid- and long-term gains to late-successional forest associated species) are more appropriately applied where existing acreage of late-successional forest is very low, and the potential for adverse impacts to spotted owls is minimal.

- Silvicultural prescriptions should address short-term risks to federally listed species as well as long-term desired future conditions. Specific recommendations related to CWD can be found in the three proposed strategies (described in detail under Chapter IV Coarse Woody Debris) for treating this essential forest structural element.

- Site-specific analysis of habitat conditions and available population information should assess the current risk to spotted owls from barred owls and great horned owls. Silvicultural prescriptions should consider achieving stand structural characteristics that optimize benefits to spotted owls while minimizing benefits to barred and great horned owls where risks to spotted owls are moderate to high from predation and/or competition.

- Within critical habitat in LSRs, the primary constituent elements of critical habitat should not be compromised during forest management activities, so as to avoid adverse modification.

- An interagency analysis of the remaining issues for owl conservation should be done at the regional scale incorporating local data to assist local teams with regional and provincial scale issues, and ensure consistency among overall regional recovery efforts. Through this process, the issue of owl conservation would be addressed at the proper scale, integrated into watershed analysis processes that address the broad array of management issues and meet the needs to manage LSRs as a network of reserves on the landscape.

Owl Sites

Maintaining and increasing the occupancy of LSRs by spotted owls is a priority. Current occupancy of LSRs by spotted owls may be below the projected occupancy rate of fully recovered LSRs, based upon data reported in the FSEIS and estimates from suitable habitat as reported in Chapter III of this document, for several of the large LSRs in this assessment area. The presence of owls will dictate location, extent and type of harvest activity. Surveys in suitable habitat prior to planning of activities (that might remove, degrade or downgrade suitable spotted owl habitat or result in incidental take due to disturbance) will help to avoid conflicts.

- We recommend that activities within LSRs avoid incidental take of spotted owls due to disturbance or habitat modification so as avoid adverse effects to known owl sites.

- All suitable habitat within LSRs should be considered as potentially occupied when assessing the possible impacts and benefits to late-successional species from management activities. While accurate determination of actual occupancy of sites in LSRs is essential to long-term recovery of the species, it remains a question that is beyond the scope of this LSRA, and is best resolved through provincial/regional analyses and effectiveness monitoring.

- Surveys for owls should be done within LSRs prior to timber management activities that may adversely affect the species.

- Activities conducted in nonsuitable habitat may be acceptable without surveys when seasonal restrictions to avoid disturbance take are implemented.

Data Needs

Confusion exists in the definition of nesting, roosting *and* foraging (as opposed to nesting, roosting *or* foraging) habitat as used to categorize suitable habitat. These discrepancies have serious implications for the retention of suitable habitat and reduction of incidental take of owls. It is recommended that the federal agencies review the existing data to resolve these discrepancies and thereby establish a more precise biological baseline for owl occupancy in LSRs.

- Conflicts with the definitions of capable and suitable habitat is a discrepancy in existing GIS data that should be corrected during future updating. These errors range from 0.3% to 6.1% (average 2.8%) of the total capable habitat acres in the LSRs.

- We recommend that owl sites within LSRs be reevaluated to estimate the likely concurrent occupancy by owls, so as to provide a more meaningful comparison to suitable habitat data.

- The Fish and Wildlife Service should lead an interagency effort to evaluate the current delineation of CHUs in the western Oregon Cascades physiographic province. Through this effort, CHUs could be redesignated to reduce or eliminate current conflicts between CHUs and NFP land allocations and their respective standards and guidelines.

In summary, this analysis describes opportunities and priorities for restoration of habitat to meet the nesting, roosting and foraging needs of spotted owls in the LSR network. LSRs such as Fall Creek, Waldo West, Quartzville and Jefferson have large amounts of currently nonsuitable habitat where restoration prescriptions could be *considered*. Local consideration of site-specific conditions should assess the relative merits of proposals to implement silvicultural prescriptions to achieve conditions favorable to spotted owl nesting, roosting and foraging in LSRs, as well as to achieve other objectives for late-successional forests and associated species. Silvicultural activities that remove, degrade or downgrade currently suitable habitat within LSRs may not be consistent with ROD direction indicating that silvicultural activities in LSRs must be beneficial to late-successional species.

OREGON SLENDER SALAMANDER (*BATROCHOSEPS WRIGHTI*)

Assume management for this species also benefits other terrestrial amphibians such as the clouded salamander (*Aneides ferreus*). Management considerations for this species applies to all LSRs in the assessment area except Waldo West and Hills Creek and are based on discussions and hypotheses of the Oregon *Batrochoseps wrighti* Working Group, in particular Dave Larson:

- Leave natural or above natural levels of down woody material in all decay classes, but in particular, decay class I with bark, and decay classes III and IV at sites where this species has been found historically or through current surveys.

- Acceleration of old-growth conditions by thinning dense stands can produce down wood suitable for the Oregon slender salamander. It also can cause deterioration of humid or damp microclimates important to Oregon slender salamander habitat. Based on ancillary observations, open stands that contain down wood may not support Oregon slender salamander or other “damp wood” dependent species until canopy closure occurs. This also may be true for 20-30 yr. old managed stands. A gap and clump approach is recommended to accelerate old-growth conditions when thinning; leaving some areas unthinned so moist patches are retained and early recruitment of smaller logs result from stand suppression

- Thinning treatments within LSRs that favors the Oregon slender salamander need to be positioned where adjacent cover and woody debris provides alternative habitat. For instance, thinning a late-mature stand that is surrounded by open stands does not allow the Oregon slender salamander a place to migrate once the canopy closure is degraded. We recommend surveys for this species prior to all thinning of mature stands or stands where CWD is present. If Oregon slender salamanders are present, canopy closure and CWD should be maintained to protect the immediate areas where they are found.

- A thick duff layer improves subterranean travel for this species so it should be provided in all management activities at sites where this species has been found historically or through current surveys.

- Harvest or ground disturbing activities should occur in late summer and after periods of dry weather when the Oregon slender salamander is most likely to be underground and in non-reproductive status.

POND BREEDERS

Protect pond breeders such as western pond turtle (*Clemmys marmorata)* and Cascade frog where breeding or nesting habitat occurs regardless of their association to late-successional habitat. These species and pond habitat are at risk outside of LSRs and there is recent evidence that they may be reliant on LSRs for persistence (Olson pers. comm.)

NORTHERN GOSHAWK (*ACCIPITER GENTILIS*)

Management considerations apply to Waldo West (RO219) and Hills Creek (RO221) LSRs and primarily in dry site Douglas-fir stands, but may apply to other stand types and LSRs as well. These management recommendations should be implemented in concert with fire management objectives.

- Implement thinning and under-burning to simulate natural stand conditions with an open understory, to provide foraging habitat.

- Protect large down woody material for small mammal habitat (prey habitat).

- A seasonal restriction for harvest and burning activities should be implemented between April and September where northern goshawk nesting and foraging areas are identified.

SPECIAL HABITATS, MEADOWS, OTHER NON-FOREST HABITATS

There are some sites in the assessment area, which are not expected to be capable of attaining late-successional structural characteristics. These sites occupy a small component of the landscape (less than one percent) and are important for their contribution add to diversity across the landscape, such as rock outcrops, wetlands and meadows and the unique species that inhabit them. They may also provide natural fuel breaks to protect adjacent late-successional habitat. Management considerations should include protection and maintenance of these special habitats. Activities on these sites may include prescribed burning to restore natural habitat conditions and to reduce the encroachment of trees into these openings.

CORE LSRS

The ROD directs management around the core LSRs should be designed to reduce the risks of natural disturbance (ROD C-10, 11). In addition, the direction is that timber management activities within these areas should comply with management guidelines for mapped LSRs. All of the management criteria included elsewhere in this document, such as levels of snags and down wood to be managed for and other uses determined to be consistent with LSR objectives, also apply to the core LSRs. However, because their size and location within the overall landscape is uniquely different from the mapped LSRs, the following criteria and recommendations apply specifically to the core LSRs.

Timber harvesting or cultural treatments immediately adjacent to core LSRs should consider the following items during project planning and design:

- Design harvests of mature timber adjacent to core LSRs to minimize creating a “wall” of tree boles and crowns in the LSR. Feathering the edge of the harvest unit to disperse or deflect maximum wind velocity should be considered.

- Consider reducing both activity-created and natural fuels in areas adjacent to core LSRs to reduce risk of fire spread and/or potential fire intensity adjacent to the LSR. Slope, slope position and other factors integral to fire behavior should also be considered in assessing fire risks.

- If low intensity underburning can effectively lower fuel loadings within or adjacent to the core LSR without adversely affecting the overall stand structure and function (i.e. large down wood, multiple canopy layers), using prescribed fire should be evaluated. As part of an overall landscape strategy, fire could reduce the risk of catastrophic loss of late-successional habitat in these small, isolated allocations.

- Treatments to accelerate development of late-successional characteristics should be conservatively applied in the core LSRs. A majority of the acres is currently in late-successional and/or old growth conditions currently. In most cases, the few acres in earlier seral stages should be left to develop without intervention, unless by doing so, it creates a specific risk to the rest of the LSR.

- When managing land adjacent to core LSRs, activities should be assessed for impacts that remove or degrade spotted owl habitat. The objective should be to manage those stands least likely to adversely affect spotted owl reproduction and survival based on distance from recently occupied LSRs, condition of suitable habitat, and reproductive history of these sites.

NON-SILVICULTURAL TREATMENTS AND ACTIVITIES

The following site conditions could trigger non-silvicultural treatment and activities:

Forest Genetics Plantations - These existing sites consist of small stands, usually less than fifteen acres, developed to study the genetics of a single tree species. The stocking of these stands has been carefully designed and developed through careful control of seed and seedlings, and grafting. Specific plans have been implemented and are followed for each site. Current plans propose thinning most of these sites. Where appropriate, sites will be managed to enhance successional characteristics,

Degraded Sites/Poor Soil Productivity (including Landslides and Debris Torrents)
Another condition on the landscape where management activities can assist in attainment of late-successional characteristics is when soil productivity is so severely degraded that the site can no longer support or maintain plant communities which would occur at healthy sites. Soil restoration activities could be employed to restore the soil quality on these sites.

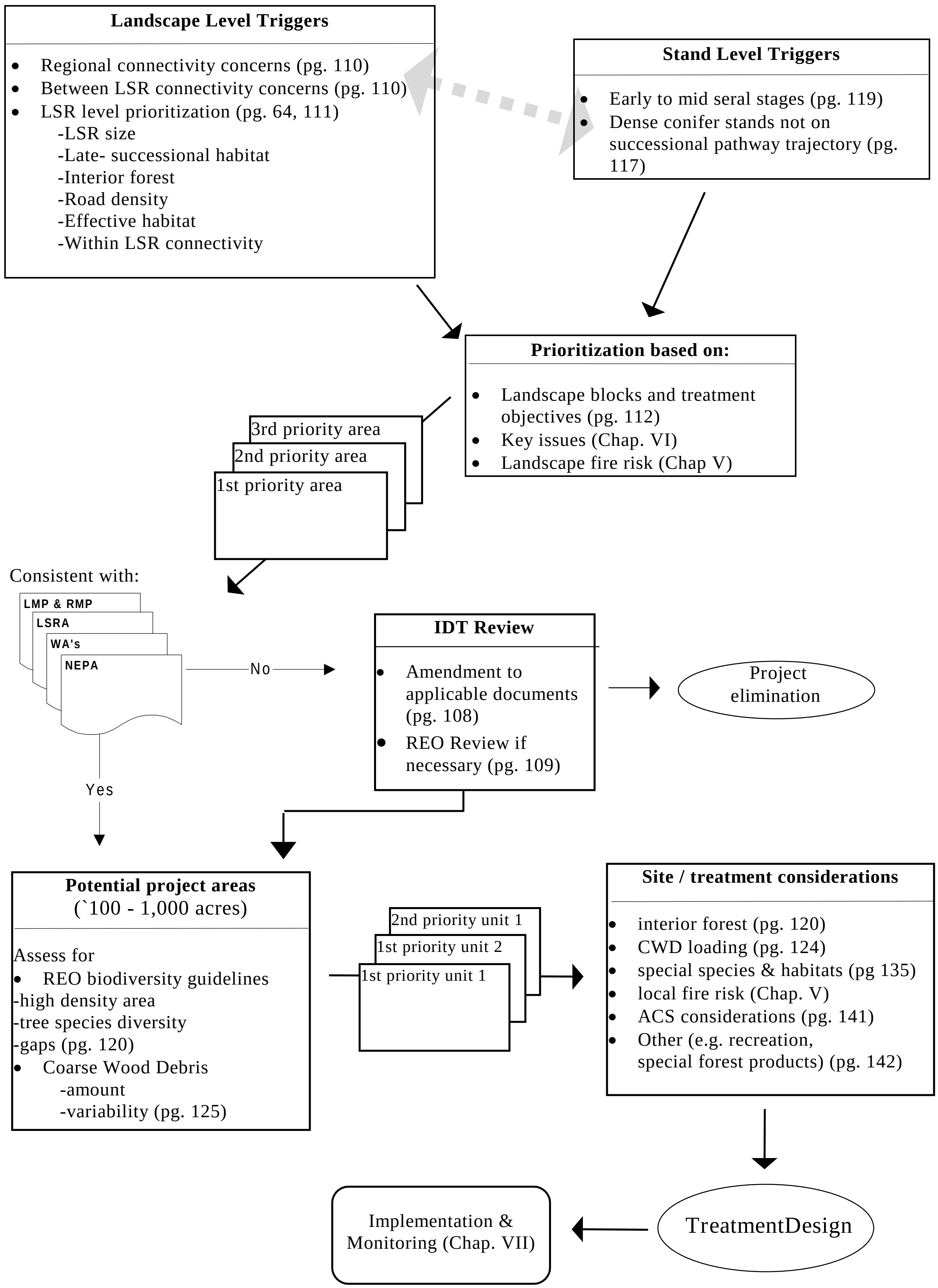
Aquatic Conservation Strategy Objectives - Existing conditions in riparian areas, wetlands, and aquatic habitats may hinder attainment of Aquatic Conservation Strategy (ACS) objectives. In order to meet ACS objectives over time, these areas should be a high priority for restoration.

Recreational Uses - Developed and undeveloped recreational uses have the potential to adversely impact late-successional habitat and associated species. When opportunities arise, existing uses are being evaluated for consistency with the NFP, which allows neutral impacts for non-silvicultural activities within the LSR. The ROD recommends "use adjustment measures such as education, use limitations, traffic control devices, or increased maintenance when dispersed and developed recreation practices retard or prevent attainment of Late-Successional Reserve Objectives." (ROD C-18) Some existing developed sites have been modified to better achieve with ACS objectives, improving riparian habitat and increasing the potential for development of late-successional characteristics. Expansion of existing facilities and uses, and proposed new facilities and uses should not preclude LSR and ACS objectives. "New development proposals that address public needs or provide significant public benefits, such as powerlines, pipelines, reservoirs, recreation sites or other public works projects will be reviewed on a case-by-case basis and may be approved when adverse effects can be minimized and mitigated." (ROD C-17)

Harvest of Special Forest Products - Some removal of special forest products, such as moss, mushrooms and firewood, have the potential to adversely impact late-successional habitat and associated species. These activities are being evaluated for consistency with the NFP, which allows neutral impacts for non-silvicultural activities within the LSR. They are managed by identifying appropriate areas for these activities, implementing the associated mitigating measures where appropriate, and monitoring to evaluate long term effects.

Current management direction in the Willamette NF Plan is that the commercial collection of special forest products is not allowed in the LSRs. However, commercial collection of special forest products in LSRs on the Willamette NF is permitted if the collection is coincidental to treatments designed to protect, enhance or accelerate the late-successional habitat conditions, such as bough collection.

Figure IV-3. Process for using the information covered in Chapter IV for assessing treatments



V. FIRE MANAGEMENT PLAN

INTRODUCTION

Major goals for managing LSRs within the NFP are to maintain and protect late-successional forest ecosystems from loss due to large-scale fire, insect and disease epidemics, and major human impacts. Natural ecosystem processes such as gap-dynamics, natural regeneration, pathogenic fungal activity, insect herbivory, and low-intensity fire should be maintained. (ROD,B-1).

Current fire protection strategies on all federal lands in this area include prevention, detection, and suppression of wildfires and fuel treatment programs. This strategy is implemented through fire management action plans by BLM, State of Oregon, and FS fire management organizations.

The goal of the fire management plan is to provide information on the fire regimes, level and distribution of current risk from catastrophic wildfire, and provide guidelines to mitigate risk. The plan provides direction for appropriate fire management activities for wildfire prevention, detection, suppression and hazard reduction. In addition, it describes the uses, benefits and priorities of prescribed fire within the assessment area.

FIRE REGIMES

Fire is an important disturbance process in the landscape. It affects stand composition and structure, as well as landscape level vegetation patterns. Knowledge of the frequency, size and severity of fires in the LSRA area will help us assess risk and determine appropriate types and frequencies of treatments to apply to maintain and protect late-successional ecosystems.

Climate, topography, and fuels all contribute to the timing, severity, and size of fire across the landscape. The LSRA area encompasses a wide range of variability in all those components. A gradient of increased lightning activity occurs from north to south in the Cascades (Agee 1993). A range of historic fire regimes is reported throughout the western hemlock zone within the LSRA (Teensma 1987, Morrison and Swanson 1990, Connelly and Kertis 1992, Garza 1995, Weisberg, 1997). We used climatic gradient, variability in fuels, and fire history studies in the LSRA area to describe and map fire regimes to display the variability in landscape and stand patterns.

We examined lightning activity data for the last 25 years, and a statewide precipitation map to assess the gradient of climate related conditions across the LSRA. We delineated landtypes across the LSRA that grouped similar areas of elevation, slope steepness, length and dissection (Appendix B). Physiographic zones were also delineated using the statewide geology layer. We overlaid the vegetation series and subseries layer on the landtypes to get the correlation between topography and potential fuel types. Fire history studies were then located, and fire regime results were correlated with appropriate landtypes and vegetation. Fire regime types were then given to similar landtypes and vegetation types across the LSRA area. Fire history studies were not available for the entire area, so watershed analysis results and assumptions about the relationship between climate, topography and fuels to fire regime based on local fire experience and knowledge were made to complete the mapping.

The variability in climatic conditions was strongly correlated to the geologic Physiographic Zones, with climatic conditions responsible for splitting out the southern from the northern in the West and Mixed Cascades. Landtypes and vegetation types were strongly correlated, thus being a good representation of physical, as well as biological conditions. Average frequency and severity describe fire regimes. We assumed a stand replacing fire killed greater than 70% or of a stand, with a partial burn having 30 to 70 percent mortality. Fire regimes were mapped (Map 18) using the modified Physiographic Zone, landtypes and vegetation types.

NORTHWEST FIRE ZONE

Fall Creek (RO219), Hagan (RO217), Wiley (RO216), Whitcomb (RO212), South Santiam-west (RO215), and Quartzville-west (RO213).

Physiographic Zone: West Cascades

Vegetation Type: Western hemlock, Pacific silver fir

Fire regime: Average low frequency (>200 years) stand replacing fires; average moderate frequency (80-200 years) partial burns (Klopsch 1985, Stewart 1986)

Fire Effects: The dominant early seral species regenerating after a stand replacement disturbance in this regime is Douglas-fir. Western hemlock and western redcedar may be components in developing stands in the western hemlock type. Pacific silver fir and noble fir may be components of developing stands in the Pacific silver fir type. One or two intermediate disturbances may occur over the life of a stand. These disturbances can kill the fire-intolerant western hemlock and Pacific silver fir, while only slightly affecting the tolerant Douglas-fir. Post-fire seedbeds will vary, with western hemlock and Pacific silver fir able to regenerate under more shady situations than Douglas-fir. These intermediate disturbances serve to increase the within as well as between, stand heterogeneity. Most stands in this regime reach classic old growth conditions of multiple layers, large snags, and down wood.

Fire Pattern: Stand replacement fires occur over large areas (greater than 1,000 acres) of the landscape infrequently, creating large, early seral patches. Stewart (1986) noted stand-replacing fires approximately 450 years ago and 130 years ago. Klopsch (1985) found remnants of a 450-year age class and a 145-year age class in Hagan LSR. Partial burns and underburns occur in a more variable pattern, creating gaps and heterogeneity across the landscape.

NORTHEAST FIRE ZONE

Jefferson (RO214), Horse Creek (RO218), South Santiam-east (RO215), Quartzville-east (RO213).

Physiographic Zone: Mixed Cascades

Vegetation Type: Dry western hemlock, Pacific silver fir

Fire regime: Average moderate frequency (80 - 200 years) stand replacing fires; average moderate frequency (80-200 years) partial burns (Teensma 1987, Morrison and Swanson 1990, Connelly and Kertis 1992)

Fire Effects: The dominant early seral species regenerating after a stand replacement disturbance in the dry western hemlock type is Douglas-fir. Western hemlock and western redcedar may be components of developing stands. Some stands in this regime reach classic old growth conditions of multiple layers, large snags, and down wood. Some stands may not develop multilayered canopies before experiencing another stand replacing event. One or two intermediate disturbances may occur over the life of a stand. These disturbances can kill the fire intolerant western hemlock and western redcedar, while only slightly affecting the tolerant Douglas-fir, leaving remnants of various densities. Post-fire seedbeds will vary, with western hemlock able to regenerate under more shady situations than Douglas-fir. These intermediate disturbances serve to increase the within as well as between, stand heterogeneity. Pacific silver fir, noble fir and Douglas-fir commonly regenerate after a stand replacing fire in the Pacific silver fir type. Some stands reach old growth conditions in this type. Intermediate disturbances have a variety of effects in this zone. Pacific silver fir, having thin bark and shallow roots, is very susceptible to mortality. Noble fir is moderately susceptible (especially when young), and Douglas-fir is quite fire tolerant. Partial stand replacing fires are quite variable, leaving patches of live stands interspersed with areas of higher mortality.

Fire Pattern: Stand replacement fires occur over large areas (greater than 1,000 acres) of the landscape at moderate frequencies (80-200 years) creating large, early seral patches. Most of the fires in the H.J. Andrews Experimental Forest (HJA) area ranged from 1,000-26,000 acres in size (Teensma 1987). Partial burns and underburns occur in a more variable pattern, creating gaps and heterogeneity across the landscape. Teensma (1987) found an average of two (one area had three) age-classes per site sampled in the HJA.

Vegetation Type: Wet western hemlock

Fire regime: Average low frequency (>200 years) stand replacing fires; average moderate frequency (80-200 years) partial burns (Teensma 1987, Connelly and Kertis 1992).

Fire Effects: These sites are often located in wet, wide valley bottoms. Environmental conditions serve to protect these sites from upland stand replacing fires. Once a site burns, it succeeds much like the fire effects in the dry western hemlock type. Most stands in this type reach classic old growth, with many tree layers, high levels of large snags and CWD. There may be a few intermediate disturbances that occur within the life of the stand. These disturbances increase the diversity within and between stands.

Fire Pattern: Stand replacement fires occur very infrequently in this type, and often cover areas greater than 1,000 acres in size. The wet western hemlock types located in the valley bottoms of the South Fork of the McKenzie, for instance, regenerated after a fire in the early 1500's. Since then there have been several scattered partial stand replacement fires that have increased the variability across the valley bottom landscape (Connelly and Kertis 1992).

SOUTHERN FIRE ZONE

Waldo West (RO220), Hills Creek (RO221).

Physiographic Zone: Mixed Cascades

Vegetation Type: Pacific silver fir

Fire regime: Average moderate frequency (80-200 years) stand replacing fires; average moderate frequency (80-200years) partial burns

Fire Effects: Fire effects in this type are similar to those found in the Northeast Zone in the Pacific silver fir zone.

Fire Pattern: Stand replacement fires occur over large areas (greater than 1,000 acres) of the landscape at moderate frequencies (80-200 years) creating large, early seral patches. Intermediate disturbances create variability on these sites, with patches of live, older stands interspersed with early seral patches. These disturbances create between stand variability in this type. The Warner Creek fire, for instance burned in a variable pattern in the Pacific silver fir type, leaving all components of pre-burn stands in patches adjacent to high mortality patches.

Vegetation Type: Western hemlock, Douglas-fir, Grand fir

Fire regime: Average moderate frequency (80-200 years) stand replacing fires; average high frequency (< 80 years) partial burns.

Fire Effects: Douglas-fir is the dominant species regenerating after a disturbance in these types. Incense cedar, grand fir and western hemlock may be components in developing stands. Some stands reach classic old growth, with multiple layers and large snags. Intermediate disturbances occur frequently in this type. Western hemlock, with its shallow roots and thin bark, is very susceptible to mortality. Douglas-fir, grand fir, and incense cedar are able to withstand moderate intensity fires and may remain in the post-fire stand. Partial stand fires may serve to increase or retard succession, may increase or decrease the amount of CWD on site, and may initiate or discourage multiple-layered stands from developing. These disturbances create the most variability in within stand and between stand characteristics of all the types in the LSRA area.

Fire Pattern: Stand replacement fires can occur in a more variable pattern in these types than in the Pacific silver fir type. The Shady Beach fire of 1988, Warner Creek fire of 1991, South Zone complex of 1996 displayed a wide variety of post-fire vegetation characteristics, from stand replacing to underburn. The frequency and pattern of these events suggest a complex fire regime in this area.

RISK ASSESSMENT AND MANAGEMENT

An important step in developing a fire management plan is to assess the current levels and distribution of risk across the landscape. Land, in or adjacent to LSRs, at higher risk for catastrophic wildfire can then be prioritized for appropriate management activities to reduce risk of losing late-successional habitat. Factors related to fire occurrence and fuel loading and fire behavior have been combined to determine the distribution of risk levels within and adjacent to the LSRA area.

We used fire occurrence information over 25-year period (1970-1994) to assess the risk of fire starts for the assessment area. Fire starts from FS and BLM records were recorded and mapped by section. A fire occurrence risk rating was developed using the number of fire starts per 1,000 acres per year. Low risk was associated with 0-.06 starts/1,000 acres/year (roughly 0-1 fire per section per 25 years); moderate risk levels were .07-.29 starts/1,000 acres/year (roughly 2-4 fires/section per 25 years); and high risk levels were greater than .29 starts/1,000 acres/year (roughly greater than 4 fires/section per 25 years). Fire occurrence risk information by LSR is contained in Map 7 and Table V-1.

Table V-1. Fire occurrence risk, fire behavior risk, and total risk information

Late-successional Reserve		Acres / Ownership	Unit of Measure	FIRE OCCURRENCE RISK			FIRE BEHAVIOR		TOTAL FIRE RISK		
				Low	Moderate	High	Low	Moderate	Low	Moderate	High
Whitcomb	RO212	3,880	Acres	2,735	1,145	0	1,968	1,912	1,968	1,912	0
		BLM	Percent	70%	30%	0%	51%	49%	51%	49%	0%
Quartzville	RO213	26,525	Acres	23,714	2,351	460	15,805	10,720	15,785	10,296	444
		BLM	Percent	89%	9%	2%	60%	40%	60%	39%	2%
		57,141	Acres	44,261	11,786	1,094	26,096	31,045	25,700	30,738	703
		FS	Percent	77%	21%	2%	46%	54%	45%	54%	1%
Jefferson	RO214	40,016	Acres	23,093	14,125	2,798	21,773	18,243	20,226	18,516	1,274
		FS	Percent	58%	35%	7%	54%	46%	51%	46%	3%
South Santiam	RO215	27,722	Acres	23,689	4,033	0	13,624	14,098	13,624	14,098	0
		FS	Percent	85%	15%	0%	49%	51%	49%	51%	0%
Wiley	RO216	608	Acres	608	0	0	224	384	224	384	0
		FS	Percent	100%	0%	0%	37%	63%	37%	63%	0%
Hagan	RO217	9,162	Acres	8,877	285	0	215	8,947	215	8,947	0
		FS	Percent	97%	3%	0%	2%	98%	2%	98%	0%
Horse Creek	RO218	26,911	Acres	23,025	3,886	0	5,878	21,033	5,878	21,033	0
		FS	Percent	86%	14%	0%	22%	78%	22%	78%	0%
Fall Creek	RO219	65,928	Acres	49,091	15,193	1,644	22,922	43,006	22,435	42,331	1,162
		FS	Percent	74%	23%	2%	35%	65%	34%	64%	2%
Waldo West	RO220	51,782	Acres	35,481	14,991	1,310	8,185	43,597	7,134	44,391	257
		FS	Percent	69%	29%	3%	16%	84%	14%	86%	0%
Hills Creek	RO221	16,592	Acres	11,411	4,270	911	3,715	12,877	2,976	13,451	165
		FS	Percent	69%	26%	5%	22%	78%	18%	81%	1%
Thomas Creek	RO246	2,389	Acres	1,952	437	0	1,860	529	1,860	529	0
		BLM	Percent	82%	18%	0%	78%	22%	78%	22%	0%

We assessed current fuel loading and associated fire behavior under severe weather conditions to evaluate the risk of fire severity. A fuel model layer was developed using vegetative class typing from satellite imagery and correlating it to National Forest Fire Laboratory (NFFL) fuel models (see Appendix M for documentation). Recent management activities have also been incorporated when possible to reflect changes in fuels composition. Fuel model characteristics are dynamic and can change over short periods of time, and changes need to be updated frequently to maintain the integrity of the fuels model layer and associated risk assessment.

We created a fire behavior layer to display areas where fire behavior will likely be the most extreme under severe weather conditions. Three zones (Northeast, Northwest and South) were developed to capture the variability in extreme weather, and appropriate conditions were assigned (see Appendix M for documentation). Fire behavior outputs (using the Behave computer model) used 90th percentile weather conditions to assess mid-length flame heights for three slope classes (0-30%; 31-60%; >60%) and six NFFL fuel models (1, 5, 8,9,10, and 11). We geographically assigned the output by slope class and NFFL fuel model layer distribution.

We assessed risk of fire severity using fire behavior information to assign a risk level to flame heights. Flame length is associated with fuel and weather conditions that produce fire behavior that can be fought by hand (0-4 ft. lengths), mechanical (5-8 ft lengths), or indirect (> 8 ft lengths) methods (Andrews and Rothermel 1982). We used fire behavior and suppression method to develop risk ratings. Low risk areas consisted of flame lengths of 0-4 ft.; moderate risk exhibited 5-8 ft. flame lengths; and greater than 8 ft flame lengths resulted in high risk areas. Table V-1 and Map 6 display the distribution and amount area in each risk level for each LSR.

We overlaid the fire occurrence risk layer and fire behavior risk layer to develop a total fire risk map (Map 7) using the fire occurrence risk and fire behavior risk combinations displayed in Table V-2.

Table V-2. Fire Occurrence and Fire Behavior Risk combinations to determine overall total risk ratings.

RISK TYPE AND RATING		
Fire Occurrence Risk Rating	Fire Behavior Risk Rating[1]	Total Risk Rating
Low – Moderate	Low	Low
Low – Moderate	Moderate	Moderate
High	Low	Moderate
High	Moderate	High

[1] no high fire behavior risk in assessment area

Table V-1 describes and displays the amount and distribution of total fire risk across the LSRA area. Total high risk areas are uncommon and scattered across the LSRA area, ranging from 0-2% of any LSR. Moderate risk occurs in all LSRs to varying extent, with highest percentages occurring at Hagan (98%), Waldo West (86%), Hills Creek (81%), and Horse Creek (78%). Low total risk areas also occur in all LSRs, ranging from 2% (Hagan) to 60% (BLM portion of Quartzville).

OPPORTUNITIES TO REDUCE RISK--TREATMENT ALTERNATIVES

In many stands within LSRs, some silvicultural activities may be proposed to maintain or accelerate the development of late-successional characteristics that create conditions conducive to large-scale fires by contributing higher fuel loading. Natural events such as insect and disease infestations, wildfires, windthrow, and snow breakage may also occur and create similar fuel loading conditions. A number of viable options are available to the fire manager to analyze and determine suitability of wildfire hazard reduction measures as they relate to proposed management activities.

In selecting hazard reduction treatments, the areas receiving the greatest emphasis will be those that provide the greatest additional area protected by a treatment. An example of this would be creating a fuel break in a large area of continuous high total fire risk. Limiting risk by closing roads, treating a portion of the hazard area, or using a variety of different methods in one area may be necessary to meet other late-successional objectives such as leaving more down wood and snags. Protection of LSRs also must be considered in management plans for land adjacent to the LSR.

Generally, dead fuels provide most of the energy to fuel fires. The smaller size fuels (<3inches) dry most rapidly and contribute most to fire spread. Hazard reduction treatments should focus on reducing fine fuels. Depending on stand age, stand condition, fire risk, and type of management activity prescribed, any of the following hazard reduction treatments would be appropriate in conjunction with a silvicultural treatment:

1) Hand piling and burning within 60-135 ft. of roads or unit perimeter.
2) Machine (grapple) piling.
3) Chipping or “brush hog” to reduce fuel bed depth.
4) Yarding tops to landing with last log.
5) Specifying smaller (3”-4”) minimum harvest diameters.
6) Lop and scatter to eliminate slash concentrations.
7) Jackpot burn fuel concentrations, generally in small areas.
8) Prescribed fire.

Prescribed fire can be used as a hazard reduction tool or to meet other LSR objectives such as protection or enhancement of stand conditions for old growth associated species. Using low intensity prescribed fire to reduce fine fuels, leaves larger fuels intact and minimizes impact on residual stands, soils, mychorrizal systems, invertebrates, and small mammals. Other objectives that can be met using prescribed fire include: increasing viability of important fire dependent species, retarding high density seedling reproduction, enhancing grasses, sedges, flora, and fauna associated with meadows, contributing to landscape diversity, and maintaining species associated with natural fire return interval in stands. Specific goals and objectives and desired outcomes for using prescribed fire should be outlined prior to treatment. The Willamette NF is developing a landscape level prescribed fire plan, building on this assessment's approach that will provide direction and priority for landscapes both within and adjacent to LSRs.

Guidelines for prescribed fire use are as follows:

- Application of prescribed fire should vary in extent, frequency of application, and intensity. The differences in application should be related to fire regime, current ecosystem need, and fire risk rating as contained in this analysis.
- Site specific burn plans must be prepared for all prescribed burn activities. Prescribed burn plans should have detailed information on specific goals and objectives and desired results and must meet agency manual direction and the FEIS for managing competing and unwanted vegetation and protection of specific species.
- Prescribed fire operations would implement the same guidelines as wildfire suppression to minimize adverse impacts to late-successional habitat.
- Prescribed fire projects and prescriptions would be designed to contribute to attainment of aquatic conservation strategy objectives.

FIRE RISK MITIGATION RECOMMENDATIONS

We used total fire risk and fire regimes to develop recommendations for fuel management activities to protect, enhance, and maintain late-successional characteristics in the LSRA area. Examination of fire regimes and current fire risk can aid in planning and prioritizing management activities in the LSRA area.

We recommend low intensity prescribed burning in all LSRs, based on the historical frequency of partial burns and underburns (80-200 years in the Northwest and Northeast Fire Zones and 60-200 years in the South Fire Zone) and current fire risk. We calculated estimates of acres to burn based only on moderate and high total fire risk acres. We express the results in acres per decade to allow accomplishment at natural disturbance size scales and to meet climatic prescription requirements. (Table V-3)

The highest priority for prescribed fire use is in the South Fire Zone (Map 7) (Waldo West and Hills Creek LSRs amd adjacent lands). Prescribed fire can be used to protect and maintain late-successional characteristics. Fuel reduction treatments adjacent to these LSRs should be considered a high priority. Use of other fuel treatments to reduce fire hazard is also recommended for protection of the LSRs. Prescribed fire and the full range of fuel reduction tools are appropriate in the South Fire Zone.

Prescribed fire in this zone is recommended in areas with moderate and high total fire risk. The expected ranges of treated acres per decade are estimated from the historic fire return interval range. Table V-3 details the recommended range of acres burned by decade for both Waldo West and Hills Creek.

Table V-3. Recommended Range of acres treated by prescribed fire per decade for Mid-Willamette LSRs.

LSR	Total LSR Acres	Acre range planned for burning per decade.
Whitcomb	3,880	100-240
Quartzville	83,666	540-1,350 (FS) 1,570-3,930 (BLM)
Jefferson	40,016	990-2,470
South Santiam	27,772	700-1,760
Wiley	608	20-50
Hagan	9,162	450-1,100
Horse Creek	26,911	1,050-2,630
Fall Creek	65,928	2,180-5,440
Waldo West	51,782	2,230-7,440
Hills Creek	16,592	680-2,270
Thomas Creek	2,389	30-60

Coarse woody debris levels are a concern for fire managers in the South Fire Zone. Protection and maintenance of late-successional habitat objectives can be met by coordinating CWD with fine fuel reduction treatments. Areas adjacent to sites with high CWD levels should be high priority for prescribed fire or other fuel reduction treatments listed in this document. The CWD section in Chapter IV outlines criteria and strategies to meet these objectives.

Second priority for protection and maintenance of LSRs is in the Northeast Fire Zone (Map 7). This zone includes Horse Creek, Jefferson, and east halves of the South Santiam and Quartzville LSRs. Within this area, the highest priority is to protect and maintain late-successional character in the moderate fire risk areas. Table V-3 lists the recommended acre range for prescribed fire treatment in this zone that are currently in moderate and high total fire risk.

In general, CWD volume and distribution concerns for fire danger are minimal in these lower risk areas except in very localized areas with high fuel loading or fire start risk.

Third priority for protection projects is the Northwest Fire Zone (Map 7). This zone includes the Fall Creek, Hagan, Wiley, Whitcomb, and west halves of South Santiam and Quartzville. Within this area, fire use priority would be to maintain fire in ecosystem processes. Slash treatment is important for hazard reduction and LSR protection. Concern for CWD volume would be the same as the Northeast Zone. Expected acres burned per decade are listed in Table V-1.

FIRE SUPPRESSION AND APPROPRIATE RESPONSE

The objective of all suppression strategies in LSRA area is to protect existing and developing late-successional characteristics. Where fire effects contribute positive value to late-successional character, there is some flexibility in choosing the most effective suppression strategy. Suppression strategies are based on fire behavior characteristics and stand development. In long-lived forests, five stages of development are described: 1) establishment, 2) thinning, 3) maturation, 4) transition, and 5) shifting gap. For this assessment, stands are describes as early seral (establishment), early -mid and mid-seral (thinning), and late seral (maturation, transition and shifting gap).

Fire effects in an early seral stand are most likely to be complete stand mortality. Thus, the only viable fire suppression strategy is protection of the established stand. Aggressive control of all fires is the only acceptable practice.

In most wildfire situations in early-mid and mid seral stands, high mortality is common, and full fire suppression should be employed. There may be a minor opportunity for allowing fire to thin in those areas with short return interval fire ecosystems in portions of the South Fire Zone (Waldo West and Hills Creek LSRs). In most natural ignition conditions, desired prescription parameters would be exceeded, and full suppression would be the selected suppression strategy.

Fire effects in late seral stands may have a variety of outcomes. Protection of overstory and developing understory, late-successional species, CWD levels, or specific habitat issues will be a priority when selecting a suppression strategy. A range of suppression strategies from aggressive control to confine and contain tactics may be chosen to achieve the most beneficial outcome in these stands.

Some disturbance is a natural part of the creation of patchy openings and standing dead trees. Years of forest management and fire suppression may have altered the natural disturbance regime, especially in the South Fire Zone. Allowing some disturbance without damaging the late-successional habitat or risking larger scale loss can still meet LSR objectives. If any fire suppression strategy, other than aggressive control is chosen, documentation of the rationale and tradeoffs made by the selected strategy will be included in the Wildland Fire Situation Analysis.

Some suppression activities can also have direct effects on late-successional characteristics. Activities that should be managed to minimize habitat damage include:

- Avoid draw down of pools of water in creeks and rivers during low water flows to protect fish habitat.
- Avoid use of retardant and dozers in riparian areas.
- Locate base and spike camps outside riparian areas and habitat of threatened and endangered species.
- Minimize the building of any new roads or widening of existing roads.
- Consider intensive mop-up of duff, snags, and large logs to maintain this habitat.
- Use minimum impact suppression tactics (MIST) when possible.
- Minimize disturbance caused by air operations.
- Involve resource advisors in the selection of suppression strategies.

CORE LSRS - FIRE RECOMMENDATIONS

Most of the above recommendations for LSRs within the three identified fire zones would also apply to the core LSRs within the same zone. Because these LSRs are smaller, and often currently contain late-successional habitat, treating surrounding landscapes is a high priority for protection of existing resources.

FIRE REHABILITATION

Rehabilitation plans must be designed to move the area towards late-successional conditions, prevent or stop sediment from reaching riparian reserves, and restore fire camp sites and similar areas to pre-fire condition. Wildfire suppression and its logistical support will cause some significant damage, regardless of how careful incident managers and firefighters are. The Incident Commander will consult with the Line Officer's designated resource advisor to mitigate all site-specific concerns. Rehabilitation planning and implementation should begin as soon as possible after firefighting efforts begin and must begin before the fire is declared contained.

POST FIRE MONITORING AND EVALUATION

Post fire monitoring and evaluation will serve to identify areas of this plan or of the suppression effort that need improvement, formulate different strategies and tactics to add to the plan, and assist in adaptive management. Initial evaluation should occur before the firefighting effort ends on all extended attack and project fires. This evaluation should discuss the strategy and tactics used and success or failure of minimum impact tactics in meeting LSR and riparian reserve objectives, standards, and guidelines. It should also discuss whether firefighter safety was compromised and what changes might be made to better protect firefighters and still meet LSR and riparian reserve objectives. Lastly, the evaluation should rate the incident resource advisor and the Escaped Fire Situation Analysis in providing clear direction to the incident management team. A copy of the evaluation should be filed with the incident management package and with the LSR assessment.

Within one year of any fire exceeding five acres, an interdisciplinary team should revisit the burn area to ascertain the success or failure of rehabilitation in meeting LSR and riparian reserve objectives and standards and guidelines. A copy of their evaluation should be filed with the incident management package, the line officer, and the LSR Assessment.

VI. INDIVIDUAL LSR SUMMARY SHEETS 156

VI. INDIVIDUAL LSR SUMMARY SHEETS

INTRODUCTION

Information from previous chapters has been compiled, sorted and summarized for each LSR. This summary sketch cn be used as a starting point for understanding the assessment and key issues for a particular LSR. To get a better picture of LSR objectives, issues and concerns, we recommend reading the appropriate chapters in the document.

WHITCOMB - RO212

3,880 Acres (1% of the Mid-Willamette LSR acres). No watershed analysis has been done.

Potential Vegetation

Series Environments - 50% warm and moist western hemlock, 47% well drained to dry western hemlock, and 2% nonforest (page 24).

Disturbance

Fire Regimes - Average low frequency (>200 years) stand replacing fires and average moderate frequency (80-200 years) partial burns in the Northwest Fire Zone (pages 38-41).

Insects and Pathogens discussion starts on page 42.

Current Vegetation

Seral Stages

2% non forest, 19% early, 10% early-mid, 11% mid, 27% mature, 30% mature.

Late-successional Forest

2,200 acres (57%) are late-successional forest with approximately 47% of those acres mature and 53% old growth (page 46). The comparative analysis puts it just above the median (page 64).

Interior Forest Habitat

1,300 acres (30% of the LSR) are interior forest or 59% of late-successional which is below the median in the comparative analysis.

Comparison of Mid-1900s and Current.

There is approximately 20% increase in the amount of late-successional forest between current and mid-1900s. The number of late-successional patches has increased and patch size has decreased (page 56). Interior forest patch sizes have decreased.

Roads

78% of the LSR has road densities >2 m/m^2 (page61). The comparative analysis puts it below the median in the network.

CONNECTIVITY

Between – Best case potential connectivity is achieved at a 891 m (7 cells) dispersal distance. Potential and current connectivity between big Whitcomb and Quartzville (Table III-2 Chapter III) represent relatively short and small differences, yet connectivity between Whitcomb and Quartzville is essential to avoid isolation of Whitcomb.

Within - The comparative analysis places Whitcomb near the median; 91% of the LSR is connected at 382-m dispersal distance (page 65).

Survey and manage species, other species of concern, as well as spotted owls and other T&E species must be considered in all actions. Consider special habitats. Read pages 78-107.

Current Fire Risk - 51% is low, 49% is moderate (pages 148-152).

Composite Analysis - Overall, Whitcomb ranks just below the median for all values analyzed (page 64,110).

Key Issues
- Interior Forest
- LSR size

LANDSCAPE BLOCKS

E.
Current Condition Description. Small LSRs located near the Willamette Valley with various amounts of each seral stage. Their small size and isolation puts them in a separate landscape block.
Objective. The objective is to maintain and protect existing late seral successional forest. Any treatments should follow the successional pathways (page 33).
Treatment Recommendations. Accelerate late-successional conditions by maintaining canopy coverage at 40% and using multiple entries; i.e., light treatments with the goal to create diverse, late-successional conditions as quickly as possible. Buffer around all interior forest within the LSR, especially on the edges to protect existing late-successional conditions (pages 120-123). Reduce road density.

Stand level treatments - See considerations beginning on page 117 for management criteria, interior forest conditions, species specific treatments, and the process for determining coarse woody debris and snag levels.

QUARTZVILLE - RO213

83,666 acres (25% of the Mid-Willamette LSR acres, the largest LSR of the network). See Middle Santiam and Blowout Watershed Analysis for more site specific and aquatic concerns. Quartzville Watershed Analysis to be done in 1999.

Potential Vegetation

Series Environments - 4% warm and moist western hemlock, 56% well drained to dry western hemlock, 27% moderate Pacific silver fir, 9% cold Pacific silver fir, and 3% nonforest (page 24).

Disturbance

Fire Regime - Quartzville is in both the Northwest and Northeast Fire Zones. Average low frequency (>200 years) stand replacing fires and average moderate frequency (80-200 years) partial burns in the Northwest Zone. Average moderate frequency (80-200 years) stand replacing fires and average moderate frequency (80-200 years) partial burns to portions of the landscape in the Northeast Zone (pages 38-41).

Insects and Pathogens discussion starts on page 42.

Current Vegetation

Seral Stages
5% non forest, 23% early, 15% early-mid, 3% mid, 5% mature, and 48% old growth.

Late-successional Forest
44,597 acres (53%) are late-successional forest with approximately 12% mature and 88% old growth (page 46). The comparative analysis puts it at the median (page 64).

Interior Forest Habitat
24,685 acres (30% of the LSR) is interior forest or 55% of late-successional. Comparative analysis ranks it just below the median (page 64).

Comparison of Mid-1900s and Current
There is approximately 32% decrease in late-successional forest. Patch number has increased while patch sizes have decreased for both late-successional and interior forest (page 56).

Roads

77% of the LSR has road densities >2 m/m^2 (page 61). The comparative analysis puts it below the median within this network of LSRs.

CONNECTIVITY

Between

Quartzville – Jefferson

- Currently the most direct connectivity is achieved to the south of the LSRs. The difference between current and potential connectivity represents a major shift across several drainages. A major proportion of the current connection is in high elevation and/or cool silver-fir zone. Currently, Upper North Santiam/Big Meadows watershed is providing the majority of low elevation connectivity habitat. Potentially, Twin Meadows, Bugaboo, Middle Blow-out, and Idanha watersheds will provide the most direct, low elevation connections between Quartzville and Jefferson LSRs. Reserve habitat between

LSRs in the southern portion of this area may be exceptionally important as refugia because of the connectivity distance between LSRs (18-32 mi.) and connectivity of isolated core acre LSRs is an issue in this area.
- Upper North Santiam/Big Meadows and Twin Meadows watersheds also provide potential low elevation connectivity to South Santiam and Horse Creek LSRs.

Quartzville - South Santiam
- Currently connectivity is achieved relatively directly and over a short distance between the eastern portions of the LSRs and is almost entirely in high elevation and/or cool silver fir zone. The difference between current and potential connectivity represents a 7.6% shift and reflects a shift between drainages. Potentially, Park, Upper Mid-Santiam, Sheep, and Donaca watersheds will provide more direct connectivity within low elevation, western hemlock, Douglas-fir plant associations. Because of the checkerboard ownership in this area, options for connectivity are limited, and federal lands within these watersheds are essential to providing LSR connectivity (See Table III-1, Maps14-15 for details).
- Mid-Santiam and Sheep watersheds also provide potential direct low elevation/western hemlock, Douglas-fir plant associations connectivity to Jefferson.

See Thomas Creek, Wiley, and Whitcomb for details on those areas of connectivity.

Within

Within Quartzville, the amount and juxtaposition of non-connected, late-successional Federal land is further compounded by the impact of private land holdings. The comparative analysis places Quartzville near the median; 95% of the LSR is connected at 382-m dispersal distance (page 65). See Map 13.

Survey and manage species, other species of concern, as well as spotted owls and other T&E species must be considered in all actions. Consider special habitats.
Read pages 78-107.

Current Fire Risk - 49% is low, 49% is moderate, and 1% is high (pages 148-152).

Composite Analysis - Overall, Quartzville has the third best relative value.

Key Issues

- Late-successional forest
- Road density
- Within and between LSR connectivity

LANDSCAPE BLOCKS

A.

Current Condition Description. This block has a high percentage (72%) of late-successional forest, mostly old growth (68%), and equal portions of the earlier seral stages. The average late seral patch size is 363 acres. It is highly functional habitat for interior habitat concerns and connectivity.

Objective. The objective is to maximize the long-term functioning of the late-successional habitat, realizing some localized short-term impacts are acceptable on a small scale.

Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, pages 33). Treat range of seral stages in plantations in as short a time as possible. Use minimum entries on those stands where site specific factors show that they will benefit from treatment. Treatment of any stands would be a low priority within this block. Close any roads not needed for other concerns.

B1.

Current Condition Description. Late-successional forest is 52% (45% old growth) with an equal mix of the earlier seral stages.

Objective. The objective is to maintain existing connectivity and interior forest. Aggregate treatments to promote large patches of developing late seral forest.

Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). A mix of treatment options should be used in this block. Multiple entries may be necessary to maintain canopy coverage in early to mid-seral stands. Buffer interior forest when doing commercial thinning treatments (page 123). In the Crabtree watershed portion and the headwaters of the South Santiam, connectivity is a concern. These are the high priority areas of treatment.

B2.

Current Condition Description. Late-successional forest is 32% (28% old growth) with early seral dominating the earlier stages (28%).

Objective. The priority in this area is accelerate succession in early stands. Buffering adjacent interior forest is not a concern when working with this seral stage.

Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). Focus on treating early seral high density stands by precommercial thinning. Multiple entries may be necessary as these stands grow. Buffer interior forest when doing commercial thinning, but not precommercial thinning.

C.

Current Condition Description. Late-successional forests comprise 24% of the area (4% old growth) with mid seral stands dominating the earlier seral stages(30%). Some of the larger patches of mid seral may be transitioning to functioning late seral habitat.

Objective. The objective is to protect existing interior habitat. Treatments should be aggregated to promote large patches of developing late-successional forest. Another objective is to protect mid seral stands that are currently functioning or transitioning. These mid seral should be evaluated for risk before treating, and treatment should be limited to smaller portions of these stands.

Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). In all seral stages, leave some stands untreated to serve as controls. Priority for treatments would be in the early and early-mid seral stands. Use multiple entries in early to early-mid seral stands to maintain existing dispersal habitat and connectivity within the block. Assess and protect mid-seral stands that are functioning as connectivity habitat or are developing late-successional characteristics. Any treatments in mid-seral stands should be confined to a smaller portion of the patch.

Stand level treatments. See considerations beginning on page 117 for management criteria, interior forest conditions, species specific treatments, and the process for determining coarse woody debris and snag levels.

Land Acquisition

The Quartzville Creek Wild and Scenic Recreation Management Plan recommends acquiring the private land along Quartzville Creek to provide for more consistent management and lessen the impacts of dispersed use. This portion of Quartzville Creek has also been shown in recent studies to be the best breeding site in Oregon for the harlequin duck. With the inception of the NFP, acquiring this land would also fulfill obligations toward attaining ACS objectives. The management objectives on private land within the Quartzville LSR will isolate blocks of habitat and disrupt connectivity and natural travel corridors. It can be assumed that the industrial forest owners will continue to manage their lands for maximum wood production on short rotations. Therefore, acquiring any of these private lands would be a high priority. The value of blocking up habitat within the center of the LSR and allowing the forest to develop into late-successional forest outweighs the values associated with the fringe lands. An opportunity exists to exchange lands along the western edge of the LSR to acquire the lands in T. 11 S., R. 3 E., S½ , Sec 24, and T. 11 S., R. 4 E., Secs. 20, 21 (SE¼W½), 28, 29, and 30. The LSR assessment team realizes that approximately the same number of acres will be exchanged from various parcels along the western and southwestern edge of Quartzville and the northeastern edge of Whitcomb. This will result in no net increase or decrease in acres of LSR. The team recommends that the land exchange be pursued and that the amount of late-successional habitat exchanged be kept to a minimum.

Recreation

The Salem District RMP and the Quartzville Creek Wild and Scenic Recreation Management Plan have several recreation projects proposed in the Quartzville LSR block.

- Group use site along Quartzville Creek. This project would include development of a group use site of approximately 3 acres about a mile upstream of Yellowbottom Recreation Site. The site is currently used as an undeveloped group site. The development would include installing restrooms, building a small shelter, improving access, and digging a well. The objective would be to provide a site with proper facilities to meet growing recreational demands and provide short-term and long-term protection for the river's resources and outstanding remarkable values.
- Campground near Quartzville Creek. Approximately 10 acres would be developed for overnight camping. The objective would be to phase out some of the dispersed camping that now occurs along the river.
- Quartzville Trail System. The project would be the development of a nonmotorized trail system through the forest to provide hiking opportunities.

This LSR assessment team finds that these proposals are consistent with this assessment since use of the area from dispersed camping and unmanaged sites can result in a negative impact to meeting LSR and ACS objectives while the development of more managed campsites will provide more benefits to the surrounding forest. A hiking trail is considered a neutral impact on LSR objectives.

Boundary Adjustments

The Thomas Creek Watershed Analysis recommended LSR boundary adjustments on one section of the Thomas Creek LSR and the northern edge of the Quartzville LSR. The delineation of boundaries by the Salem District RMP followed legal boundaries instead of ecological features. Managing along these legal boundaries is inconsistent with the management of ecosystems. Known owl sites would also be better protected by the proposed change. A change in the Snow Peak area would protect older forest habitat and associated special habitats and protect the *Oxyporus nobilissimus* population.

Because the adjustment would result in an increase in the number of acres of LSR and no other LSR lands in the proximity are available, the following approach is suggested. The Cascades Resource Area of the Salem District BLM will assess all land use allocations in their jurisdiction and by adjusting some boundaries in the North Willamette LSRA area try to balance the land allocations and adjust the LSR boundaries in the south. This will result in no change in the number of acres of land use allocations.

JEFFERSON - RO214

40,016 acres (12% of the Mid-Willamette LSR acres). For more site specific and aquatic concerns, see Upper North Santiam and Breitenbush Watershed Analyses.

Potential Vegetation

Series Environments - 1% grand fir, 59% well drained to dry western hemlock, 26% moderate Pacific silver fir, 7% cold Pacific silver fir, 2% mountain hemlock, and 4% nonforest (page 24).

Disturbance

Fire Regime - Average moderate frequency (80-200 years) and low frequency (>200 years) stand replacing fires and average moderate frequency (80-200 years) partial burns in the Northeast Fire Zone (pages 38-41).

Insect and Pathogens discussion starts on page 42.

Current Vegetation

Seral Stages

4% non-forest, 23% early, 5% early-mid, 20% mid, 13% mature, and 34% old growth.

Late-Successional Forest

18,852 acres (47%) is late-successional forest, with approximately 27% mature and 73% old growth (page 46). The comparative analysis puts it near the median (page 64).

Interior Forest Habitat

10,305 acres (26% of the LSR) is interior forest or 55% of the late seral. Comparative analysis puts it just below the median.

Comparison of Mid-1900s and Current

There is approximately 32% decrease in late seral. The number of late seral patches has increased, and the patch sizes have decreased (page 56).

Roads

72% of the LSR has road densities > 2 m/m^2 (page 61). The comparative analysis puts it just below the median of the network.

CONNECTIVITY

Between

The analysis for connectivity shows that the connection to the Quartzville LSR is a major concern. This is a large area with younger seral stands where Riparian Reserves will be late-successional only in the long term. See previous Individual LSR summary for Quartzville, Maps 14-15, Table III-1.

Within

The comparative analysis places Jefferson near the median; 91% of the LSR is connected at 382-m dispersal distance (page 65). Within Jefferson the amount and juxtaposition of non-connected late-successional federal land is further compounded by the impact of private land-holdings. See Map 13.

Survey and manage species, other species of concern, as well as spotted owls and other T&E species must be considered in all actions. Consider special habitats. Read pages 78-107.

Fire Risk - 51% is low, 46% is moderate, and 3% is high (pages 148-152).

Composite Analysis - Overall, Jefferson is just above median for all values analyzed (page 64,110).

Key Issues

- Interior forest
- Road density
- Connectivity within and between LSRs

LANDSCAPE BLOCKS

B1.

Current Condition Description. Late-successional forest is 62% (46% old growth) with an equal mix of the earlier seral stages.
Objective. The objective is to maintain existing connectivity and interior forest. Aggregate treatments to promote large patches of developing late-successional forest.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, pages 33). A mix of treatment options should be used in this block. Multiple entries may be necessary to maintain canopy coverage in early to mid-seral stands. Buffer interior forest when doing commercial thinning treatments (pages 120-123).

C.

Current Condition Description. Late-successional forests comprise 36% of the area (17% old growth) with mid seral stands dominating the earlier seral stages (30%). Some of the larger patches of mid seral may be transitioning to functioning late seral habitat.
Objective. The objective is to protect existing interior habitat. Priority for treatments would be in the early and early-mid seral stands. Treatments in early and early-mid should be aggregated to promote large patches of developing late seral forest. Another objective is to protect mid seral stands that are currently functioning or transitioning. These mid seral should be evaluated for risk before treating, and treatment should be limited to smaller portions of these stands.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, pages 33). In all seral stages leave some stands untreated to serve as controls. Use multiple entries in early to early-mid seral stands to maintain existing dispersal habitat and connectivity within the block. Assess and protect mid-seral stands that are functioning as connectivity habitat or are developing late-successional characteristics. Any treatments in mid-seral stands should be confined to a smaller portion of the patch. Multiple entries for treatment should be used to maintain canopy closure in the NW corner in areas adjacent to private land. Connectivity is a concern, so reducing road density is a high priority.

D.

Current Condition Description. Late-successional forests comprise 50% of the area (40% old growth) with mid seral dominating the earlier seral stages. Fragmentation is moderate (better than in block B) because the patch size is larger, and distribution of patches of late seral and mid seral are often adjacent. Some of the mid seral stands may be transitioning to functional late seral habitat.

Objective. The objective is to protect existing late seral forests. A priority would be to treat non-functioning mid seral stands to create larger patches of late-successional habitat in the short to mid term.

Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, pages 33). Leave some stands untreated to serve as controls. Risks should be evaluated in high elevation stands before any treatment. Treat large blocks to accelerate late-successional habitat development. Design treatments to minimize future entries. Use multiple entries in the early-mid to mid seral stands in the western and northern edge of this block because of between LSR connectivity.

SOUTH SANTIAM- RO215

27,722 acres (8% of the Mid-Willamette LSRs; ranks 5th in the network in size). See South Santiam Watershed Analysis for site specific and aquatic resources.

Potential Vegetation

1% Douglas-fir, 4% grand fir, 8% warm and moist western hemlock, 54% well drained to dry western hemlock, 24% moderate Pacific silver fir, 5% cold Pacific silver fir, and 4% non-forest (page 24).

Disturbance

Fire Regime - South Santiam is in both the Northwest and Northeast Fire Zones. The Northwest Zone has average low frequency (>200 years) stand replacing fires and average moderate frequency (80-200 years) partial burns. The Northeast Zone adds average moderate frequency (80-200 years) stand replacing fires and average moderate frequency (80-200 years) partial burns to portions of the landscape. (pages 38-41).

Insect and Pathogens discussion starts on page 42.

Current Vegetation

Seral Stages

4% non-forest, 12% early, 10% early-mid, 40% mid, 6% mature, 28% old growth.

Late-Successional Forest

9,393 acres (34%) is late-successional forest, with approximately 18% of that mature and 82% of that old growth. Comparative analysis ranks it below the median (page 64).

Interior Forest Habitat

6,804 acres (25%) is interior forest or 72% of the late seral forest. Comparative analysis ranks it third or above the median (page 64).

Comparison of Mid-1900s and Current.

There is approximately 27% reduction in late seral forest. The number has increased while the patch sizes have decreased for both late-successional and interior forest (page 56).

Roads

53% of the LSR has road densities $>2m/m^2$ (page 61). The comparative analysis ranks it above the median within this network of LSR (page 64).

CONNECTIVITY

Between

South Santiam - Quartzville

- See previous Individual LSR summary for Quartzville, Maps 14-15, Table III-1.

South Santiam - Horse Creek

- We assume primary LSR connectivity will be provided via the Blue River Project and the H.J. Andrew's Experimental Forest. The area South and Southwest of the Experimental Forest will be important for insuring connectivity to Horse Creek LSR and the southern portion of the LSR network. Landownership and habitat conditions in this area may preclude direct connectivity for some species.

- Currently, the west portions of Boulder/Frissel and Lost Creek/White Branch watersheds provide the majority of connectivity in low elevation/western hemlock, Douglas-fir plant associations to the east of the Blue River Project. Potentially, these same areas, Deer Creek, and the eastern portion of Lower Horse Creek will provide the most direct, low elevation connections between S. Santiam and Horse Creek LSRs.
- Specifically, Spring Creek Drainage in the East portion of Lower Horse Creek is a key potential connection, and functions as a node for several potential connectivity routes between multiple LSRs.

South Santiam west - Hagan

- We assume connectivity is primarily achieved through the Blue River Project, additionally, connectivity to the west of this project may be important. Currently in Upper Blue River, Tidbits, Calapooia, and Blue R Reservoir watersheds over 50% of the connectivity is high elevation and/or cool silver-fir zone. Important watersheds for potential connectivity are Upper Canyon Creek and Calapooia watersheds. B.R Reservoir watershed is important as a node for all connections through low elevation habitat.

See Maps 14-15, Table III-1 for details of between LSR connectivity.

Within

Northeast corner is isolated, and northwest third is discontiguous. The comparative analysis places South Santiam below the median or ninth. Eighty percent of the LSR is connected at 382-m dispersal distance. The majority of the 20% that is not connected are in concentrated patches (page 65). See Map 12.

Survey and manage species, other species of concern, as well as spotted owls and other T&E species must be considered in all actions. Consider special habitats. Read pages 78-107.

Current Fire Risk - 49% is low, and 51% is moderate (pages 148-152).

Composite Analysis - Overall, South Santiam ranks at the median for all values analyzed (page 64,110).

Key Issues

- Lack of late-successional and interior forest
- Connectivity within the LSR
- Road density within certain areas

LANDSCAPE BLOCKS

A.

Current Condition Description. These is an area with a high percentage (87%) of late seral forest, mostly old growth (86%), and equal portions of the earlier seral stages. The average late seral patch size is 300 acres. It is highly functional habitat for interior habitat concerns and connectivity.

Objective. The objective is to maximize the long-term functioning of the late-successional habitat, realizing some localized short-term impacts are acceptable on a small scale.

Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, pages 33). Treat range of seral states in plantations in as short a time as possible. Use minimum entries on those stands where site specific factors show that they will benefit from treatment. Treatment of any stands would be a low priority within this block. Close any roads not needed for other concerns.

B2.

Current Condition Description. Late-successional forest is 35% (35% old growth) with early seral dominating the earlier stages (39%).
Objective. The priority in this area is accelerate succession in early stands. Buffering adjacent interior forest is not a concern when working with this seral stage.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, pages 33). Focus on treating early seral high-density stands by precommercial thinning. Multiple entries may be necessary as these stands grow. Buffer interior forest when doing commercial thinning, but not precommercial thinning.

F.

Current Condition Description. Fire regenerated mid seral stage patches averaging 75 acres dominate these landscape blocks. Late-successional forest comprise 29% (20% old growth).
Objective. Priority would be to treat earlier seral stands. The objective is to protect functioning mid and late seral habitat. Evaluation of mid seral is important. Treatments to these mid seral may be risky because they are the best and closest to functioning late-successional that is present.
Treatment Recommendation. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, pages 33). Prioritize treatments in early seral stands. Assess mid-seral stands for structural characteristics and function to determine if stands are transitioning to late-successional habitat. Risk assessments should be used to determine whether management is beneficial. Protect existing late interior stands by buffering treatments adjacent to late-successional forest. Consider treatments that emphasize snags and coarse woody debris, and move stands into understory reinitiation. Accelerate successional through multiple entries with a range of treatments. Do not compromise any existing suitable owl habitat.

WILEY - RO216

608 acres (0% of the Mid-Willamette LSR acres; smallest LSR). No watershed analysis has been done.

Potential Vegetation

Series Environments - 11% Douglas-fir, 36% warm and moist western hemlock, 53% well drained to dry western hemlock (page 24).

Disturbance

Fire Regimes - Average low frequency (>200 years) stand replacing fires and average moderate frequency (80-200 years) partial burns in the Northwest Fire Zone (pages 38-41).

Insect and Pathogen discussion starts on page 42.

Current Vegetation

Seral Stages
16% early, 4% early-mid, 10% mid, and 70% old growth.

Late-successional Forest
424 acres (70%) is late-successional forest all shown as old growth. The comparative analysis puts it highest for the percent of the LSR that is late-successional (page 64).

Interior Forest Habitat
294 acres is interior forest or 70% of the late-seral. The comparative analysis puts this LSR right above the median.

Comparison of Mid-1900s and Current.
Wiley has a 50% increase of late-successional forest. Patch size has decreased because of timber harvesting outside the LSR.

Roads

16% of the LSR has road densities >2 m/m^2(page 61). The comparative analysis puts it the highest or best of the network with the lowest road density of all the LSRs.

CONNECTIVITY

Between - This is an isolated block with 4.83 km the least possible dispersal distance through reserve habitat. There is no difference between current and potential. The focus should be on achieving the best habitat conditions within the LSR, acknowledging its isolation. Acquiring lands is the only option to improve reserve connectivity. Maps 14-15, Table III-1.

Within - The comparative analysis places Wiley in the highest quartile; 96% of the LSR is connected at 382-m dispersal distance (page 65). See Map 12.

Survey and manage species, other species of concern, as well as spotted owls and other T&E species must be considered in all actions. Consider special habitats. Read pages 78-107.

Current Fire Risk - 37% is low; 63% is moderate (pages 148-152).

Composite Analysis - Overall, Wiley is the second best of all the LSRs for all values analyzed (page 64, 110).

Key Issues

- Between LSR connectivity
- LSR size

LANDSCAPE BLOCKS

E.

Current Condition Description. A small LSR located near the Willamette Valley with mostly old growth. The small size and isolation puts them in this landscape block.
Objective. The objective is to maintain and protect existing late-successional forest. Any treatments should follow the successional pathways (page 33).
Treatment Recommendations. Accelerate late-successional conditions by maintaining canopy coverage at 40% and using multiple entries, i.e. light treatments with the goal to create diverse, late-successional conditions as quickly as possible. Buffer around all interior forest within the LSR, especially on the edges to protect existing late-successional conditions (pages 120-123). Reduce road density.

Stand level treatments - See considerations beginning on page 117 for management criteria, interior forest conditions, species specific treatments, and the process for determining coarse woody debris and snag levels.

HAGAN - RO217

9,162 acres (2.8% of the Mid-Willamette LSR acres). For more site specific and aquatic concerns, see Blue River Watershed Analysis. Lower McKensie Tribs is not done.

Potential Vegetation

Series Environments - 8% Douglas-fir, 20% warm and moist western hemlock, 71% well drained to dry western hemlock, and 1% moderate Pacific silver fir (page 24).

Disturbance

Fire Regime - Average low frequency (>200 years) stand replacing fires and average moderate frequency (80-200 years) partial burns in the Northwest Zone (pages 38-41).

Insect and Pathogen discussion starts on page 42.

Current Vegetation

Seral Stages –
3% early, 89% mid, and 7% old growth.

Late-Successional Forest
710 acres (8%) is late-successional forest with approximately 4% mature and 96% old growth. The comparative analysis puts it in the lowest quartile (page 64).

Interior Forest Habitat
604 acres are interior forest or 85% of the late-successional. Comparative analysis puts it the highest for the amount of interior forest

Comparison of Mid-1900s and Current
There has been a 23% decrease and the patch sizes have decreased.

Roads

21% of the LSR has road densities >2 m/m^2(page 61). The comparative analysis puts it in the highest quartile of the network with the second lowest road density of all the LSRs.

CONNECTIVITY

Between

See South Santiam and Horse Creek Individual LSR accounts.

Within - The comparative analysis places Hagan at the lowest; only 26% of the LSR is connected at 382-m dispersal distance (page 65 and Map 12). Within connectivity expected to improve dramatically within 50 years as the majority of the LSR grows into a late-seral condition.

Current Fire Risk - 2% is low; 98% is moderate (pages 148-152).

Composite Analysis - Overall, Hagan is in the lowest quartile for all values analyzed (page 64, 110).

Survey and manage species, other species of concern, as well as spotted owls and other T&E species must be considered in all actions. Consider special habitats. Read pages 78-107.

Key Issues

- Lack of late-successional forest. Lowest of all the LSRs
- Lack of interior forest. Maintaining existing late-successional interior forest.
- Within LSR connectivity. Between LSR connectivity, specifically between Horse Creek and Fall Creek.

LANDSCAPE BLOCKS

F.

Current Condition Description. Large 900+ acre average patches of mid-seral stands often fire origin with only small patches of late-successional forest.
Objective. The objective is to protect functioning mid seral and late-successional habitat.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). This is a low priority area for treating. Consider treating any early seral stands. Protect existing late interior stands. Consider treatments that emphasize snags and coarse woody debris, and move stands in understory reinitiation. Many mid seral stands may be transitioning into functional late-successional habitat so any treatment in these stands should be evaluated carefully.

HORSE CREEK - RO218

26,911 acres (8% of the Mid-Willamette LSR acres, 6th largest). For more site specific and aquatic concerns see Horse Creek and the South Fork McKenzie Watershed Analyses.

Potential Vegetation

Series Environments - 1% Douglas-fir, 3% grand fir, 6% warm and moist western hemlock, 48% well drained to dry western hemlock, 25% moderate Pacific silver fir, 9% cold Pacific silver fir, 4% mountain hemlock, and 4% nonforest. The most diverse for plant series of all the LSRs (page 24).

Disturbance

Fire Regimes- Average low (>200 years) to moderate frequency (80-200 years) stand replacing fires and average moderate frequency (80-200 years) partial burns in the Northeast Zone (pages 38-41).

Insect and Pathogen discussion starts on page 42.

Current Vegetation

Seral Stages

4% non-forest, 14% early, 2% early-mid, 18% mid, 6% mature, and 56% old growth.

Late-Successional Forest

16,769 acres (62%) is late-successional forest with 9% of those acres mature and 91% old growth. The comparative analysis puts it in the highest quartile (page 64).

Interior Forest Habitat

11,635 acres are interior forest or 69% of the late-successional. The comparative analysis puts it just above the median (page 64).

Comparison of Mid-1900s and Current

There is a 10% decrease in late seral forest while the number of patches has increased within the network.

Roads - 53% of the LSR has road densities >2 m/m^2 (page 61). The comparative analysis puts it in the highest quartile of the network.

CONNECTIVITY

Between -

Horse Creek - South Santiam

- See South Santiam Individual LSR account

Horse Creek - Fall Creek

- Watersheds associated with current and potential connectivity are the same, with the biggest potential for improvement along the west slope of Cougar Reservoir, along Lytle Creek, Indian Creek, Starr, and Hardy Creek
- The highest area of congestion for the entire LSR network is including and between Lower S.F. McKenzie, Cougar Reservoir (especially west of Cougar Reservoir), Hardy Ridge/Rebel Creek, and Upper Christy Watersheds. Also Homestead Camp, Augusta, French Pete, Quartz Creek, Devil's Canyon, Fisher Creek watersheds are essential for connectivity with the southern portion of Horse Creek. Potential and current connectivity

for 382 - 891 m dispersal distance from the northern portion of the LSR network to the southern portion of the LSR network is reliant on this area. The sensitivity of this area for LSR connectivity is compounded by a predominant high elevation/silver-fir band running southeast from Fall Creek LSR, with Augusta Drainage providing the only low elevation/non silver fir connection north and south. Lower elevation connectivity habitat in the above watersheds may serve as refugia in this area because of the elevation/vegetation bottleneck to the south.

Horse Creek - Waldo West

- Potential and current connectivity for several LSRs are important especially in Fisher and Devil's Canyon Watersheds.

See Maps 14-15, Table III-1 for details of between LSR connectivity.

Within - The comparative analysis places Horse Creek as the best for connectivity within the LSR; 97% of the LSR is connected at 382-m dispersal distance (page 65). See Map 12.

Survey and manage species, other species of concern, as well as spotted owls and other T&E species must be considered in all actions. Consider special habitats. Read pages 78-107.

Current Fire Risk - 22% is low; 78% is moderate (pages 148-152).

Composite Analysis - Overall, Horse Creek is the best (page 66, 110).

Key Issues

- Importance as a keystone for the network.
- Existing high quality late-successional habitat

LANDSCAPE BLOCKS

A.

Current Condition Description. These is an area with a high percentage (77%) of late successional forest, mostly old growth (72%), and portions of the earlier seral stages. The average late seral patch size is 338 acres. It is highly functional habitat for interior habitat concerns and connectivity.
Objective. The objective is to maximize the long-term functioning of the late-successional habitat; some localized short-term impacts are acceptable on a small scale.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). Treat range of seral states in plantations in as short a time as possible. Use minimum entries on those stands where site specific factors show that they will benefit from treatment. Treatment of any stands would be a low priority within this block. Close any roads not needed for other concerns.

C.

Current Condition Description. Late-successional forests comprise 29% of the area (19% old growth) with mid seral stands dominating the earlier seral stages(39%). Some of the larger patches of mid seral may be transitioning to functioning late-successional habitat.
Objective. The objective is to protect existing interior habitat. Priority for treatments would be in the early and early-mid seral stands. Treatments in early and early-mid should be aggregated to promote large patches of developing late-successional forest. Another objective

is to protect mid seral stands that are currently functioning or transitioning. These mid seral should be evaluated for risk before treating and treatment should be limited to smaller portions of these stands.

Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). Any treatments would be a low priority. In all seral stages, leave some stands untreated to serve as controls. Treat early to early-mid seral stands with minimal entries and then consider closing roads. Assess and protect mid-seral stands that are functioning as connectivity habitat or are developing late-successional characteristics. Any treatments in mid-seral stands should be confined to a smaller portion of the patch.

Stand level treatments - See considerations beginning on page 117 for management criteria, interior forest conditions, species specific treatments, and the process for determining coarse woody debris and snag levels.

FALL CREEK - RO219

65,928 acres (20% of the LSR acres, 2nd largest). For more site specific and aquatic concerns, see Fall Creek and North Fork of the Middle Fork of the WillametteWatershed Analysis

Potential Vegetation

Series Environments - 4% Douglas-fir, 2% grand fir, 15% warm and moist western hemlock, 76% well drained to dry western hemlock, 3% moderate Pacific silver fir (page 24).

Disturbance

Fire Regime - Average low frequency (>200 years) stand replacing fires and average moderate frequency (80-200 years) partial burns in the Northwest Fire Zone (pages 48-51).

Insect and Pathogens discussion starts on page 42.

Current Vegetation

Seral Stages
22% early, 14% early-mid, 15% mid, 10% mature, and 38% old growth.

Late-Successional Forest
31,379 acres (48%) is late-successional forest with approximately 21% of that mature and 79% old growth. The comparative analysis puts it just below the median (page 64).

Interior Forest Habitat
16,475 acres are interior forest or 52% of the late-successional . The comparative analysis puts it in the lowest quartile, placing it 9th of 11 (page 64).

Comparison of Mid-1900s and Current
There is approximately a 39% decrease of late-successional forests. Patch sizes have decreased.

Roads

89% of the LSR has road densities $>2m/m^2$ (page 61). The comparative analysis places it 9th of 11 within this network of LSR. (page 65)

CONNECTIVITY

Between

Fall Creek- Horse Creek

- See Horse Creek Individual LSR account.

Fall Creek - Waldo West

- Potential connectivity through low elevation habitat over a relatively short distance (5.8 mi.) is possible. Currently connectivity is achieved indirectly (8.2 mi.) representing a 29.3% difference from potential and approximately 30% of the distance is in high elevation/cool silver fir zones. Upper Christy and the eastern portion of Devil's Canyon watersheds are important to connectivity. Potentially, lower elevation habitat in Upper Christy, Lower Christy and the eastern portion of Devil's Canyon watersheds between Fall Creek and Waldo West LSRs are important connectors. Lower elevation connectivity habitat may serve as important refugia in this area because of the elevation/vegetation bottleneck to the northeast.

- The southeast portion of Fall Creek LSR provides direct current and potential connectivity between several LSRs.

Fall Creek - 222

- The potential for connectivity between the eastern portion of Fall Creek and 222 is a relatively short distance, but connectivity is currently indirect and several watersheds away.

Fall Creek - Hills Creek

- Potential connectivity is relatively long (18.4 mi.), and currently connectivity is achieved indirectly (27.5 mi.). Lower Salmon, Lower Salt, and Hills Creek watersheds are important for achieving potential connectivity.
- Because of the long span between these LSRs, connectivity habitat may serve as refugia.

See Maps 14-15, Table III-1 for details of between LSR connectivity.

Within - The comparative analysis places Fall Creek as the median. Ninety-two percent of the LSR is connected at 382-m dispersal distance (page 65, 76. See Map 12).

Survey and manage species, other species of concern, as well as spotted owls and other T&E species must be considered in all actions. Consider special habitats. Read pages 78-107.

Fire Risk - 18% is low, 81% is moderate, and 1% is high (pages 148-152).

Composite Analysis - Overall, Fall Creek is in the lower quartile, 9 of 11, for all values analyzed (page 66, 110).

Key Issues

- interior forest
- road density
- between LSR connectivity- North to Hagan; East to Horse Creek

LANDSCAPE BLOCKS

B1.

Current Condition Description. Late-successional forest is 56% (47% old growth) with an equal mix of the earlier seral stages.
Objective. The objective is to maintain existing connectivity and interior forest. Aggregate treatments to promote large patches of developing late-successional forest.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). A mix of treatment options should be used in this block. Multiple entries may be necessary to maintain canopy coverage in early to mid-seral stands. Buffer interior forest when doing commercial thinning treatments (page 105). Emphasize road closures subsequent from treatments.

B2.

Current Condition Description. Late-successional forest is 43% (37% old growth) with early seral dominating the earlier stages (40%).
Objective. The priority in this area is to accelerate succession in early stands. Buffering adjacent interior forest is not a concern when working with this seral stage.

Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). Focus on treating early seral high-density stands by precommercial thinning. Multiple entries may be necessary as these stands grow. Buffer interior forest when doing commercial thinning, but not precommercial thinning.

C.

Current Condition Description. Late-successional forests comprise 35% of the area (10% old growth) with mid seral stands dominating the earlier seral stages(36%). Some of the larger patches of mid seral may be transitioning to functioning late-successional habitat.
Objective. The objective is to protect existing interior habitat. Priority for treatments would be in the early and early-mid seral stands. Treatments in early and early-mid should be aggregated to promote large patches of developing late-successional forest. Another objective is to protect mid seral stands that are currently functioning or transitioning. These mid seral should be evaluated for risk before treating and treatment should be limited to smaller portions of these stands.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). In all seral stages, leave some stands untreated to serve as controls. Use multiple entries in early to early-mid seral stands to maintain existing dispersal habitat and connectivity within the block. Assess and protect mid-seral stands that are functioning as connectivity habitat or are developing late-successional characteristics. Any treatments in mid-seral stands should be confined to a smaller portion of the patch.

Stand level treatments - See considerations beginning on page 117 for management criteria, interior forest conditions, species specific treatments, and the process for determining coarse woody debris and snag levels.

WALDO WEST- RO220

51,728 acres (16% of the MW LSR acres, third largest). For more site specific and aquatic concerns, see Salt Creek and Salmon Creek Watershed Analysis.

Potential Vegetation

Series Environments - 6% grand fir, 47% well drained to dry western hemlock, 23% moderate Pacific silver fir, 9% cold Pacific silver fir, 10% mountain hemlock, and 5% nonforest (page 24).

Disturbance

Fire Regimes - Average moderate frequency (80-200 years) stand replacing fires and average moderate (80 -200 years) to high frequency (<80 years) partial burns in the Southern Fire Zone (pages 48-51).

Insect and Pathogens discussion starts on page 42.

Current Vegetation

Seral Stages

5% non-forest, 31% early, 1% early-mid, 10% mid, 27% mature, and 27% old growth.

Late-Successional Forest

27,812 acres (54%) is late-successional forest with approximately equal distribution between mature and old growth. The comparative analysis puts it just above the median (page 64).

Interior Forest Habitat

12,497 acres are interior forest or 45% of the late-successional. The comparative analysis puts it the lowest for the amount of late-successional that is interior forest (page 64).

Comparison of Mid-1900s and Current

There is approximately a 25% decrease of late-successional forest with increased patch number and decreased patch size.

Roads

60% of the LSR has road densities >2 m/m^2 (page 61). The comparative analysis puts it just above the median within this network of LSRs.

CONNECTIVITY

Between -

Waldo West - Hills Creek

- Potentially, these LSRs could be connected over a short distance (2.7 mi.) of low elevation habitat. Currently connectivity is achieved indirectly (6.7 mi.) representing a 59.7% difference. Current connectivity passes through roughly 50% high elevation/cool silver fir habitat. Potential connectivity is possible through the eastern portion of Lower Salt Creek and the western portion of Middle Salt Creek Watersheds.
- The area in these two watersheds is a key node for connectivity to LSRs to the North.

Waldo West - Fall Creek

- See Horse Creek and Fall Creek Individual LSR accounts.

Waldo West - 222 mid

- The shift between current and potential connectivity is not large, but the distances are relatively long, and connectivity habitat may also be especially important as refugia. Hills Creek and Middle Fork Willamette (Hills Creek Reservoir and Pine) are important watersheds for addressing connectivity.

See Maps 14-15, Table III-1.

Within - The comparative analysis places Waldo in the highest quartile; 96% of the LSR is connected at 382-m dispersal distance (page 65, 76. See Map 12)

Survey and manage species, other species of concern, as well as spotted owls and other T&E species must be considered in all actions. Consider special habitats. Read pages 78-107.

Current Fire Risk - 14% is low, 86% is moderate. Waldo is in the Southern Fire Zone (pages 148-152).

Composite Analysis - Overall, Waldo is in the highest quartile (4th highest) for all values analyzed (page 66, 110).

Key Issues

- Lack of interior forest (the lowest of all the LSRs).
- This is a high priority area for using prescribed fire as a tool for fuel reduction (fire risk) as well as maintenance of late-successional characteristics.

LANDSCAPE BLOCKS

B1.

Current Condition Description. Late-successional forest is 63% (33% old growth) with mix of the earlier seral stages.
Objective. The objective is to maintain existing connectivity and interior forest. Disperse treatments in early seral stands. Prioritize fuel reduction in stands adjacent to late-successional.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). A mix of treatment options should be used in this block. Multiple entries may be necessary to maintain canopy coverage in early to mid-seral stands. Buffer interior forest when doing commercial thinning treatments (pages 120-123). Prescribed fire may be used for fuel reduction as well as a late-successional maintenance tool. (See Chapter V. Fire Management Plan)

B2.

Current Condition Description. Late-successional forest is 48% (24% old growth) with early seral dominating the earlier stages (47%).
Objective. The priority in this area is accelerate succession in early stands. Buffering adjacent interior forest is not a concern when working with this seral stage. Fine fuel reduction objectives would be a priority.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). Focus on treating early seral high density stands by precommercial thinning.

Multiple entries may be necessary as these stands grow. Buffer interior forest when doing commercial thinning, but not precommercial thinning.

C.

Current Condition Description. Late-successional forests comprise 53% of the area (14% old growth) with mid seral stands dominating the earlier seral stages(31%). Some of the larger patches of mid seral may be transitioning to functioning late-successional habitat.
Objective. The objective is to protect existing interior habitat. Priority for treatments would be in the early and early-mid seral stands. Treatments in early and early-mid should be aggregated to promote large patches of developing late seral forest. Another objective is to protect mid seral stands that are currently functioning or transitioning. These mid seral should be evaluated for risk before treating, and treatment should be limited to smaller portions of these stands.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). This is a low priority area for treatment but high priority for fine fuel reduction treatment.

Stand level treatments - See considerations beginning on page 117 for management criteria, interior forest conditions, species specific treatments, and the process for determining coarse woody debris and snag levels.

Other Recommendations
See coarse woody debris section for Southern Fire Zone.

HILLS CREEK- RO221

16,592 acres (5% of the MW LSR acres, 7th of 11 in the network). For more site specific and aquatic concerns, see Hills Creek Watershed Analysis.

Potential Vegetation

Series Environments

2% Douglas-fir, 10% grand fir, 34% well drained to dry western hemlock, 42% moderate Pacific silver fir, 5% cold Pacific silver fir, 4% mountain hemlock, and 3% nonforest (page 24).

Disturbance

Fire Regime - Average moderate frequency (80-200 years) stand replacing fires and average moderate (80-200 years) to high frequency (<80 years) partial burns in the Southern Fire Zone (pages 48-51).

Insect and Pathogens discussion starts on page 42.

Current Vegetation

Seral Stages

3% non-forest, 28% early, 1% early-mid, 8% mid, 17% mature, and 42% old growth.

Late-Successional Forest

9,867 acres (60%) is late-successional forest with approximately 29% of those acres mature and 71% old growth. The comparative analysis puts it in the highest quartile (page 64).

Interior Forest Habitat

4,671 acres are interior forest or 47% of the late seral. The comparative analysis puts it in the lowest quartile (page 64).

Comparison of Mid-1900s and Current

There is approximately a 33% decrease in late-seral forest. The number of late seral patches has increased and the patch size decreased.

Roads

85% of the LSR has road densities >2 m/m^2 (page 61). The comparative analysis puts it in the lowest quartile within this network of LSRs.

CONNECTIVITY

Between

Hills Creek - Fall Creek

Hills Creek - Waldo West

- See Waldo West and Fall Creek Individual LSR accounts.

Hills Creek - 222

- Potential connectivity between Hills Creek and 222 improves low elevation habitat connection over current connectivity. Watersheds important to improving connectivity are Hills Creek and Middle Fork Willamette (Hills Creek Reservoir and Pine).

See Maps 14-15, Table III-1.

Within - The comparative analysis places Hills Creek in the highest quartile; 97% of the LSR is connected at 382-m dispersal distance (page 65, 76. See Map 12).

Survey and manage species, other species of concern, as well as spotted owls and other T&E species must be considered in all actions. Consider special habitats. Read pages 78-107.

Current Fire Risk - 18% is low, 81% is moderate, 1% is high. It is the Southern Fire Zone (pages 148-152).

Composite Analysis - Hills Creek is above the median for all values analyzed (page 66, 110).

Key Issues

- Interior forest
- Road density
- This is a high priority area for using prescribed fire as a tool for fuel reduction (fire risk) as well as maintenance of late-successional characteristics.

LANDSCAPE BLOCKS

B1.

Current Condition Description. Late-successional forest is 65% (41% old growth) with mix of the earlier seral stages.
Objective. The objective is to maintain existing connectivity and interior forest. Disperse treatments in early seral stands. Prioritize fuel reduction in stands adjacent to late seral.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). A mix of treatment options should be used in this block. Multiple entries may be necessary to maintain canopy coverage in early to mid-seral stands. Buffer interior forest when doing commercial thinning treatments (page 120-123). Prescribed fire may be used for fuel reduction as well as a late-successional maintenance tool. (See Chapter V. Fire Management Plan.)

B2.

Current Condition Description. Late-successional forest is 54% (49% old growth) with early seral dominating the earlier stages (42%).
Objective. The priority in this area is to accelerate succession in early stands. Buffering adjacent interior forest is not a concern when working with this seral stage. Fine fuel reduction objectives would be a priority.
Treatment Recommendations. Any stand that appears to be on the right trajectory to reach potential late-successional forest habitat should not be treated (see Successional Pathways, page 33). Focus on treating early seral high density stands by precommercial thinning. Multiple entries may be necessary as these stands grow. Buffer interior forest when doing commercial thinning, but not precommercial thinning.

Stand level treatments - See considerations beginning on page 117 for management criteria, interior forest conditions, species specific treatments, and the process for determining coarse woody debris and snag levels.

Boundary Adjustment

We considered a minor boundary adjustment to the Hills Creek LSR and determined that it did not have any adverse impacts on the function of that LSR. A small area, approximately 25 acres, extends over the ridgeline of Pinto Mountain in the southeast corner of the LSR. Only part of the area is mature forest with old cutting units adjacent to it. The proposal is to replace the 25 acres with an equal or greater number of acres in the southwest corner of the LSR that contain large Douglas-fir and would provide a contiguous connection between the LSTR and adjacent wildlife special habitat management area.

THOMAS CREEK - RO246

2,389 acres (0.7% of the Mid-Willamette LSR acres, second smallest LSR). For more site specific and aquatic concerns, see Thomas Creek Watershed Analysis. (BLM)

Potential Vegetation

Series Environments - 37% warm and moist western hemlock, 36% well drained to dry western hemlock, 15% moderate Pacific silver fir, 6% cold Pacific silver fir, and 6% nonforest (page 24).

Disturbance

Fire Regimes - Average low frequency (>200 years) stand replacing fires and average moderate frequency (80-200 years) partial burns in the Northwest Fire Zone (pages 48-51).

Insect and Pathogens discussion starts on page 42.

Current Vegetation

Seral Stages
6% non-forest, 9% early, 15% early-mid, 39% mid, 15% mature, and 16% old growth.

Late-Successional Forest
740 acres (31%) is late-successional forest with approximately equal amounts of mature and old growth. The comparative analysis puts it as the second lowest for the percent of the LSR that is late-successional (page 64).

Interior Forest Habitat
589 acres (25%) are interior forest or 80% of the late-successional. The comparative analysis puts this LSR in the lowest quartile.

Comparison of Mid-1900s and Current.
Not much difference exists, but the patch distribution has changed. The patch analysis shows a 35% decrease in interior forest.

Roads

96% of the LSR has road densities >2 m/m^2 (page 61). The comparative analysis puts it in the lowest quartile of the network, with the highest road density of all the LSRs.

CONNECTIVITY

Between - The connection to other LSRs is significantly influenced by private land holdings. The difference between current connectivity and potential is from 0 to 14% which means potentially the connection can be improved by 14% with the Federal Riparian Reserve system, mostly within the Crabtree Watershed. (See Table III-1). Thomas Creek provides refugia habitat since the best case for connectivity is at 1.65 km (see Maps 14-15).

Within - Within the separate sections there is clumped, uneven distribution of late-successional with contiguous areas not connected. These unconnected areas are often found adjacent to the section edge where they are further confounded by their adjacency to private lands. Between the sections of the LSR, there is low connectivity because of the private lands. The comparative analysis places Thomas Creek in the lowest quartile; 60% of the LSR is connected at 382-m dispersal distance (page 65, 76). See Map 12.

Survey and manage species, other species of concern, as well as spotted owls and other T&E species must be considered in all actions. Consider special habitats. Read pages 78-107.

Current Fire Risk - 78% is low; 22% is moderate (pages 148-152).

Composite Analysis - Overall, Thomas Creek has the lowest relative value of all the LSRs (page 66, 110).

Key Issues

- LSR are between LSR and within LSR connectivity.
- Lack of late-successional forest.
- Lack of interior forest.
- Road density.

LANDSCAPE BLOCKS

E.

Current Condition Description. A small LSRs located near the Willamette Valley with various amounts of each seral stage. Its small size and isolation puts it in this landscape block.
Objective. The objective is to maintain and protect existing late seral successional forest. Any treatments should follow the successional pathways (page 33).
Treatment Recommendations. Accelerate late-successional conditions by maintaining canopy coverage at 40% and using multiple entries; i.e., light treatments with the goal to create diverse, late-successional conditions as quickly as possible. Buffer around all interior forest within the LSR, especially on the edges to protect existing late-successional conditions (pages 120-123). Reduce road density. Between LSR blocks and between Thomas Creek and Lower Crabtree Creek watersheds is an important connectivity corridor. Restoration in this area would be a priority (See Thomas Creek WA riparian reserve module).

Stand level treatments - See considerations beginning on page 117 for management criteria, interior forest conditions, species specific treatments, and the process for determining coarse woody debris and snag levels.

VII MONITORING

Monitoring is critical to evaluating our success in achieving late-successional structural characteristics across the landscape. Several large-scale ecological questions surfaced in this assessment. These questions generally revolve around management activities to improve older forest patch function by increasing the area of late-successional and interior forest, the connectivity between patches, and/or controlling human access. These questions are not new and have been extensively discussed in the literature and locally in the following documents: FEMAT (1993), First Approximation of Ecosystem Health (1993), in the Assessment Report... (1995), and a biodiversity conservation plan by Noss (1992).

CURRENT MONITORING EFFORTS

IMPLEMENTATION MONITORING

Implementation monitoring is already done under the Forest Plan monitoring plan. Key items to monitor include: Are timber harvests consistent with standards and guidelines and with REO review requirements? Other management activities in the Late-Successional Reserve consistent with the standards and guidelines (e.g. prescribed fire and resulting emissions) Late-Successional Reserve plan completed? Management activities consistent with the Late-Successional Reserve Plan?(ROD p. E-5)

On BLM lands at least twenty percent of management activities within Late Successional Reserves will be examined following project completion, to determine: a) whether proposed activities within the LSR were well defined and stipulated in the supporting documentation, b) whether the proposal clearly documented how the activities were consistent with LSR objectives and appropriate Standards and Guidelines, and c) whether post project results were consistent with the proposal.

The Willamette National Forest Supervisor annually selects a project from each Ranger District to review for consistency with Forest Plan direction. In addition, the District Rangers also select projects that are reviewed by an interdisciplinary team for consistency Forest Plan direction. Although neither of these implementation monitoring programs specifically targets LSR activities, it is likely that LSR activities would be included in the projects monitored by these existing processes.

In addition to the FS and BLM implementation monitoring, timber sale and restoration projects in the Province are randomly selected and monitored each year for compliance with NWFP standards and guidelines. In the first two years of Province monitoring, two LSR thinning projects have been part of the randomly selected projects.

EFFECTIVENESS MONITORING

Silvicultural standards and guidelines for Late-Successional Reserves provide examples of the close relationship between effectiveness and validation monitoring and research. Thinning in young stands is permitted for the purpose of maintaining or creating late-successional forest conditions. Monitoring the effectiveness of various thinning strategies will be important so that managers can apply those techniques which will be most likely to create and maintain late-successional conditions. It requires a measurable set of late-successional attributes which can provide the basis for assessment of post-thinning successes and failures. General attributes have been identified, but further research is required to identify those characteristics, which are key elements of late-successional forests, i.e. the desired outcomes of thinning programs must be further refined. Effectiveness monitoring programs could be designed to answer evaluation questions such as: "did silvicultural treatments benefit the creation and maintenance of late-successional conditions?"

It would be more efficient to combine effectiveness with validation monitoring and research to provide a more complete critical input to adaptive management. Therefore, an effectiveness monitoring program for standards and guidelines may best be developed as an element of a combined effectiveness and validation monitoring plan. Since this will establish research priorities, significant input from research is needed. (Report of the Monitoring Design Team, 1995)

The long-term goal is to provide future managers, scientists, and citizens with better information and the opportunity to evaluate the effectiveness of different management approaches to achieving LSR objectives. A landscape level approach needs to be implemented to address such issues as the amount of late-successional habitat, interior forest habitat, and connectivity. The Province level teams are working on baseline data for this approach by querying existing vegetation databases using agreed upon late-successional and old growth criteria. A pilot project in the Coast Range Province will be evaluating the following questions for an effectiveness monitoring plan.
1.What are the amount and distribution of forest classes, including LSOG, at the large landscape scale? How are they expected to change in the foreseeable future?
2. What is the patch size distribution, patch interior area distribution, and interpatch distance distribution of LSOG at the large landscape scale?
3. What are the effects of silvicultural treatment and salvage on LSOG composition and structure at the stand scale?
4. What is the trend in amount and changes in distribution of habitat, particularly in Late-Successional Reserves?
5. What is the trend in amount and distribution of dispersal habitat?

MONITORING SPECIFIC TO THIS LSR ASSESSMENT

Implementation
Utilize the current monitoring efforts. The following are site-specific questions to be considered that are specific to this LSR assessment. This list is not all-inclusive, but should be developed by the project ID team as they work through a project.

LSR objectives
* Are management activities consistent with the recommendations of this assessment?
* Are treatments consistent with the priorities established in the LSR Assessment to focus on young managed stands first?
*Are stands that appear to be on the right trajectory to develop late-successional characteristics on their own being left to develop?
*Are concerns with interior forest habitat being addressed in documentation and integrated into the treatment?

Growth Enhancement.
* Were the stocking density and species distribution goals achieved in young stand thinnings?
* Are wider spaced thinning treatments accelerating the development of late-successional characteristics such as tree growth?
* Where dispersal habitat is a current concern, were thinnings used that will achieve rapid canopy closure to maintain and enhance connectivity?

CWD goals
* Are the CWD goals established for the LSR being meant in treatment areas?
* If not, is there a written plan established for meeting those goals?
* Is CWD already on-site retained and protected during treatments?

Insects and pathogens
* Are risk assessments being done on the impacts of insect and disease prior to treatments, especially for salvage?
* Are treatments being monitored after treatment to assess the impact?

Road management
*Are road closures being considered and addressed along with management activities and for other wildlife concerns?

Other treatments.
*Is the roadside salvage of hazard trees consistent with the objectives of this plan?. .
* Are recreation activities consistent with LSR goals and objectives?

Late-successional species
* Are survey and manage species protocols being followed?
* Are specific species addressed in the assessment being managed for in a project?

Exotic species
* What is the status/trend of late-seral associated invasive weeds and their impact on LSR objectives?
* Are noxious weed treatments effectively eradicating or controlling their spread?

Fire
* Are the fire plan monitoring and evaluation guidelines of this LSR assessment being followed during a fire situation?

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United States Department of Agriculture **Forest Service** **R-5/R-6**

File Code: 1920 **Date**: January 22, 1996
Route To:

Subject: Late-Successional Reserves Assessments

To: Forest Supervisors, Owl Forests, Regions 5 and 6

The enclosed document, "REO Review of LSR and MLSA Assessments," clarifies how REO will implement the ROD requirement to review LSR Assessments (page C-11). The REO review document has been developed cooperatively with the interagency LSR Work Group, as well as with the Forest Service and Bureau of Land Management Issue Resolution Teams. A prior draft was also reviewed by field units earlier this year, and many of your comments have been incorporated.

The document is not intended to set minimum requirements nor standards. Rather, it reflects questions regarding consistency with LSR Standards and Guidelines that have been frequently raised during REO reviews of proposed projects.

Please address any questions regarding this guidance to Joyce Casey at 503-326-5817 (J.Casey:R06A), or Tom Hussey at 503-326-3589 (T.Hussey:R06A) of the Issue Resolution Team.

/S/ NANCY GRAYBEAL /S/ STEVE CLAUSON
FOR FOR

JOHN E. LOWE LYNN SPRAGUE
Regional Forester, R-6 Regional Forester, R-5

Enclosure

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Memorandum

Date: December 15, 1995

To: Regional Interagency Executive Committee

Ken Feigner, Director, Forest & Salmon Group, Environmental Protection Agency
John E. Lowe, Regional Forester, R-6, Forest Service
Stan M. Speaks, Area Director, Bureau of Indian Affairs
Michael J. Spear, Regional Director, U.S. Fish & Wildlife Service
William Stelle, Jr., Regional Director, National Marine Fisheries Service
William C. Walters, Deputy Field Director, National Park Service
Elaine Y. Zielinski, State Director, Oregon/Washington, Bureau of Land Management

California Federal Executives

Ed Hastey, State Director, California, Bureau of Land Management
G. Lynn Sprague, Regional Forester, R-5, Forest Service

From: Donald R. Knowles, Executive Director

Subject: Late-Successional Reserves Assessments

Purpose

The purpose of this memorandum is to help clarify proposed Regional Ecosystem Office (REO) implementation of the Record of Decision (ROD) requirement on page C-11, for the REO review of Late-Successional Reserves (LSR) Assessments. These assessments, which are subject to REO review, should be prepared prior to designing and implementing habitat manipulation activities within LSRs, beginning in FY 1997.

Background

There are three primary ROD references which describe REO responsibilities relative to LSR activities.

First, the ROD provides for a phased-in implementation of the requirement for development of LSR Assessments (pages 57 and A-7). In FY 1994-96, project proposals do not need to be supported by a detailed assessment of the entire LSR. Individual silviculture, salvage, and fire management related proposals are subject to REO review to determine consistency with LSR Standards and Guidelines (S&Gs). To date, REO has reviewed about 40 proposals involving over 100 actions in LSRs. REO has provided consistency findings for these proposals to agency executives.

Second, in lieu of reviewing all projects, the REO may develop criteria exempting certain proposed LSR activities from REO review (pages C-12, C-13, and C-18). On April 20, 1995, the REO published a set of criteria exempting certain young stand thinning, release, and reforestation projects from subsequent REO review. The REO is currently developing criteria to exempt additional silvicultural treatments with specific features from REO review. These exemptions only pertain to the ROD requirement for REO review--projects still must meet LSR S&Gs, other ROD requirements (e.g., watershed analysis, survey and manage), and other relevant statutory and regulatory requirements (e.g., NEPA analysis, Endangered Species Act, and Clean Water Act).

Third, agencies are to develop assessments for large LSRs or groups of LSRs, prior to design and implementation of habitat activities, beginning in FY 1997. These assessments are subject to REO review, as described on page C-11. While the ROD language does not explicitly prescribe the purpose or standard of this REO review, it does identify eight elements that should generally be included in LSR Assessments. Forest Service (FS) and Bureau of Land Management (BLM) field units have requested clarification regarding the content of LSR Assessments.

The REO, with the cooperation of the interagency LSR Work Group and the FS and BLM Issue Resolution Teams (IRTs), has developed a document to clarify REO review of LSR Assessments. A draft version of this document was provided to field managers of the FS and BLM in September 1995. Copies were also provided to the REO agency representatives and field staff. The enclosed revised version incorporates comments from the field.

Content of the Review Document

The enclosed is an advance copy of the REO review document. It is intended to help agencies prepare LSR Assessments and will also be used by the REO in the review of LSR Assessments. While it has already been revised to reflect field comments, it will remain a working document, subject to future revision as experience is gained in the preparation and review of assessments, and as the use of assessments in planning and conducting activities in LSRs is refined. The document does not establish minimum standards or core topics. Rather, it reflects the experience gained over the past year of IRT, work group, and REO reviews. It is presented as a series of questions frequently raised during the IRT and REO review processes. It recognizes that every question does not apply to every assessment and some assessments will likely need to address things not covered by the questions.

Proposal

The REO proposes the following:

1. The enclosed advance copy of the REO review document be distributed to field units to facilitate preparation of LSR Assessments. This review document is intended to clarify ROD direction and to help responsible officials prepare assessments that address the eight elements that should generally be included (page C-11). The

information provided by assessments will help establish the LSR context and information needed to guide future activities in LSRs.

2. The REO proposes to utilize LSR Assessments to help ensure that potential actions further attainment of LSR Objectives. Potential activities (with attendant treatment criteria) which are adequately described in assessments may not require subsequent REO consistency review. Our objective is to review potential activities described in assessments concurrently with the other seven elements of LSR Assessments. REO proposes to provide exemption from subsequent REO consistency reviews for those actions which, when carried out consistent with LSR Assessment provisions, further attainment of LSR Objectives or are otherwise consistent with LSR S&Gs.

3. The REO will also continue to work with the agencies and the Research and Monitoring Committee to ensure that projects exempted through REO s review of LSR Assessments from subsequent project specific review will be considered during implementation, effectiveness, and validation monitoring.

We recommend that the enclosed transmittal be tailored to fit individual agency formats, and that the advance version of the review document be transmitted to all appropriate field units as soon as is practicable. We will continue to provide you updates on our efforts to link our review of LSR Assessments with exemption from later project reviews. We will supersede this advance copy with a final version, along with a jointly signed transmittal from relevant RIEC agencies, as soon as it is practicable, which we estimate to be around the first of February 1996.

Please do not hesitate to let us know if we can provide additional information.

cc:
IAC
REO

576/ly

REO Review of LSR and MLSA Assessments

This document lists questions that REO uses when reviewing assessments prepared for Late-Successional Reserves (LSR) and Managed Late-Successional Areas (Record of Decision (ROD), pages C-11 and C-26) for the Northwest Forest Plan. Page C-11 of the ROD lists eight components that should generally be included in LSR Assessments. The first three components (vegetation history, species list, and land uses) are useful in describing the history and the current condition of the LSR. This can be used to determine how the LSR is functioning in relation to the objectives established in the Forest Plan. Components 4-7 (fire management plan, treatment criteria, location, and scheduling) establish activities that would move the LSR from its current condition toward the objectives and goals already defined. An LSR Assessment, therefore, should provide the information from which to evaluate needed and proposed management activities, and assure that these activities will meet LSR Standards and Guidelines (S&Gs) and further LSR Objectives. The final component (monitoring) will help determine if the proposed activities are meeting LSR Objectives, a necessary step in the adaptive management process.

Listed below are the eight components described on page C-11 of the ROD. Within each of these components are examples of questions that the LSR Work Group has raised during the review of LSR Assessments and specific projects within LSRs that have been submitted to REO for review. These questions are not provided as minimums or standards, but do reflect the questions that the work group has raised during the review of LSR Assessments. We recognize that every question in the document may not apply to every LSR and that some LSR Assessments may need to address things not covered by the questions. This document will likely evolve as the LSR Work Group and field gain more experience with LSR Assessments. We welcome your feedback and suggestions.

1. **History and inventory of overall vegetative conditions**.

Describing vegetative conditions in terms of the late-successional characteristics discussed in Chapter B of the S&Gs will provide the foundation from which to assess the current condition and logically determine the appropriate management activities necessary to achieve LSR Objectives. Example questions include:

Is vegetation addressed in an ecologically based description such as communities, assemblages, or plant associations?

Are the current vegetative conditions described and mapped?

Are vegetative conditions described in terms of their contribution (quality and quantity of existing and potential habitat) to late-successional species so species known or likely to occur can be identified?

Are the vegetative associations described in terms of the late-successional forest structure, function and processes found in Chapter B of the ROD s S&Gs?

Is the potential to create or improve late-successional conditions, either in quality, quantity or distribution identified (consideration of historical patterns and disturbance factors may help determine this)?

2. **List of late-successional associated species known to exist in the LSR and information on known locations**.

This information is intended to help identify species or habitats that need special emphasis or consideration in subsequent management actions. Example questions include:

Is there a list of late-successional associated vertebrate, invertebrate, vascular, and non-vascular plant species known to occur in the LSR under the current habitat conditions?

Does the assessment present information on known locations of late-successional species?

Are late-successional associated species that have been extirpated from the LSR, but could inhabit the LSR under natural conditions, addressed?

Given the late-successional species identified, is there a discussion of how the LSR functions within the surrounding LSR network (i.e., in terms of dispersal, recruitment, refugia, etc.)?

Have habitat conditions for late-successional species on adjacent lands (including nearby LSRs) with implications for this LSR and its management been addressed?

Have species of management concern, known or likely to occur in the LSR, been identified and have habitat needs that may conflict with LSR Objectives been discussed?

Are specific late-successional structure and functions for associated species or groups of species identified?

Is the discussion of the habitat associations sufficient to permit a logical determination that activities conducted under proposed treatment criteria will achieve LSR Objectives?

3. **History and description of current land uses in the LSR.**

Example questions include:

Is there a description of existing facilities, activities (e.g., recreation, mining, grazing), developments, hydro projects, special uses, other agreements, etc.?

Does the assessment explain how these uses (e.g., location, extent, timing, size, existing mitigation) affect the distribution, quality and quantity of late-successional habitat and, where appropriate, the effects on late-successional associated species?

Does the assessment explain how relevant historic land uses have resulted in current late-successional conditions?

Is there a description of and location information for introduced non-native species, and does the assessment explain how these non-native species affect native late-successional associated species?

4. **Fire management plan**.

Specific suggestions on what should be included in the fire management plan can be found in Appendix B8 of the NFP EIS. Example questions include:

Does the management strategy for the LSR consider risks and threats to the LSR and its ability to function as a part of the surrounding LSR network?

Does the fire management plan recommend strategies and prescriptions to prevent large-scale disturbances?

Are risk factors (e.g., fuel loading, ignition points and sources, land-use patterns, fire frequency and intensity, etc.) and their implications in meeting LSR Objectives addressed?

Does the fire management plan consider fire prescriptions that will help meet LSR Objectives based on existing conditions?

If large-scale loss of late-successional habitat to fire is considered a significant risk, are management actions identified to reduce that risk?

For proposed risk-reduction treatments that may result in short-term loss of late-successional habitat or species, is consideration given to the balance between reducing risk of large scale fire and maintaining late-successional conditions?

Are the risk levels and prescriptions based on local fire history?
Where appropriate, are opportunities for naturally ignited or human-ignited prescribed fire identified?

Are special suppression techniques identified for all or portions of this LSR?

5. **Criteria for developing appropriate treatments**.

Questions for LSR Assessment components 5 & 6 are combined below.

6. **Identification of specific areas that may be treated under developed criteria**.

Treatment criteria and locations will compose an LSR management strategy based on the current LSR conditions, and the desired conditions. Criteria and supporting logic should clearly indicate that treatments are appropriate for a given type of ground at a given location at a given point in time to further late-successional conditions (as described in Chapter B of the S&Gs) or meet other LSR Objectives. Example questions include:

Do treatment criteria and locations clearly indicate:

A specific condition (or conditions) that would prompt management action?

Treatment objectives for each specific condition?

Known treatment techniques that will achieve or move the site toward desired conditions, including their scientific basis?

Quantitative or qualitative standards or constraints which should be applied to any of the treatments?

Are late-successional components/characteristics (e.g., down woody debris, snags, tree density, canopy closure) quantified by vegetation type, series, or plant association?

Are the sources of the quantified characteristics provided (e.g., research, literature, field transects)?

Are other components such as vertical and horizontal structure and species composition qualitatively described?

Is the expected post-treatment condition described quantitatively?

Were empirical information or models used to show that a prescribed treatment will meet late-successional objectives?

For proposed risk reduction treatments that may result in short-term loss of late-successional habitat or species, is consideration given to the balance between reducing risk of large scale disturbance and maintaining late-successional conditions?

Does the assessment consider activities other than silviculture and salvage?

7. **Proposed implementation schedule tiered to higher order plans**.

Are priorities for treatment appropriately tied to province plans, LRMPs and RMPs, appropriate species Recovery Plans, etc.?

8. **Proposed monitoring and evaluation components to help evaluate if future activities are carried out as intended and achieve desired results.**

Does the assessment identify issues or ecosystem components that should be monitored in addition to items found in implementation, effectiveness, and validation monitoring plans for individual management units and those developed at the regional or state level?

Are existing and desired conditions and activity criteria described in sufficient detail so that implementation and effectiveness monitoring can be effectively conducted?

ADDITIONAL THOUGHTS

Interagency cooperation is a foundation of the ROD (E-18). Although interagency teams are not required to complete an LSR Assessment, agencies having an interest in the LSR should be given the opportunity to participate in the assessment process. The LSR Assessment should note the level of interagency involvement. Additionally, state, tribal, and county input should be sought to identify issues relevant to the LSR Assessment.

LSRs do not stand alone but were designed to function within a network of LSRs that are connected through Riparian Reserves and other land allocations (ROD, page 6). Certain issues and desired projects may necessitate consideration of the condition of surrounding LSRs and related connectivity.

It is expected that an LSR Assessment will include the entire LSRs in its analysis. Large reserves are designed to accommodate self-sustaining populations of most late-successional organisms (S&Gs, pages B4-5; FEMAT, page IV-187). An assessment that covers the entire LSR and its relationship to the network of LSRs provides a more complete picture of its current condition and lays a more credible foundation for structuring needed treatments to reach LSR Objectives.

Appendix B

Table B-1 Landtypes of the Mid Willamette LSRA Area

Physiographic Zone	Geologic Substrate	Landtype Number	Elevation Range (ft)	Slope Length*	Slope Dissection+	Slope Steepness#	LSR
Mixed Cascades	Altered Basalt and Andesite Lavas	1A	3000-5000	short-mod	high		214, 221, 220
West Cascades, Mixed Cascades	Altered Basalt and Andesite Lavas	1B	5000-6000	short	low	gentle	220, 221, 219
West Cascades, Mixed Cascades	Altered Basalt and Andesite Lavas	1C	3000-45000	short-mod	moderate	moderate	212, 213, 219, 246
West Cascades, Mixed Cascades	Pyroclastic Rocks	2A	<3000	short		gentle	213, 215, 219, 220, 221, 246
West Cascades, Mixed Cascades	Pyroclastic Rocks	2B	< 4000	mod-long		moderate	212, 213, 214, 215, 216, 217, 219, 246
West Cascades	Pyroclastic Rocks	2C			high	steep	213, 217, 219
Mixed Cascades	Ridge Capping Basalts	3A	5000-6000	short	low	gentle	213, 214, 220
Mixed Cascades	Ridge Capping Basalts	3B					213, 214, 215, 218, 220
Mixed Cascades	Lava Flows and Pyroclastic	5A	2000-5000	mod	low-moderate	moderate-steep	218
Mixed Cascades	Lava Flows and Pyroclastic	5B	2000-5000	mod	high	moderate-steep	218
Mixed Cascades	Lava Flows and Pyroclastic	5C	4000-5000	short-mod	low-moderate	moderate	218
Mixed Cascades	Lava Flows and Pyroclastic	5D	3000-5000	mod - long	moderate	moderate	218
Mixed Cascades	Fluvial	6					218
West Cascades	Sedimentary and Volcanics	7A	2000-4000	short-mod	high	steep	215
West Cascades	Sedimentary and Volcanics	7B					215, 216
Mixed Cascades	Layered Volcanic/ Landslides	8					213, 215, 219
High Cascades	High Cascades Plateau	11					214, 218, 220, 221

*slope length: short = < 500 ft; mod = 500 - 1000 ft.; long = > 1000 ft.
+slope dissection: low = < 2 streams; mod = 2-5 streams; high = > 5 streams
#slope steepness: gentle = < 11%; moderate = 11-50%; steep = >50%

APPENDIX C

SERAL STAGE DESIGNATIONS USED FOR MAPPING CURRENT VEGETATION DISTRIBUTION

We developed a crosswalk to determine seral stages for FS and BLM vegetation coverages. We used the following series and/or subseries to most adequately account for variation in environments responsible for seral conditions.

Table C-1. Plant associations in each series or subseries used to stratify the seral stages

Environment	Site Class	Plant Associations
Western hemlock groups:		
Warm, moist	I,II	dwarf Oregon grape/Oregon oxalis; Oregon oxalis; swordfern
Well drained-dry	III,IV	dwarf Oregon grape; dwarf Oregon grape-salal; salal; rhodendron-dwarf Oregon grape; hododendron-salal;/rhododendron/twinflower; vanilla leaf;dwarf Oregon grape/vanilla leaf; twinflower; rhododendron-Alaska huckleberry/dogwood bunchberry; rhododendron/beargrass
Pacific silver fir groups:		
Moderate	III,IV	vine maple/coolwort foamflower; Oregon oxalis; coolwort foamflower; rhododendron-Alaska huckleberry/dogwood bunchberry; Alaska huckleberry/dogwood bunchberry; big huckleberry/queencup beadlilly; Oregon grape; rhododendron-dwarf Oregon grape; -grand fir/false solomon's seal
Cold	V	big huckleberry/beargrass; rhododendron/beargrass
Douglas-fir series		
Grand fir series		

To develop the crosswalk between stand age (contained in BLM and some FS stands) and dominant size class (contained in most FS stands), we used the following seral stage designations:

Early; Early-mid; Mid; Mature; Old-growth; Non-forest (includes meadow, rock, admin, and other non-forest stands).

Tables C-2. Seral stage definitions

Seral stage	---Age---		Dominant size class
	warm,moist	dry	
Western Hemlock:			
Early	0-20	0-25	<5 "
Early-mid	21-40	26-40	5-9"
Mid	41-80	41-100	9-21"
Mature	81-200	101-250	21-32"
Old-growth	>200	>250	>32"

Seral Stage	---Age---		Dominant size class	
	moderate	cold	moderate	cold
Pacific Silver Fir				
Early	0-30	0-35	<5"	<5"
Early-mid	31-50	36-50	5-9"	5-9"
Mid	51-150	51-175	9-21"	5-9"
Mature	151-250	176-300	22-32"	9-21"
Old-growth	>250	>300	>32"	>21"

Seral Stage	Age	Dominant size class
Douglas-fir:		
Early	0-30	<5"
Early-mid	31-50	5-9"
Mid	51-125	9-21"
Mature	126-250	22-32"
Old-growth	>250	>32"
Grand fir:		
Early	0-25	<5"
Early-mid	26-50	5-9"
Mid	51-125	5-9""
Mature	126-250	10-21"
Old-growth	>250	>250

Species Reference List

ABAM	Abies amabilis	Pacific silver fir
ABGR	Abies grandis	Grand fir
ABPR	Abies procera	Noble fir
PSME	Pseudotsuga menziesii	Douglas-fir
THPL	Thuja plicata	Western redcedar
TSHE	Tsuga heterophylla	Western hemlock
TSME	Tsuga mertensiana	Mountain hemlock
Shrubs		
ACCI	Acer circinatum	Vine Maple
ARUV	Arctostaphylos uva-ursi	Kinnikinnick
BENE2	Berberis nervosa	Dwarf Oregon grape
(Mahonia nervosa var. nervosa)		
GASH	Gaultheria shallon	Salal
HODI	Holodiscus discolor	Oceanspray
OPHO	Oplophanax horridum	Devil• s club
RHMA	Rhododendron macrophyllum	Rhododendron
SYAL	Symphoricarpos albus	Snowberry
VAAL	Vaccinium alaskaense	Alaskan huckleberry
Ferns & Allies		
POMU	Polystichum munitum	Sword fern
Herbs		
ACTR	Achlys triphylla	Vanilla leaf
ACRU2	Actaea rubra	Baneberry
GOOB2	Goodyera oblongifolia	Rattlesnake orchid
LIBO3	Linnaea borealis	Twinflower
OXOR	Oxalis oregana	Oregon oxalis
TITR	Tiarella trifoliata	Threeleaf foamflower
WHMO	Whipplea modesta	Whipplevine
XETE	Xerophyllum tenax	Beargrass

APPENDIX D

SERAL STRUCTURE ANALYSIS

Willamette NF plot data were analyzed to characterize MID, mature, and old growth stand structures. Data on coarse woody debris and density of live poles were available only from Current Vegetation Survey (CVS) plots. Also all data on the silver fir series' structure came from CVS plots. Ecology plot data and CVS data were combined to describe live structure in the other series.

Factors which would have major affects on density and size class distribution such as creeks, large rock outcrops, non-forest areas, harvest, or roads were used to screen CVS plots to ensure use of only plots which had all points in the same stand, with a majority of the points in the same subseries. The ecology plots had been located in homogeneous stands to avoid such confounding factors.

Table D-1 summarizes criteria for assigning CVS plots to seral stages. These criteria were developed using species, size, age, and densities recorded for each plot. The first variable is the largest size class with a minimum of 8 trees per acre ("BIGCLASS"). Fewer remnant trees were not considered adequate to represent the seral stage of the stand as a whole. The second variable ("AVEDBH") is the mean diameter of all trees >5"dbh. The third variable ("CV") is the coefficient of variation of "AVEDBH". This is a surrogate for layering. The higher the coefficient of variation, the wider the range of size classes present in the stand. Note that the smaller the average stand diameter, the higher coefficient of variation needed to assign the stand to a late seral stage.

The values in the table below are empirical, and likely are specific to the set of plots from which they were derived.

Table D-1. Criteria for assigning CVS plots to seral stages

Subseries	Big class	Ave dbh	CVS	Seral stage
ABAMHI	Giant			old growth
	Large	>=24		old growth
		16-23.9	>70	old growth
			<=70	mature
		<16	>=80	old growth
			<80	mature
	Medium	>15	>=85	old growth
			65-84.9	mature
		9-15	>97	mature
ABAMLO	Giant			old growth
	Large			old growth
	Medium		>84	old growth
			67-84	mature
	Small		>80	mature
ABGR	Giant			old growth
	Large	>=17	>=80	old growth
		<17	<80	mature
	Medium		>65	mature
PSME	Large		>77	old growth
			55-77	mature
	Medium	>=18	>=40	mature
		15-17.9	>60	mature
TSHEHI	Giant			old growth
	Large		>=70	old growth
			<70	mature
	Medium			mature
TSHELO	Giant			old growth
	Large	>22		old growth
		18-22	>53	old growth
			<=53	mature
		<18	>=94	old growth
			<94	mature
	Medium	>14	>81	old growth
			60-81	mature
		<=14	>=81	old growth
			72-80.9	mature
	Small		>100	old growth
			69-100	mature

APPENDIX E

DEVELOPMENT OF THE MID-1900'S SERAL STAGES

Table E-1. Classification used to stratified mid-1900's seral stages.

Seral Stage	Vegetation	Size Class	Size
Early	balsam firs-mountain hemlock	small	< 10" DBH
	deforested burn		
	Douglas fir	seedlings and saplings	< 5" DBH
	Douglas fir	seedlings and saplings	< 6" DBH
	fir-mountain hemlock	small	< 16" DBH
	lodgepole pine	seedlings and saplings	0-5" DBH
	lodgepole pine	small	< 12" DBH
	non-restocked cutovers		
	ponderosa pine	seedlings and saplings	0-5" DBH
	recent cutovers		
	true fir-mountain hemlock	seedlings and saplings	0-5" DBH
	western hemlock	seedlings and saplings	< 6" DBH
	western hemlock	seedlings and saplings	0-5" DBH
mid	Douglas fir	pole timber	5-11" DBH
	Douglas fir	small saw timber	11-21" DBH
	Douglas fir	small second growth	6-20" DBH
	lodgepole pine	large	> 12" DBH
	lodgepole pine	pole timber	5-11" DBH
	ponderosa pine	pole timber	5-11" DBH
	ponderosa pine	small saw timber	11-21" DBH
	true fir-mountain hemlock	pole timber	5-11" DBH
	true fir-mountain hemlock	small saw timber	11-21" DBH
	western hemlock	pole timber	5-11" DBH
	western hemlock	small	6-24" DBH
	western hemlock	small saw timber	11-21" DBH
	white fir	small	< 20" DBH
	white fir	small saw timber	11-21" DBH
	white pines	small saw timber	11-21" DBH

Table E-1. Classification used to stratified mid-1900's seral stages.

Seral Stage	Vegetation	Size Class	Size
late	balsam firs-mountain hemlock	large	> 12" DBH
	cedar	large saw timber	> 21" DBH
	Douglas fir	large old growth	> 21" DBH
	Douglas fir	large old growth	> 40" DBH
	Douglas fir	large saw timber	> 21" DBH
	Douglas fir	large second growth	22-40" DBH
	Douglas fir	old growth	> 22" DBH
	Douglas fir	small old growth	22-40" DBH
	fir-mountain hemlock	large	> 16" DBH
	ponderosa pine	large saw timber	> 21" DBH
	sitka spruce	large saw timber	> 21" DBH
	true fir-mountain hemlock	large saw timber	> 21" DBH
	western hemlock	large	> 20" DBH
	western hemlock	large saw timber	> 21" DBH
	western redcedar	large	> 24" DBH
	white fir	large saw timber	> 21" DBH
	white pines	large saw timber	> 21" DBH
hardwoods	hardwoods		
	hardwoods	pole timber	5-11" DBH
	hardwoods	seedlings and saplings	0-5" DBH
	hardwoods	small saw timber	11-21" DBH
nonforest	agricultural		
	cultivated, grass, brush		
	grass, sagebrush, brush	nonforest	
	non-agricultural nonforest		
	open		
	rock		
	water		
subalpine	subalpine		
unknown			
	oak madrone		
	ponderosa pine		
	woodland		
	true fir-mountain hemlock		
	unknown		
	white fir		

APPENDIX F

CWD

We compared our values for big snags (>20”, >16’) and big logs (>21”, >20”) expressed in medians and quartiles to means and ranges (plus or minus one standard deviation) from log transformed data. We did this because of the possibility that the calculation affected the results since these values are higher than published data of 2.4 snags per hectare (Spies et al. 1988). However, the values from both methods were comparable. Further, values for large snags reported from the Mt. Hood CVS data are also much higher than the Spies’ values (snags >15” in ABAM OG=14, and TSME OG=15).

Table F-1.

Series	Seral Stage	Mean	Range TPA	Median	25-75% Quartiles
ABAM	MAT	21	11-40	21	14-29
ABAM	OG	24	11-55	32	18-43
ABGR	MAT	11	2-52	22	0-33
ABGR	OG	8	1-57	16	1-38
PSME	MAT	3	2-7	0	0-5
PSME	OG	12	4-35	21	11-21
TSHE	MAT	10	4-26	11	5-21
TSHE	OG	23	10-53	24	13-42

Table F-2.

Series	Seral Stage	Mean	Range TPA	Median	25-75% Quartiles
ABAM	MAT	9	3-30	13	5-19
ABAM	OG	9	3-24	12	7-16
ABGR	MAT	12	9-16	12	10-14
ABGR	OG	14	ND	14	NA
PSME	MAT	9	ND	9	NA
PSME	OG	14	8-24	13	9-22
TSHE	MAT	12	5-31	11	8-25
TSHE	OG	14	6-30	14	9-21

MID-SERAL STANDS.

Values for snags and logs for mature and old growth stands are found in Table II-6 and II-7 on pages II-23 through II-25. Values for the mid stands are used to generate recommendations for CWD levels in stand treatment prescriptions and for salvage (Tables IV-4 and IV-5). Tables F-3 and F-4 summarize the CVS plot data for mid stands.

Table F-3. Snag CVS plot data for mid stands

Series	Plots	Lg.-tpa	Lg.-vol	Med.tpa	Med-vol	sml-tpa	sml-vol	total vol
ABAM	12	0	0	5	603	81	1269	4746
		(0-5)	(0-543)	(0-11)	(0-1454)	(41-142)	(1044-4153)	(3785-6855)
ABGR	2	0	0	0	0	131	2675	3061
						(20-242)	(108-5242)	(248-5875)
PSME	13	5	668	0	0	33	788	2645
		(5-11)	(227-1286)	(0-11)	(0-534)	(16-112)	(268-1853)	(1645-3693)
TSHE	16	0	0	3	0	79	886	2385
		(0-5)	(0-156)	(0-5)	(0-539)	(31-107)	(466-1657)	(1821-3257)

Median values are displayed above ranges from 25th to 75th quartiles. Data from Current Vegetation Survey plots on the Willamette National Forest. TPA=trees per acre. Volume is in cubic feet per acre.

Table F-4. Down log CVS plot data for mid stands

Series	Plots	Lg-vol	Med-vol	Sm-vol	%hard	big logs-ppa	biglogs-vol	biglogs-%vol	total vol
ABAM	12	1880	371	604	21	11	715	63	1060
		(419-3064)	(209-941)	(242-612)		(10-11)	(607-1237)	(39-77)	(398-3004)
ABGR	2	975	28	23	34	28	1137	73	1822
		NA	NA	NA		NA	(975-1299)	(49-98)	(998-2647)
PSME	13	1964	326	82	19	11	835	37	1333
		(1044-2459)	(276-1075)	(0-551)		(10-17)	(209-2735)	(19-83)	(750-2735)
TSHE	16	2750	326	232	3	25	1605	79	1514
		(2118-6165)	(189-1719)	(44-335)		(19-33)	(338-2868)	(49-88)	(528-3008)

Median values are displayed above ranges from 25th to 75th quartiles. Data from Current Vegetation Survey plots on the Willamette National Forest. PPA=pieces per acre. Volume is in cubic feet per acre.

SPECIES' ASSOCIATION TO CWD

Table F-5. Coarse woody debris association and management status of terrestrial vertebrate species designated by FEMAT as associated with late-successional forest habitat within LSRs in the Mid-Willamette assessment area.

Species' Common Name [1]	Species' Scientific Name	Coarse Woody Debris [2]
AMPHIBIANS		
Northwestern salamander	*Ambystoma gracile*	L
Pacific giant salamander	*Dicamptodon tenebrosus*	L
Cascade torrent salamander	*Rhyacotriton cascadae*	
Clouded salamander	*Aneides ferreus*	
Oregon slender salamander	*Batrachoseps wrighti*	L
Dunn's salamander	*Plethodon dunni*	L
Rough-skinned newt	*Taricha granulosa*	L
Tailed frog	*Ascaphus truei*	L
Cascades frog	*Rana cascadae*	
Spotted frog	*Rana pretiosa*	
BIRDS		
Wood duck	*Aix sponsa*	S, L
Harlequin duck	*Histrionicus histrionicus*	
Barrow's goldeneye	*Bucephala islandica*	S
Bufflehead	*Bucephala albeola*	S
Hooded merganser	*Lophodytes cucullatus*	S
Common merganser	*Mergus merganser*	S
Bald eagle	*Haliaeetus leucocephalus*	S
Northern goshawk	*Accipiter gentilis*	
Peregrine falcon	*Falco peregrinus*	
Flammulated owl	*Otus flammeolus*	S
Northern pygmy-owl	*Glaucidium gnoma*	S
Northern spotted owl	*Strix occidentalis caurina*	S
Barred owl	*Strix varia*	S
Great gray owl	*Strix nebulosa*	S
Vaux's swift	*Chaetura vauxi*	S
Red-breasted sapsucker	*Sphyrapicus ruber*	S
Williamson's sapsucker	*Sphyrapicus thyroideus*	S
Hairy woodpecker	*Picoides villosus*	S
Three-toed woodpecker	*Picoides tridactylus*	S, L
Black-backed woodpecker	*Picoides arcticus*	S
Northern flicker	*Colaptes auratus*	S, L
Pileated woodpecker	*Dryocopus pileatus*	S, L
Hammond's flycatcher	*Empidonax hammondii*	
Pacific-slope flycatcher	*Empidonax difficilis*	
American crow	*Corvus brachyrhynchos*	
Common raven	*Corvus corax*	
Chestnut-backed chickadee	*Parus rufescens*	S
Red-breasted nuthatch	*Sitta canadensis*	S, L
White-breasted nuthatch	*Sitta carolinensis*	S
Pygmy nuthatch	*Sitta pygmaea*	S

Table F-5. Coarse woody debris association and management status of terrestrial vertebrate species designated by FEMAT as associated with late-successional forest habitat within LSRs in the Mid-Willamette assessment area con't.

Species' Common Name [1]	Species' Scientific Name	Coarse Woody Debris [2]
Brown creeper	*Certhia americana*	S
Winter wren	*Troglodytes troglodytes*	L
Golden-crowned kinglet	*Regulus satrapa*	
Hermit thrush	*Catharus guttatus*	
Varied thrush	*Ixoreus naevius*	
Warbling vireo	*Vireo gilvus*	
Hermit warbler	*Dendroica occidentalis*	
Wilson's warbler	*Wilsonia pusilla*	
Red crossbill	*Loxia curvirostra*	
MAMMALS		
Vagrant shrew	*Sorex vagrans*	
Baird's shrew	*Sorex bairdii*	
Dusky shrew	*Sorex monticolus*	
Fog shrew	*Sorex sonomae*	
Shrew-mole	*Neurotrichus gibbsii*	L
Little brown myotis	*Myotis lucifugus*	S, L
Yuma myotis	*Myotis yumanensis*	S
Long-eared myotis	*Myotis evotis*	S
Fringed myotis	*Myotis thysanodes*	
Long-legged myotis	*Myotis volans*	S
Silver-haired bat	*Lasionycteris noctivagans*	S
Big brown bat	*Eptesicus fuscus*	S
Hoary bat	*Lasiurus cinereus*	
Townsend's chipmunk	*Tamias townsendii*	
Siskiyou chipmunk	*Tamias siskiyou*	
Douglas' squirrel	*Tamiasciurus douglasii*	S, L
Northern flying squirrel	*Glaucomys sabrinus*	S, L
Deer mouse	*Peromyscus maniculatus*	
Western red-backed vole	*Clethrionomys californicus*	S, L
Red tree vole	*(arborimus) phenacomys longicaudus*	
Marten	*Martes americana*	S, L
Fisher	*Martes pennanti*	S, L
Elk	*Cervus elaphus*	
REPTILES		
Northern alligator lizard	*Elgaria coerulea*	

1 Common and scientific names of species closely associated with late-successional forest (from "FEMAT", pages IV-39-40; USDA et al. 1993).

2 Species closely associated with coarse woody debris for some of their life needs ("SAT Report" USDA 1993)..
S = species associated with snags and other standing dead wood
L = species associated with down woody debris

CONVERSIONS

Table F-6. Diameter/length to % cover to cubic feet volume.

Douglas-fir logs					
LE diam	Length	SE diam	Sq.Feet	%cover/acre	volume cu.ft/acre
6	20	4.88	9.07	0.021	3.26
8	30	6.22	17.77	0.041	8.40
10	40	7.41	29.02	0.067	16.90
12	20	9.76	18.13	0.042	13.05
12	40	8.89	34.82	0.080	24.33
12	65	7.81	53.66	0.123	36.34
15	20	12.20	22.66	0.052	20.38
15	40	11.12	43.53	0.100	38.02
15	60	10.04	62.59	0.144	53.29
15	75	9.23	75.70	0.174	63.43
20	20	16.26	30.22	0.069	36.24
20	40	14.82	58.03	0.133	67.59
20	60	13.38	83.45	0.192	94.74
20	80	11.94	106.47	0.244	118.37
20	100	10.50	127.08	0.292	139.15
30	20	24.39	45.33	0.104	81.53
30	40	22.23	87.05	0.200	152.08
30	60	20.07	125.18	0.287	213.17
30	80	17.91	159.70	0.367	266.33
30	100	15.75	190.63	0.438	313.09
30	140	11.43	241.68	0.555	393.49
40	20	32.52	60.43	0.139	144.95
40	40	29.64	116.07	0.266	270.37
40	60	26.76	166.90	0.383	378.97
40	100	21.00	254.17	0.583	556.60
40	155	13.08	342.81	0.787	748.63

WESTERN HEMLOCK LOGS					
LE diam	Length	SE diam	Sq.Feet	%cover/acre	volume
6	20	4.75	9.07	0.021	3.26
8	30	5.90	17.77	0.041	8.40
10	40	6.82	29.02	0.067	16.90
12	20	9.50	18.13	0.042	13.05
12	40	8.18	34.82	0.080	24.33
12	65	6.53	53.66	0.123	36.34
15	20	11.88	22.66	0.052	20.38
15	40	10.23	43.53	0.100	38.02
15	60	8.58	62.59	0.144	53.29
15	75	7.34	75.70	0.174	63.43
20	20	15.84	30.22	0.069	36.24
20	40	13.64	58.03	0.133	67.59
20	60	11.44	83.45	0.192	94.74
20	80	9.24	106.47	0.244	118.37
20	100	7.04	127.08	0.292	139.15
30	20	23.76	45.33	0.104	81.53
30	40	20.46	87.05	0.200	152.08
30	60	17.16	125.18	0.287	213.17
30	80	13.86	159.70	0.367	266.33
30	100	10.56	190.63	0.438	313.09
30	140	3.96	241.68	0.555	393.49
40	20	31.68	60.43	0.139	144.95
40	40	27.28	116.07	0.266	270.37
40	60	22.88	166.90	0.383	378.97
40	100	14.08	254.17	0.583	556.60
40	155	1.98	342.81	0.787	748.63

APPENDIX G

ROAD DENSITY ASSESSMENT

To assess the effects of roads in this LSRA analysis area, a method was developed that estimates the overall effects of roads on each sample point of the LSR landscape (in this method, a “sample point” on the landscape equals a 1 acre pixel). For each point within an LSR, the number of road miles within a 1 square mile circle (radius 2979 feet, or slightly greater than ½ mile) around the point is calculated in GIS, a so-called “moving window”. The selection of a one square mile circle as the unit of measure attempts to estimate the significant zone of road effects around a point; other radii could be selected in future fine tuning of this method to address specific management issues more quantitatively related to precise distances from roads. No attempt was made to weight the effects of the roads by distance to the sample point, other than their occurrence within the sample distance. To avoid an edge bias, roads immediately adjacent to the LSR boundaries are included in the sampling universe for this method. Thus, each point is assigned a road density value, measured in miles per square mile, based on a 1 square mile circular window around the point.

APPENDIX H

DESCRIPTION OF THE CONCEPT AND ANALYSIS OF PROPOSED LANDSCAPE BLOCKS

Two primary characteristics can be used to differentiate among the 7 distinct LSR sub-blocks (landscape blocks) in the analysis area. These characteristics are the relative proportion of seral stages occurring in the landscape blocks, and the relative size of the seral stage patch sizes found in each block. These characteristics can be used to facilitate decisions about the application of silvicultural prescriptions to existing stand conditions to achieve landscape level management goals.

We subdivide LSRs into landscapes that have similar juxtaposition and proportion of seral stages. This classification allows more landscape-specific management recommendations to be developed. These management recommendations could more effectively balance the opportunities for restoration of late-successional habitats with the relative short-term risk to late-successional species from conducting these activities based on landscape conditions. The following descriptions present the major criteria that are used to differentiate between landscape blocks.

Block A: These sub-blocks, found in Quartzville, Horse Creek and South Santiam LSRs, contain a relatively high proportion of old growth and mature stands (ranging from 72% to 87%), with the remaining occurring in about equal proportions of earlier seral stages. Old growth dominates the late-successional stages, and average patch size of old growth stands is 349 acres. These landscape blocks are considered highly functional, relative to the criteria analyzed in this LSRA (e.g., interior forest, connectivity, patch size, road density).

Block B1: Both the B1 and B2 landscape blocks contain intermediate amounts of late-successional forest, ranging from 35% to 65%, although type B1 contains somewhat more late-successional than do B2 types. These types also contain a relatively high amount of old growth, although substantially below that of the A types. In addition, average patch size of old growth stands is less than 70 acres. Block B1 includes 35% to 45% of the landscape in early, early-mid and mid seral stages.

Block B2: The primary difference between this Block and the B1 type is the seral stage composition of the non-late-successional stands. Within B2, the proportion of early, early-mid and mid seral ranges from 45% to 65%. This is composed primarily of early and early-mid seral stages wherein most silvicultural activities during the next several years are likely to be precommercial thinning or post-and-pole thinning.

Block C: We defined this Block primarily based upon the high proportion of mid seral stage currently existing, as well as the relatively low proportion of old growth on the landscape. Average patch size of old growth stands is less than 20 acres. The high level of fragmentation, low amount of interior forest, and poorer quality of connectivity all indicate the relatively lower risk to late-successional species from activities designed to promote and accelerate the restoration of late-successional structural conditions in early to mid seral stands.

Block D: The seral stage distribution in this Block most closely resembles that in the B1 blocks. The primary difference was that adjacent blocks were mid to old growth so the potential for larger functioning patches exists here and not in B1**.**

Block E: The primary characteristic of this block is the overall small size due to the small size of the LSR itself (E landscape blocks are found in the Thomas Creek, Whitcomb and Wiley LSRs). Although the current seral distributions are reminiscent of the A and B1 landscape blocks, their small size reduces the potential for management of large blocks of late-successional forest in the long term.

Block F: These blocks (found in South Santiam and Hagan LSRs) are dominated by fire generated stands that are in a mid seral/mature transition. The current amount of late-successional forest is very low, ranging from 7% to 28% and the size of old growth blocks averages less than 32 acres. The total acreage of mid seral forest that might qualify for restoration thinning is very high, especially in South Santiam. However, each stand will need on-site review to determine the current structural condition relative to the post-fire successional pathway, and the risks to late-successional species from conducting habitat-modifying activities.

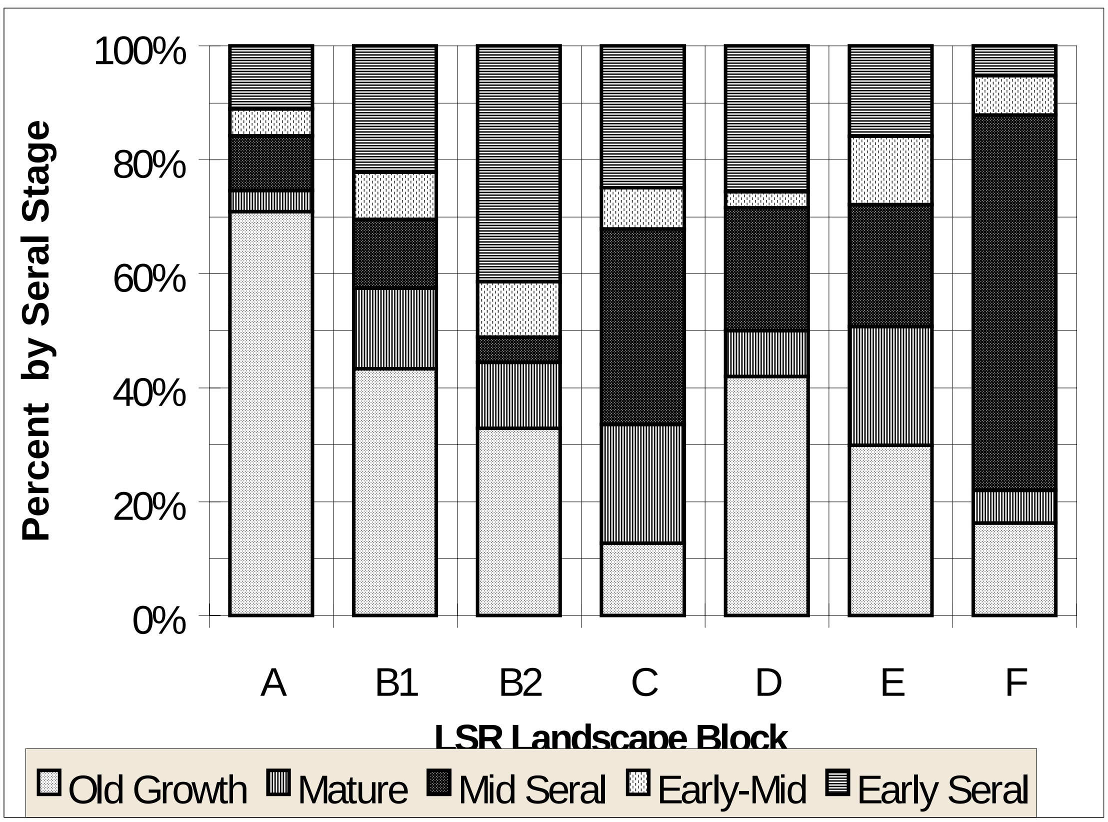


Figure H-1. Seral stage percentages by landscape block.

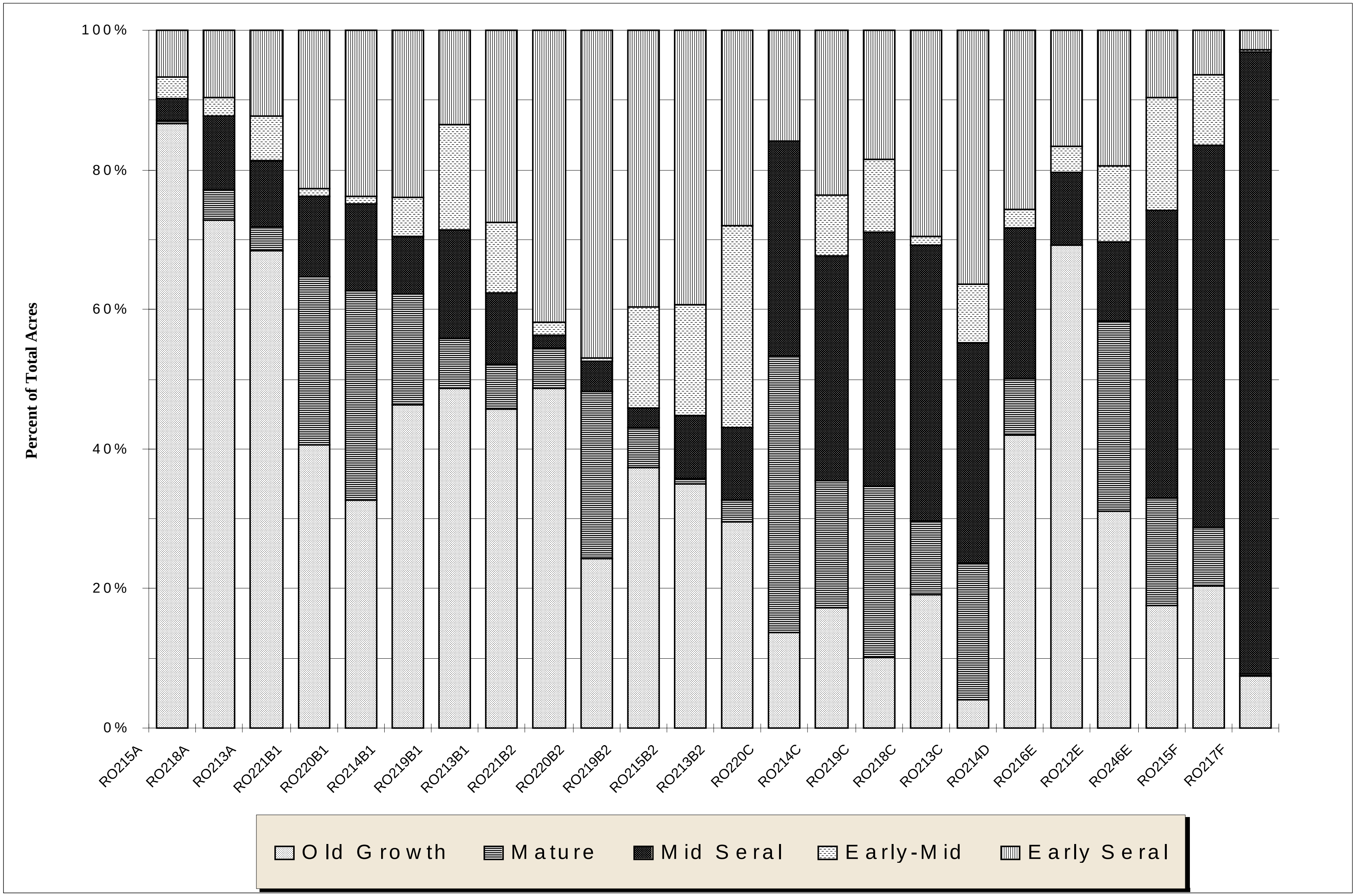


Figure H-2. Percent by seral stage within different landscape blocks by LSR.

Table H-1. Acres of seral stages by each landscape block within LSRs.

Seral Stage	*215A*	*218A*	*213A*
Early	163	1,842	3,482
Early-mid	73	505	1,772
Mid	75	2,008	2,695
Mature	14	849	969
Old growth	2,095	13,866	19,284

Seral Stage	*221B1*	*220B1*	*214B1*	*219B1*	*213B1*
Early	2,483	6,336	2,771	4,470	10,999
Early-mid	113	264	643	4,989	4,064
Mid	1,266	3,322	966	5,128	4,098
Mature	2,626	7,933	1,838	2,349	2,574
Old growth	4,438	8,689	5,365	16,070	18,316

Seral Stage	*221B2*	*220B2*	*219B2*	*215B2*
Early	2,149	8,998	8,051	1,847
Early-mid	94	107	2,920	743
Mid	100	818	575	429
Mature	291	4,589	1,167	36
Old growth	2,504	4,668	7,564	1,642

Seral Stage	*220C*	*214C*	*219C*	*218C*	*213C*
Early	568	2,836	2,283	2,030	2,923
Early-mid	1	1,048	1,284	84	685
Mid	1,097	3,885	4,482	2,709	2,536
Mature	1,422	2,194	3,016	725	1,579
Old growth	488	2,070	1,249	1,311	322

Seral Stage	*214D*	*216E*	*212E*	*246E*
Early	3,779	102	733	218
Early-mid	405	22	408	363
Mid	3,187	63	429	930
Mature	1,184	0	1,031	348
Old growth	6,189	420	1,172	395

Table H-2. Average Patch Size by LSR and Landscape Block

SERAL	Block	LSRUNIT	AVERAGE PATCH SIZE
Early	A	RO213	20.6056
		RO218	16.5945
		RO215	7.1004
	B1	RO220	43.1
		RO213	37.1598
		RO214	30.1228
		RO219	26.1406
		RO221	19.708
	B2	RO220	96.756
		RO219	49.0942
		RO221	34.1097
		RO213	29.8394
		RO215	28.4222
	C	RO213	42.9786
		RO218	39.8129
		RO214	29.5422
		RO219	27.1836
		RO220	17.2161
	D	RO214	38.9617
	E	RO212	19.8134
		RO216	10.1527
		RO246	7.7876
	F	RO215	12.5508
		RO217	8.3572
Early-mid	A	RO215	18.2508
		RO213	15.2742
		RO218	14.8438
	B1	RO219	38.3768
		RO213	22.7038
		RO214	14.9627
		RO220	13.2128
		RO221	11.2978
	B2	RO213	32.5396
		RO219	32.0882
		RO215	18.5807
		RO221	11.7509
		RO220	10.6969
	C	RO219	35.663
		RO214	18.0641
		RO213	12.4612
		RO218	5.6017
		RO220	0.334
	D	RO214	6.226
	E	RO212	22.6742
		RO246	21.332
		RO216	5.5785
	F	RO215	26.6944
	F	RO217	1.4436
Mid	A	RO213	20.7295
		RO218	16.8739
		RO215	3.7381

SERAL	Block	LSRUNIT	AVERAGE PATCH SIZE
	B1	RO219	40.0642
		RO213	23.963
		RO221	17.8316
		RO220	12.7281
		RO214	10.2737
	B2	RO215	13.8258
		RO213	11.2783
		RO219	7.9896
		RO220	7.8701
		RO221	2.773
	C	RO219	140.0521
		RO214	34.6855
		RO218	28.518
		RO213	27.274
		RO220	15.2418
	D	RO214	15.4711
	E	RO246	116.2636
		RO212	35.7136
		RO216	4.4952
	F	RO217	905.5991
		RO215	74.7628
Late-mature	A	RO213	7.5138
		RO218	6.903
		RO215	1.438
	B1	RO219	71.1967
		RO221	20.357
		RO220	20.34
		RO214	17.5003
		RO213	12.6155
	B2	RO220	30.5937
		RO219	17.4114
		RO213	7.4991
		RO221	5.2906
		RO215	1.4261
	C	RO219	111.7051
		RO220	16.3396
		RO214	13.0595
		RO213	9.3442
		RO218	4.0975
	D	RO214	4.484
	E	RO212	51.5433
		RO246	38.6854
		RO216	0.0895
	F	RO215	4.7456
		RO217	1.5314

Late old growth	A	RO213	363.8525
		RO218	338.1971
		RO215	299.3331
	B1	RO219	236.3276
		RO213	95.8936
		RO214	61.6613
		RO221	32.8744
		RO220	27.848
	B2	RO219	74.1606
		RO213	60.3644
		RO221	52.1626
		RO215	39.0853
		RO220	33.5813
	C	RO219	40.2786
		RO218	39.7374
		RO214	22.9953
		RO220	9.3876
		RO213	4.125
	D	RO214	44.5245
	E	RO216	210.2135
		RO212	61.6877
		RO246	49.3121
	F	RO215	31.5632
		RO217	29.56

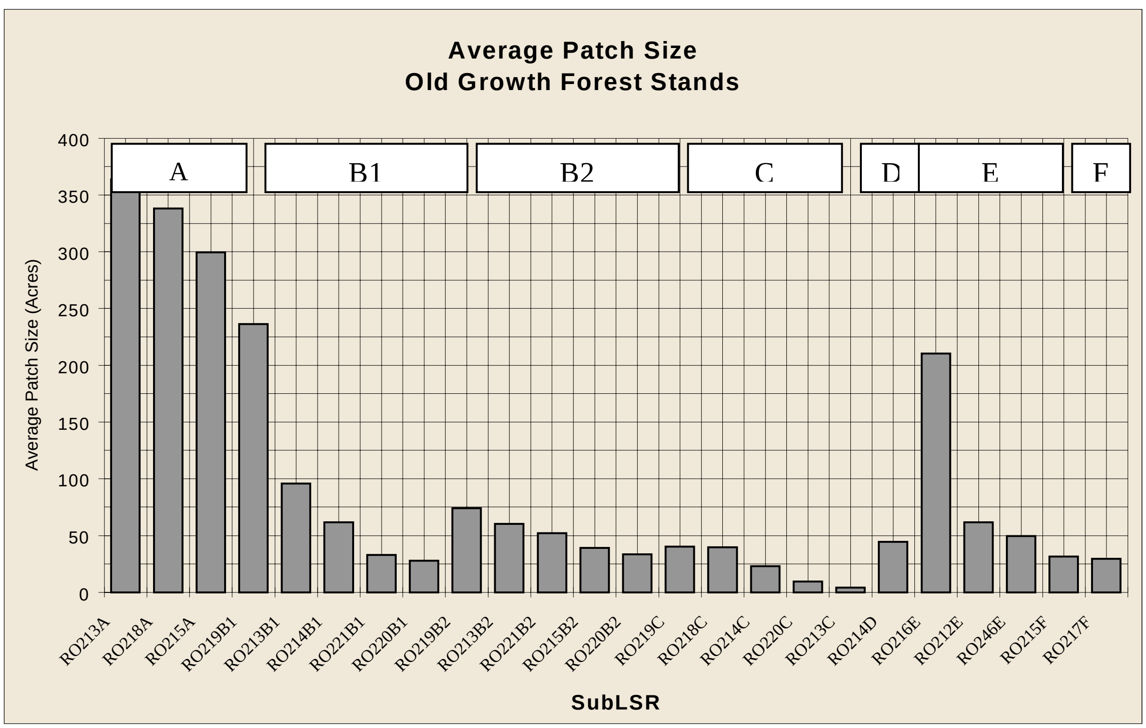


Figure H-3. Average Patch Size old growth stands by landscape block within the LSRs.

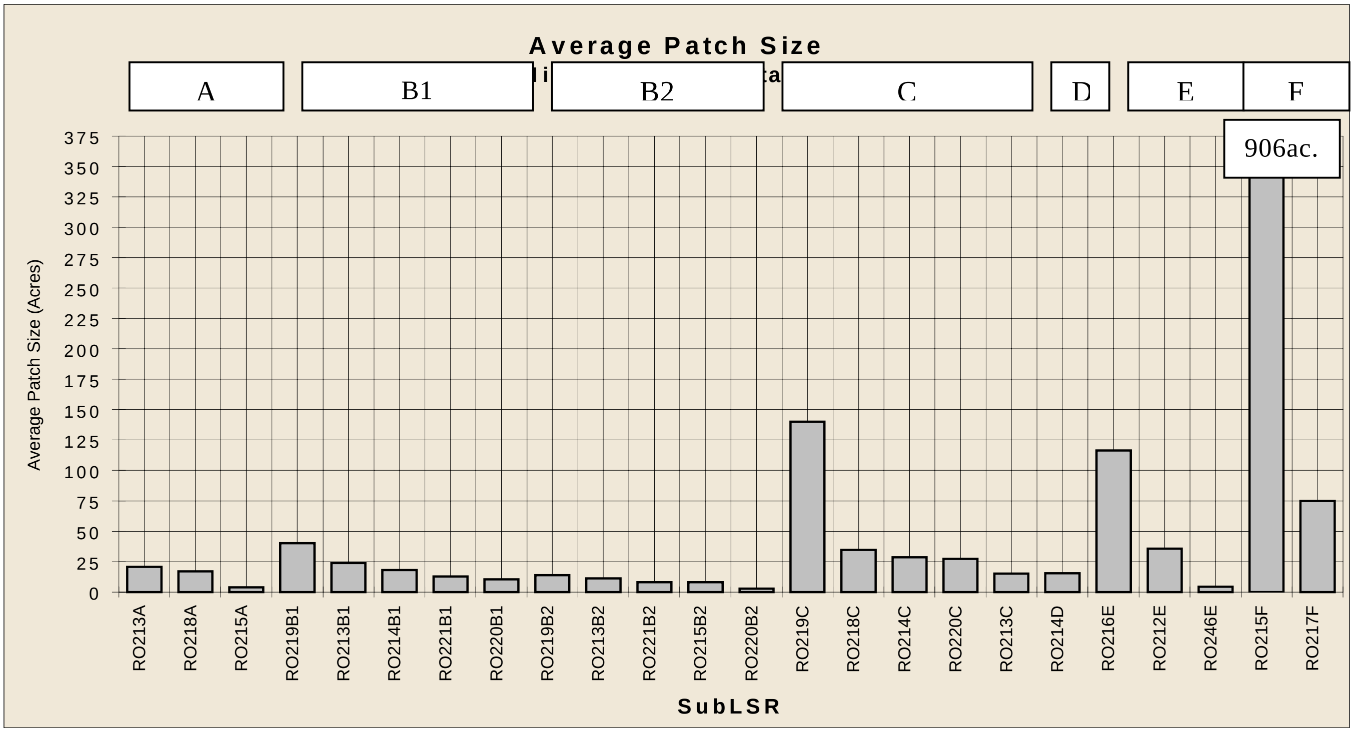


Figure H-4. Average Patch Size mid seral stands by landscape block within LSRs.

APPENDIX I

LATE SUCCESSIONAL ASSOCIATED BOTANICAL SPECIES

Table I-1: Plant species associated with old growth on the Willamette NF but not considered at risk.

Species Name	Common Name
Achlys triphylla	Vanillaleaf
Adiantum pedatum	Maidenhair fern
Allotropa virgata	Candystick
Anemone deltoidea	Threeleaf windflower
Aralia california	Elk clover, False ginseng
Asarum caudatum	Wild ginger
Calypso bulbosa	Ladyslipper or calaypso orchid
Chimaphila menziesii *Chimaphila umbellata*	Little Prince's-pine or pipsissewa Prince's-pine
Clintonia uniflora	Queen cup beadlily
Coptis laciniata	Goldthread
Corallorhiza maculata *Corallorhiza mertensiana* *Corallorhiza striata*	Spotted coralroot Western coralroot Striped coralroot
Cyprepedium montanum	Mountain ladyslipper
Disporum hookeri *Disporum smithii*	Hooker fairy-bell Smith fairybell
Dryopteris austriaca	Wood fern
Eburophyton austiniae	Phantom orchid
Goodyeara oblongifolia	Rattlesnake plantain
Gymnocarpium dryopteris	Oak fern
Hemitomes congestum	Gnome plant
Hypopitys monotropa	Pinesap
Listera caurina *Listera cordata*	Western twayblade Heart-leaf twayblade
Mitella breweri *Mitella caulescens* *Mitella ovalis* *Mitella pentandra*	Brewer's mitrewort Leafy mitrewort Oval-leaved mitrewort Alpine mitrewort
Monotropa uniflora	Indian pipe
Oxalis oregana *Oxalis trillifolia*	Oregon oxalis or wood sorrel Great oxalis
Pityopus californica	Pine-foot
Pleuricospora fimbriolata	Fringed pinesap
Polystichum californicum	California swordfern

Table I-1: Plant species associated with old growth on the Willamette NF but not considered at risk, con't.

Species Name	Common Name
Pyrola asarifolia *Pyrola dentata* *Pyrola picta* *Pyrola secunda* *Pyrola uniflora*	Alpine wintergreen Toothleaf pyrola White-vein pyrola Sidebells pyrola Woodnymph
Rubus lasiococcus *Rubus nivalis*	Dwarf bramble Snow dewberry
Sciliopus hallii	Fetid adder's tongue
Smilacina racemosa *Smilacina stellata*	False solomon's seal Starry solomon's seal
Streptopus amplexifolius *Streptopus roseus*	Twistedstalk Rosy twistedstalk
Tiarella trifoliata	Coolwort or Foamflower
Trillium ovatum	Wake robin
Vaccinium ovalifolium *Vaccinium parvifolium*	Oval-leaf huckleberry Red huckleberry
Vancouveria hexandra	Insideout Flower
Viola glabella *Viola orbiculata*	Common wood violet Round-leaved violet

Table I-2 Survey and managed species with potential to occur on the Willamette NF in Late Successional Reserves.

Group	Species	Presence[1]
Bryophytes		
Liverwort	*Douinia ovata*	Y
	Herbertus aduncus	U
	Kurzia makinoana	U
	Marsupella emarginata var. aquatica	Y
	Plagiochila satol	U
	Plagiochila semidecurrens	U
	Ptilidium californicum	Y
	Radula brunnea	U
	Tritomaria exsectiformis	U
	Tritomaria quinquedentata	U
Moss	*Antitrichia curtipendula*	Y
	Bartramiopsis lescurii	U
	Brotherella roelli	U
	Encalypta brevicolla var. crumiana	U
	Iwatsuklella leucotricha	U
	Pleuroziopsis ruthenica	U
	Racomitrium aquaticum	U
	Scouleria marginata	U
	Tetraphis geniculata	U
	Thamnobryum neckeroides	U

[1] Y = Documented U = Unknown, Suspected

Table I-2 Survey and managed species with potential to occur on the Willamette NF in Late Successional Reserves, con't.

Group	Species	Presence[1]
Fungi		
Boletes	*Gastroboletus subalpinus*	U
	Gastroboletus turbinatus	U
Boletes, low elevation	*Boletus piperatus*	U
	Tylopilus pseudoscaber	U
Bondarzewia Polypore	*Bondarzewia montana*	U
Branched Coral Fungi	*Clavulina cinerea*	U
	Clavulina cristata	U
	Clavulina ornatipes	U
Cauliflower Mushroom	*Sparassis crispa*	Y
Chanterelles	*Cantharellus cibarius*	Y
	Cantharellus subalbidus	Y
	Cantharellus tubaeformis	U
Chanterelles - Gomphus	*Gomphus bonarii*	U
	Gomphus clavatus	U
	Gomphus floccosus	U
	Gomphus kauffmanii	U
Club Coral Fungi	*Clavariadelphus borealis*	U
	Clavariadelphus ligula	U
	Clavariadelphus lovejoyae	U
	Clavariadelphus pistilaris	U
	Clavariadelphus sachalinensis	U
	Clavariadelphus subfastigiatus	U
	Clavariadelphus truncatus	U
Coral Fungi	*Clavicorona avellanea*	U
False Truffles	*Nivatogastrium nubigenum*	U
	Rhizopogon abietis	Y
	Rhizopogon atroviolaceus	Y
	Rhizopogon truncatus	Y
	Thaxterogaster pingue	Y
Jelly Mushroom	*Phlogoitis helevlloides*	U
Moss Dwelling Mushrooms	*Cyphellostereum laeve*	U
	Gallerina atkinsoniana	U
	Gallerina cerina	U
	Gallerina heterocystis	U
	Gallerina sphagnicola	U
	Gallerina vaittaeformis	U
	Rickenella setipes	U
Mushroom Lichen	*Phytoconis ericetorum*	U
Noble Polypore (rare and endangered)	*Oxyporus nobilissimus*	U

[1] Y = Documented U = Unknown, Suspected

Table I-2 Survey and managed species with potential to occur on the Willamette NF in Late Successional Reserves, con't.

Group	Species	Presence[1]
Fungi, con't		
Parasitic Fungi	*Asterophora lycoperdoides*	U
	Asterophora parasitica	U
	Cordycepys capitata	U
	Cordycepys ophioglossoides	U
	Hypomyces luteovirens	U
Phaeocollybia	*Phaeocollybia attenuata*	U
	Phaeocollybia californica	U
	Phaeocollybia carmanahensis	U
	Phaeocollybia dissiliens	U
	Phaeocollybia fallax	U
	Phaeocollybia gregaria	U
	Phaeocollybia kauffmanii	U
	Phaeocollybia olivacea	U
	Phaeocollybia oregonenis	U
	Phaeocollybia piceae	U
	Phaeocollybia pseudofestiva	U
	Phaeocollybia scatesiae	U
	Phaeocollybia sipei	U
	Phaeocollybia spadicea	U
Rare Boletes	*Boletus haematinus*	U
	Boletus pulcherrimus	U
	Gastroboletus imbelellus	Y
	Gastroboletus ruber	Y
Rare Chanterelles	*Cantharellus formosus*	U
	Polyozellus multiplex	U
Rare Coral Fungi	*Ramaria amyloidea*	U
	Ramaria aurantiisiccescens	U
	Ramaria celerivirescens	U
	Ramaria claviramulata	U
	Ramaria concolor f. marri	U
	Ramaria cyaneigranosa	U
	Ramaria gracilis	U
	Ramaria hilaris var. olympiana	U
	Ramaria lorithamnus	U
	Ramaria maculatipes	U
	Ramaria rainierensis	U
	Ramaria rubribrunnescens	U
	Ramaria spinulosa	U
	Ramaria stuntzii	U
	Ramaria verlotensis	U

[1] Y = Documented U = Unknown, Suspected

Table I-2 Survey and managed species with potential to occur on the Willamette NF in Late Successional Reserves, con't.

Group	Species	Presence[1]
Fungi, con't		
Rare Cup Fungi	*Aleuria rhenana*	U
	Bryoglossum gracile	U
	Gelatindoiscus flavidus	U
	Helvella compressa	U
	Helvella crassitunicata	U
	Helvella elastica	U
	Helvella maculata	U
	Neournula pouchetii	U
	Pithya vulgaris	U
	Plectania latahensis	U
	Plectania milleri	U
Rare Ecto-Polypores	*Albatrellus avellaneus*	U
	Albatrellus caeruleoporus	U
Rare False Truffles	*Alpova alexsmithii*	Y
	Alpova olivaceotinctus	U
	Destuntzia fusca	Y
	Destuntzia rubra	U
	Gautieria magnicellaris	Y
	Gautieria otthii	U
	Leucogaster citrinus	U
	Leucogaster microsporus	Y
	Macowanites lymanensis	U
	Macowanites mollis	U
	Martellia fragrans	U
	Martellia idahoensis	Y
	Martellia monticola	Y
	Octavianina macrospora	U
	Rhizopogon brunneiniger	U
	Rhizopogon evadens var. subalpinus	Y
	Rhizopogon exiguus	U
	Rhizopogon flavofibrillosus	U
	Rhizopogon inquinatus	Y
	Sedecula pulvinata	U
Rare Gilled Mushrooms	*Chroogomphus loculatus*	Y
	Clitocybe senilis	U
	Clitocybe subditopoda	U
	Cortinarius canabarba	U
	Cortinarius rainierensis	U
	Cortinarius variipes	U

[1] Y = Documented U = Unknown, Suspected

Table I-2 Survey and managed species with potential to occur on the Willamette NF in Late Successional Reserves, con't.

Group	Species	Presence[1]
Fungi, con't		
Rare Gilled Mushrooms, con't	*Cortinarius verrucisporus*	U
	Cortinarius wiebeae	U
	Neolentinus adherens	U
	Rhodocybe nitida	U
	Rhodocybe speciosa	U
	Tricholoma venenatum	U
	Tricholomopsis fulvescens	U
Rare Resupinates and Polypores	*Aleurodiscus farlowii*	U
	Dichostereum granulosum	U
	Grandinia microsporella	U
	Phlebia diffusa	U
	Polyporoletus sublividus	U
	Postia rennyii	U
	Scytinostroma cf. galatinum	U
Rare Truffles	*Choiromyces alveolatus*	U
	Choiromyces venosus	U
	Elaphomyces anthracinus	U
	Elaphomyces subviscidus	U
Rare Zygomycetes	*Endogone acrogena*	U
	Glomus radiatum	Y
Tooth Fungi	*Hydnum repandum*	Y
	Hydnum umbilicatum	U
	Phellodon atratum	U
	Sarcodon fuscoindicum	U
	Sarcodon imbricatus	U
Uncommon Coral Fungi	*Ramaria abietina*	U
	Ramaria araiospora	U
	Ramaria botryis var. aurantiiramosa	U
	Ramaria concolor f. tsugina	U
	Ramaria coulterae	U
	Ramaria fasciculata var. sparsiramosa	U
	Ramaria gelatiniaurantia	U
	Ramaria largentii	U
	Ramaria rubella var. blanda	U
	Ramaria rubrievanescens	U
	Ramaria rubripermanens	U
	Ramaria suecica	U
	Ramaria thiersii	U

[1] Y = Documented U = Unknown, Suspected

Table I-2 Survey and managed species with potential to occur on the Willamette NF in Late Successional Reserves, con't.

Group	Species	Presence[1]
Fungi, con't		
Uncommon Cup Fungi	*Cudonia circinans*	U
	Cudonia monticola	U
	Gyromitra californica	U
	Gyromitra esculenta	U
	Gyromitra infula	U
	Gyromitra melaleucoides	U
	Gyromitra montana (syn. G. gigas)	U
	Otidea leporina	U
	Otidea onotica	U
	Otidea smithii	U
	Plectania melastoma	Y
	Podostroma alutaceum	U
	Sarcosphaera eximia	U
	Spathularia flavida	U
Uncommon Ecto-Polypores	*Albatrellus ellisii*	U
	Albatrellus flettii	U
Uncommon False Truffle	*Macowanites chlorinosmus*	U
Uncommon Gilled Mushrooms	*Baeospora myriadophylla*	U
	Catathelasma ventricosa	Y
	Chrysomphalina grossula	U
	Collybia bakerensis	U
	Cortinarius azureus	U
	Cortinarius boulderensis	U
	Cortinarius cyanites	U
	Cortinarius magnivelatus	U
	Cortinarius olympianus	U
	Cortinarius spilomius	U
	Cortinarius tabularis	U
	Cortinarius valgus	U
	Dermocybe humboldtensis	U
	Fayodia gracilipes (rainierensis)	U
	Gymnopilus puntifolius	U
	Hebeloma olympiana	U
	Hygrophorus caeruleus	U
	Hygrophorus karstenii	U
	Hygrophorus vernalis	U
	Marasmius applanatipes	U
	Mycena hudsoniana	U
	Mycena lilacifolia	U
	Mycena marginella	U

[1] Y = Documented U = Unknown, Suspected

Table I-2 Survey and managed species with potential to occur on the Willamette NF in Late Successional Reserves, con't.

Group	Species	Presence[1]
Fungi, con't		
Uncommon Gilled Mushrooms, con't	*Mycena monticola*	U
	Mycena overholtsii	U
	Mycena quinaultensis	U
	Mycena tenax	U
	Mythicomyces corneipes	U
	Pholiota albivelata	U
	Russula mustelina	U
	Stagnicola perplexa	U
Undescribed Taxa, Rare Truffles & False Truffles	*Alpova sp. nov. # Trappe 1966*	Y
	Alpova sp. nov. # Trappe 9730	U
	Arcangeliella sp. nov. # Trappe 12382	U
	Gastroboletus sp. nov. # Trappe 2897	U
	Gastroboletus sp. nov. # Trappe 7515	U
	Gastrosuillus sp. nov. # Trappe 7516	U
	Gastrosuillus sp. nov. # Trappe 9608	U
	Gymnomyces sp. nov. # Trappe 1690, 1706, 1710	Y
	Gymnomyces sp. nov. # Trappe 4703, 5576	U
	Gymnomyces sp. nov. # Trappe 5052	U
	Gymnomyces sp. nov. # Trappe 7545	U
	Hydnotrya sp. nov. # Trappe 787, 792	Y
	Hydnotrya subnix sp. nov. # Trappe 1861	U
	Martellia sp. nov. # Trappe 1700	Y
	Martellia sp. nov. # Trappe 311	U
	Martellia sp. nov. # Trappe 5903	Y
	Martellia sp. nov. # Trappe 649	U
	Octavianina sp. nov. # Trappe 7502	Y
	Rhizopogon sp. nov. # Trappe 1692	Y
	Rhizopogon sp. nov. # Trappe 1698	Y
	Rhizopogon sp. nov. # Trappe 9432	U
Lichen		
Additional Lichen Species	*Cladonia norvegica*	U
	Heterodermia sitchensis	U
	Hygomnia vittata	U
	Hypotrachyna revoluta	U
	Nephroma isidiosum	U
	Ramalina pollinaria	U
Aquatic Lichens	*Dermatocarpon luridum*	U
	Hydrothyria venosa	Y
	Leptogium rivale	Y

[1] Y = Documented U = Unknown, Suspected

Table I-2 Survey and managed species with potential to occur on the Willamette NF in Late Successional Reserves, con't.

Group	Species	Presence[1]
Lichen, con't		
Nitrogen-fixing Lichens	*Lobaria oregana*	U
	Lobaria pulmonaria	U
	Lobaria scrobiculata	Y
	Nephroma bellum	U
	Nephroma helveticum	U
	Nephroma laevigatum	U
	Nephroma parile	U
	Nephroma resupinatum	Y
	Pannaria leucostictoides	U
	Pannaria mediterranea	U
	Pannaria saubinetii	U
	Peltigera collina	U
	Peltigera neckeri	U
	Peltigera pacifica	U
	Pseudocyphellaria anomala	U
	Pseudocyphellaria anthraspis	U
	Pseudocyphellaria crocata	U
	Sticta beauvoisii	U
	Sticta fuliginosa	U
	Sticta limbata	U
Pin Lichens	*Calicium abietinum*	U
	Calicium adaequatum	U
	Calicium adspersum	U
	Calicium glaucellum	U
	Calicium viride	U
	Chaenotheca brunneola	U
	Chaenotheca chrysocephala	U
	Chaenotheca ferruginea	U
	Chaenotheca furfuracea	U
	Chaenotheca subroscida	U
	Chaenothecopis pusilla	U
	Cyphelium inquinans	U
	Microcalicium arenarium	U
	Mycocalicium subtile	U
	Stenocybe clavata	U
	Stenocybe major	U
Rare Forage Lichen	*Bryoria tortuosa*	U
Rare Leafy (arboreal) Lichens	*Tholurna dissimilis*	Y

[1] Y = Documented U = Unknown, Suspected

Table I-2 Survey and managed species with potential to occur on the Willamette NF in Late Successional Reserves, con't.

Group	Species	Presence[1]
Lichen, con't		
Rare Nitrogen-fixing Lichens	*Dendriscocaulon intricatulum*	U
	Lobaria hallii	U
	Lobaria linita	U
	Nephroma occultum	Y
	Pannaria rubiginosa	U
	Pseudocyphellaria rainierensis	Y
Rare Oceanic Influenced Lichens	*Hypogymnia oceanica*	Y
Rare Rock Lichens	*Pilophorus nigricaulis*	U
Riparian Lichens	*Cetrelia cetrarioides*	U
	Collema nigrescens	U
	Leptogium burnetiae var. hirsutum	U
	Leptogium cyanescens	U
	Leptogium saturninum	U
	Leptogium teretiusculum	U
	Platismatia lacunosa	U
	Ramalina thrausta	U
	Usnea longissima	Y
Vascular Plants		
	Allotropa virgata	Y
	Arceuthobium tsugense	Y
	Botrychium minganense	Y
	Botrychium montanum	Y
	Clintonia andrewsiana	U
	Coptis asplenifolia	U
	Coptis trifolia	U
	Corydalis aquae-gelidae	U
	Cypripedium montanum (west Cascades)	Y
	Galium kamtschaticum	U
	Habenaria orbiculata	U

[1] Y = Documented U = Unknown, Suspected

APPENDIX J

SPECIAL HABITATS COMBINED BY AGENCY

APPENDIX KEY

Special Habitat	Habitat Components
Meadow Dry-	
BLM	DS-Dry Shallow Soils DM- Dry Meadows
FS	MD- Meadow Dry
Rock	
BLM	CL-Cliff/Rock Outcrop RO-Rock outcrop/Dry Meadow
FS	RO-Rock Outcrop RC-Rock Cliff
Shrub	
FS	SX-Shrubland MS-Meadow shrub SA-Shrub alder
Talus	
BLM	T-Talus
FS	NX-Barrenland ST- Shrub talus RT-Rock talus
Wet Meadow	
BLM	WP-Permanent wetland
FS	QX-Aquatic MW-Meadow wet
Mesic Meadow	
BLM	WS-Seasonal Wetland
FS	YX-Herbland MM-Mesic meadow
Pond	
BLM	WW-Surface water
FS	WX-Open Water WP-Water Pond

United States Department of Agriculture   Forest Service   R-6/R-5

Reply to: 2470/1920   **Date:** May 9, 1995

Subject: Criteria to Exempt Specific Silvicultural Activities in LSRs and MLSAs from REO Review

To: Forest Supervisors, Owl Forests

Enclosed is a memorandum from the Regional Ecosystem Office (REO) exempting certain precommercial thinning, release, and reforestation activities within LSRs from REO review. I am pleased about this exemption and consider it a key step toward accomplishing ecosystem management objectives in a timely manner. However, since some readers will view the criteria as unnecessarily restrictive, I ask you to keep the following points in mind.

This is the first REO review exemption. It is based on proposals submitted to REO for review or upon proposals REO has discussed in the field. It is, of necessity, conservative. REO continues to express a desire to expand this exemption to other types of activities at the earliest possible time.

Before this memorandum was signed, all silvicultural activities were subject to REO review. Now most young stand thinning (including related sale), release, and reforestation proposals are not subject to review. This is a positive step, and there is little to be gained by discussing whether the criteria should have gone farther at this time. Since no commercial thinning proposals have ever been submitted to REO for review, for example, REO had little basis to expand these criteria at this time.

The criteria do not infer a right or wrong, or consistency or non-consistency with standards and guidelines. The criteria simply draws the line between those proposals no longer subject to REO review, and those that remain subject to review. Proposals not meeting the criteria should be submitted for review as in the past, and REO expects to continue to meet its committment to complete such reviews within 3 weeks, or less, of date received.

Note that the exemption for reforestation is in addition to the somewhat broader exemption already included in the standards and guidelines for reforestation activities required because of existing timber sales.

This exemption also applies to the Issue Resolution Team (IRT) since IRT review was only required in preparation for sending to REO. Specific questions about this exemption should be adressed to the President's Forest Plan coordinator on your unit.

/s/ John E. Lowe	/s/Steve Clauson (for)
JOHN LOWE Regional Forester, R-6	LYNN SPRAGUE Regional Forester, R-5

Enclosure

Regional Ecosystem Office
P.O. Box 3623
Portland, Oregon 97208
(503) 326-6265
FAX: (503) 326-6282

Memorandum

Date: April 20, 1995

To: Regional Interagency Executive Committee (See Distribution List)

From: Donald R. Knowles, Executive Director /s/ Don Knowles

Subject: Criteria to Exempt Specific Silvicultural Activities in LSRs and MLSAs from REO Review

Pages C-12 and C-26 of the Record of Decision (ROD) for the Northwest Forest Plan state that "[t]he Regional Ecosystem Office may develop criteria that would exempt some activities from review." Enclosed are criteria that exempt certain young-stand thinning, release, and reforestation projects that are proposed in Late-Successional Reserves (LSRs) and Managed Late-Successional Areas (MLSAs) from review by the Regional Ecosystem Office (REO). These criteria were developed by an interagency work group and the REO based on the review of silvicultural projects, field visits, and discussions with agencies and technical specialists. The REO may expand the review exemption criteria as experience with additional forest management activities is gained. Please distribute the attached REO review exemption criteria to the field.

It is important to note that these criteria do not affect the kind of activities the ROD permits within LSRs and MLSAs. The criteria apply only to the requirement for REO review of silvicultural activities in LSRs and MLSAs and only to a specific subset of silvicultural treatments. It should also be noted that compliance with the ROD's standards and guidelines and other statutory and regulatory requirements is not affected by these exemption criteria. For example, requirements to do watershed analyses and Endangered Species Act consultation are not affected by the REO review exemption criteria.

Enclosure

cc:
IAC Members (See Distribution List)
362/ly

Distribution List Date: April 20, 1995

Subject Criteria to Exempt Specific Silvicultural Activities in LSRs and MLSAs from REO Review

TO: Regional Interagency Executive Committee

Anita Frankel, Director, Forest and Salmon Group, Environmental Protection Agency
John Lowe, Regional Forester, USDA Forest Service, R-6
Stan Speaks, Area Director, Bureau of Indian Affairs
Michael Spear, Regional Director, U.S. Fish & Wildlife Service
William Stelle, Jr., Regional Director, National Marine Fisheries Service
William Walters, Acting Regional Director, National Park Service
Elaine Zielinski, State Director, Bureau of Land Management, OR/WA

cc: Other Members of Intergovernmental Advisory Committee

California
Francie Sullivan, Shasta County Supervisor
Terry Gorton, Assistant Secretary, Forestry and Rural Economic Dev., California Resource Agency

Oregon
Rocky McVay, Curry County Commissioner
Paula Burgess, Federal Forest and Resource Policy Advisor, Office of the Governor

Washington
Harvey Wolden, Skagit County Commissioner
Amy F. Bell, Deputy Supervisor for Community Relations, WA Dept. of Natural Resources
Bob Nichols, Senior Executive Policy Assistant, Governor's Office (Alternate)

Tribes
Greg Blomstrom, Planning Forester, CA Indian Forest & Fire Mgmt. Council
Mel Moon, Commissioner, NW Indian Fisheries Commission
Jim Anderson, Executive Director, NW Indian Fisheries Commission (Alternate)
Gary Morishima, Technical Advisor, Intertribal Timber Council
Guy McMinds, Executive Office Advisor, Quinault Indian Nation

Federal Agencies
Michael Collopy, Director, Forest and Rangeland Ecosystem Science Center,
National Biological Service
Eugene Andreuccetti, Regional Conservationist, Natural Resources Conservation Service
Bob Graham, State Conservationist, Natural Resources Conservation Service (Alternate)
G. Lynn Sprague, Regional Forester, USDA Forest Service, R-5 (Alternate)
Thomas Murphy, Director, Environmental Research Laboratory, Environmental Protection Agency
Charles Philpot, Station Director, Forest Service, PNW
Tom Tuchmann, Director, Office of Forestry and Economic Development (Ex
Officio)
Ed Hastey, State Director, Bureau of Land Management, CA (Alternate)

REO Review Exemption Criteria

Background

Standards and Guidelines (S&Gs) in the "Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl" (referred to as the ROD) provide that silvicultural activities within Late-Successional Reserves (LSRs) and Managed Late-Successional Areas (MLSAs) are subject to review by the Regional Ecosystem Office (REO). The S&Gs also state that "REO may develop criteria that would exempt some activities [within LSRs and MLSAs] from review."

Based upon proposals submitted to REO for review, field visits, discussions with the agencies and technical specialists, and our understanding of LSR objectives, REO is hereby exempting the following types of activities from the REO review requirement stated on pages C-12 and C-26 of the ROD. Silvicultural projects meeting the following criteria are exempted from REO review because such projects have a high likelihood of benefitting late-successional forest characteristics.

Activities must still comply with all S&Gs in the ROD (e.g., initial LSR assessments, watershed analysis, riparian reserves) and with other statutory and regulatory requirements (e.g., National Forest Management Act, Federal Land Management Policy Act, National Environmental Policy Act, Endangered Species Act, Clean Water Act). This exemption applies only to the REO review requirement found on pages C-12 and C-26 in the ROD. Silvicultural activities described in the S&Gs that do not meet the criteria listed below continue to be subject to REO review at this time.

Silvicultural treatments in LSRs and MLSAs are exempted from REO review (ROD, pages C-12 and C-26), where the agency proposing the treatments finds that the following criteria are met:

1. <u>Young-Stand Thinning,</u> commonly referred to as TSI or precommercial thinning, where:

a. Young stands, or the young-stand component (understory) of two-storied stands, is overstocked. Overstocked means that reaching the management objective of late-successional conditions will be significantly delayed, or desirable components of the stand may be eliminated, because of stocking levels. The prescription should be supported by empirical information or modeling (for similar, but not necessarily these specific, sites) indicating the development of late-successional conditions will be accelerated or enhanced.

b. Cut trees are less than 8" dbh, and any sale is incidental to the primary objective.

c. Tracked, tired, or similar ground-based skidders or harvesters are not used.

d. Treatments promote a natural species diversity appropriate to meet late-successional objectives; including hardwoods, shrubs, forbs, etc..

e. Treatments include substantially varied spacing in order to provide for some very large trees as quickly as possible, maintain areas of heavy canopy closure and decadence, and encourage the growth of a variety of species appropriate to the site and the late-successional objective.

f. Treatments minimize, to the extent practicable, the need for future entries.

g. Cutting is by hand tools, including chain saws.

2. Release, also commonly referred to as TSI, where:

a. There is undesirable vegetation (competition) which delays attainment of the management objective of late-successional conditions, or desirable components of the stand may be eliminated, because of such competition. The prescription should be supported by empirical information or modeling (for similar, but not necessarily these specific, sites) indicating the development of late-successional conditions will be accelerated or enhanced.

b. Cut material is less than 8" dbh, and any sale is incidental to the primary objective.

c. Tracked, tired, or similar ground-based skidders or harvesters are not used.

d. Treatments promote a natural species diversity appropriate to meet late-successional objectives, including hardwoods, shrubs, forbs, etc.

e. Cutting is by hand tools, including chain saws.

3. Reforestation and Revegetation, including incidental site preparation, release for survival, and animal damage control, where:

a. No site preparation is required other than hand scalping.

b. Reforestation is necessary to quickly reach late-successional conditions, protect site quality, or achieve other ROD objectives.

c. Treatments promote a natural species diversity appropriate to meet late-successional objectives, including hardwoods, shrubs, forbs, etc.

d. Treatments, either through spacing, planting area designation, or expected survival or growth patterns, result in substantially varied spacing in order to provide for some very large trees as quickly as possible, create areas of heavy canopy closure and decadence, and encourage the growth of a variety of species appropriate to the site and the late-successional objective.

e. Treatments minimize, to the extent practicable, the need for future entries.

Regional Ecosystem Office
333 SW 1st
P.O. Box 3623
Portland, Oregon 97208-3623
Phone: 503-326-6265 FAX: 503-326-6282

Memorandum

Date: July 9, 1996

To: Regional Interagency Executive Committee (RIEC)

Ken Feigner, Director, Forest & Salmon Group, Environmental Protection Agency
Robert W. Williams, Regional Forester, R-6, Forest Service
Stan M. Speaks, Area Director, Bureau of Indian Affairs
Michael J. Spear, Regional Director, U.S. Fish & Wildlife Service
William Stelle, Jr., Regional Director, National Marine Fisheries Service
William C. Walters, Deputy Field Director, National Park Service
Elaine Y. Zielinski, State Director, Oregon/Washington, Bureau of Land Management

From: Donald R. Knowles, Executive Director

Subject: Criteria to Exempt Specific Silvicultural Activities in Late-Successional Reserves and Managed Late-Successional Areas from Regional Ecosystem Office Review

Enclosed are criteria that exempt certain commercial thinning projects in Late-Successional Reserves (LSRs) and Managed Late-Successional Areas (MLSAs) from review by the Regional Ecosystem Office (REO), pursuant to pages C-12 and C-26 of the Northwest Forest Plan (NFP) Record of Decision (ROD). These criteria were developed by an interagency work group and the REO based on review of silvicultural projects, field visits, and comments from agencies, researchers, and technical specialists.

We believe we are ready for these exemptions. Several versions of these criteria have been distributed to your agencies and others for review over the last several months. The comments received have been used to help clarify and focus the criteria. Use of the criteria will expedite implementation of beneficial silvicultural treatments in LSRs and MLSAs. We suggest that you transmit them to your field units at your earliest convenience.

It is important to note that these criteria do not affect the kind of activities the ROD permits within LSRs and MLSAs. The criteria simply exempt a specific subset of silvicultural treatments from the requirement for project level REO review of silvicultural activities within LSRs and MLSAs. Please also note that compliance with the ROD's standards and guidelines and other statutory and regulatory requirements is not affected by these exemption criteria. For example, requirements to do watershed analyses and Endangered Species Act consultation are not affected by the

We expect implementation monitoring procedures of the Northwest Forest Plan to select enough silvicultural projects within LSRs and MLSAs, both exempted and reviewed, to determine if actual projects meet standards and appropriate criteria. Obviously, if any of you have questions or comments about the attached, please call me directly at 503-326-6266, Dave Powers at 503-326-6271, or Gary S. Sims at 503-326-6274.

cc: IAC, RMC, LSR Workgroup

Enclosure

694/ly

Criteria Exempting Certain Commercial Thinning Activities From REO Review

Background

Standards and Guidelines (S&Gs) in the Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl (ROD) provide that silvicultural activities within Late-Successional Reserves (LSRs) and Managed Late-Successional Areas (MLSAs) are subject to review by the Regional Ecosystem Office (REO). The S&Gs also state that the REO may develop criteria that would exempt some activities (within LSRs and MLSAs) from review.

Based upon project proposals submitted to the REO for review, field visits, discussions with the agencies, researchers, and technical specialists, and our understanding of LSR objectives, the REO is hereby exempting certain commercial thinning activities (sometimes referred to as density management activities) from the REO review requirement (ROD, pages C-12 and C-26). Silvicultural projects meeting the criteria below are exempted from REO review because such projects have a high likelihood of benefiting late-successional forest conditions. Many of the commercial thinning proposals reviewed thus far by the REO have met these criteria.

In some cases the criteria refer to the prescription. All silvicultural treatments within LSRs will be conducted according to a silvicultural prescription fully meeting agency standards for such documents. A description of the desired future condition (DFC), and how the proposed treatment is needed to achieve the DFC, are key elements in this prescription. The description of desired future condition should typically include desired tree species, canopy layers, overstory tree size (e.g., diameter breast height), and structural components such as the range of coarse woody debris (CWD) and snags.

Some elements of these exemption criteria may seem prescriptive, and reviewers suggested several changes to accommodate specific forest priorities. While such suggestions may have been within the scope of the S&Gs, there are several reasons they are not included here:

These criteria are based on numerous submittals already reviewed by the REO and found to be consistent with the S&Gs. Other treatments, such as thinning with fire, may be equally appropriate. The REO simply has not had sufficient experience with such prescriptions within LSRs to write appropriate exemption criteria at this time. Agencies are encouraged to develop and submit such prescriptions for review. The REO will consider supplementing or modifying these criteria over time.

These criteria apply range wide. It may be more appropriate to seek exemption at the time of LSR assessment review where specific vegetation types, provincial issues, or objectives do not fit within these criteria or where silvicultural prescriptions are needed other than as described below.

These exemption criteria are not standards and guidelines, and projects meeting LSR objectives but not fitting these criteria should continue to be forwarded to the REO for review.

Four other key points about thinning are important to consider when developing thinning prescriptions:

1. We urge caution in the use of silvicultural treatments within LSRs. Silvicultural treatments within old habitat conservation areas (HCAs) and designated conservation areas (DCAs) were extremely limited, and many of the participants in the Forest Ecosystem Management Assessment Team/Supplemental Environmental Impact Statement (FEMAT/SEIS) process advanced good reasons for continuing such restrictions. Only high eastside risks and a case made that late-successional conditions could clearly be advanced by treatments in certain stand conditions led decision makers toward the current S&Gs. Note that the examples for the westside (S&Gs, page C-12) are for even-age stands and young single-species stands. Agencies must recognize when younger stands are developing adequately and are beginning to become valuable to late-successional species. Such stands should be left untreated unless they are at substantial risk to large-scale disturbance.

2. Thinning can easily remove structural components or impede natural processes such as decay, disease, or windthrow, reducing the stand s value to late-successional forest-related species. Thinning prescriptions that say leave the best, healthiest trees could eliminate structural components important to LSR objectives.

3. While historic stand conditions may be an indicator of a sustainable forest, they are not the de facto objectives. The S&Gs require an emphasis toward late-successional conditions **to the extent sustainable.**

4. Treatments need to take advantage of opportunities to improve habitat conditions beyond natural conditions. For example, exceeding natural levels of CWD within a 35-year-old stand can substantially improve the utility of these stands for late-successional forest-related species. Treatments must take advantage of opportunities to optimize habitat for late-successional forest-related species in the short term.

Relation to S&Gs and Other Exemption Criteria

Exempted thinnings must still comply with all pertinent S&Gs in the ROD (e.g., initial LSR assessments, watershed analyses, riparian reserves) and with other statutory and regulatory requirements (e.g., National Forest Management Act, Federal Land Management Policy Act, National Environmental Policy Act, Endangered Species Act, Clean Water Act). Interagency cooperation, monitoring, and adaptive management are key components of the ROD and were key assumptions underlying the development of these criteria. Additionally, field units are strongly encouraged to engage in intergovernmental consultation when developing projects. This exemption applies only to the REO review requirement (ROD, pages C-12 and C-26). Many treatments not meeting these exemption criteria may be appropriate within LSRs and MLSAs, and these treatments remain subject to REO review. These exemption criteria are in addition to criteria issued April 20, 1995, for Young Stand Thinning, Release, and Reforestation and Revegetation, and are in addition to exemption criteria adopted through the LSR assessment review process.

EXEMPTION CRITERIA

Silvicultural treatments in LSRs and MLSAs are exempted from REO review (ROD, pages C-12 and C-26) **where the agency proposing the treatments finds that ALL of the following criteria are met:**

Objectives

1. The objective or purpose of the treatment is to develop late-successional conditions or to reduce the risk of large-scale disturbance that would result in the loss of key late-successional structure. Further, the specific treatment would result in the long-term development of vertical and horizontal diversity, snags, CWD (logs), and other stand components benefiting late-successional forest-related species. The treatment will also, to the extent practicable, create components that will benefit late-successional forest-related species in the short term.

   Timber volume production is only incidental to these objectives and is not, in itself, one of the objectives of the treatment. Creation or retention of habitat for early successional forest-related species is not a treatment objective.

2. Negative short-term effects to late-successional forest-related species are outweighed by the long-term benefits to such species and will not lessen short-term functionality of the LSR as a whole.

3. The leave-tree criteria provide for such things as culturing individual trees specifically for large crowns and limbs and for the retention of certain characteristics that induce disease, damage, and other mortality or habitat,

consistent with LSR objectives. Healthiest, best tree criteria typical of matrix prescriptions are modified to reflect LSR objectives.

4. Within the limits dictated by acceptable fire risk, CWD objectives should be based on research that shows optimum levels of habitat for late-successional forest-related species, and not be based simply on measurements within natural stands. For example, recent research by Carey and Johnson in young stands on the westside indicates owl prey base increases as CWD (over 4") within Douglas-fir forests increases, up to 8- to 10-percent groundcover south of the town of Drain, Oregon, and 15-percent groundcover north of Drain, increasing to 15 to 20 percent in the Olympic Peninsula and Western Washington Cascades. Other references that could help identify initial considerations involving natural ranges of variability in CWD include Spies and Franklin, for discussions on Washington Cascades, Oregon Cascades, and Coast Ranges; and Graham, et al., for east of the Cascades.

   If tree size, stocking, or other considerations preclude achievement of this objective at this time, the prescription includes a description of how and when it will be achieved in the future.

5. Agencies having an interest in LSR projects proposed under these criteria should continue to be given the opportunity to participate in project development.

Stand Attributes

1. The stand is currently **not** a complex, diverse stand that will soon meet and retain late-successional conditions without treatment.
2. West of the Cascades outside of the Oregon and California Klamath Provinces, the basal-area-weighted average age of the stand is less than 80 years. Individual trees exceeding 80 years in those provinces, or exceeding 20-inches dbh in **any** province, shall not be harvested except for the purpose of creating openings, providing other habitat structure such as downed logs, elimination of a hazard from a standing danger tree, or cutting minimal yarding corridors. Where older trees or trees larger than 20-inches dbh are cut, they will be left in place to contribute toward meeting the overall CWD objective. Thinning will be from below, except in individual circumstances where specific species retention objectives have a higher priority. Cutting older trees or trees exceeding

   20-inches dbh for **any** purpose will be the exception, not the rule.

3. The stand is overstocked. Overstocked means that reaching late-successional conditions will be substantially delayed, or desirable components of the stand will likely be eliminated, because of stocking levels.

Treatment Standards

1. The treatment is primarily an intermediate treatment designed to increase tree size, crown development, or other desirable characteristics (S&Gs, page B-5, third paragraph); to maintain vigor for optimum late-successional development; to reduce large-scale loss of key late-successional structure; to increase diversity of stocking levels and size classes within the stand or landscape; or to provide various stand components beneficial to late-successional forest-related species.

2. The prescription is supported by empirical information or modeling (for similar, but not necessarily these specific sites) indicating that achievement of late-successional conditions would be accelerated.

3. The treatment is primarily an intermediate thinning, and harvest for the purpose of regenerating a second canopy layer in existing stands is no more than an associated, limited objective as described below under openings and heavily thinned patches.

4. The treatment will increase diversity within relatively uniform stands by including areas of variable spacing as follows:

   Ten percent or more of the resultant stand would be in unthinned patches to retain processes and conditions such as thermal and visual cover, natural suppression and mortality, small trees, natural size differentiation, and undisturbed debris.

   Three to 10 percent of the resultant stand would be in openings, roughly 1/4 to 1/2 acre in size to encourage the initiation of structural diversity.

   Three to 10 percent of the resultant stand would be in heavily thinned patches (e.g., less than 50 trees per acre) to maximize individual tree development and encourage some understory vegetation development.

   The treatment does not inappropriately simplify stands by removing layers or structural components, creating uniform stocking levels, or removing broken and diseased trees important for snag recruitment, nesting habitat, and retention of insects and diseases important to late-successional development and processes.

5. To the extent practicable for the diameter and age of the stand being treated, the treatment includes falling green trees or leaving snags and existing debris to meet or make substantial progress toward meeting an overall CWD objective.

6. Snag objectives are to be identified as part of the DFC. Prescriptions must be designed to make substantial progress toward the overall snag objective, including developing large trees for future snag recruitment and retaining agents of mortality or damage. To the extent practicable for the diameter and age of the stand being treated, each treatment includes retention and creation of snags to meet the DFC. Publications useful in identifying snag-related DFCs include but are not limited to Spies, et al.

   To the extent snag requirements for late-successional species are known, one objective is to attain 100 percent of potential populations for all snag-dependent species.
7. The project-related habitat improvements outweigh habitat losses due to road construction.

Cited References:

Carey, A.B., and M.L. Johnson. 1995. Small mammals in managed, naturally young, and old-growth forests. Ecological Applications 5:336-352.

Graham, R.T., A.E. Harvey, M.F. Jurgensen, T.B. Jain, J.R. Tonn, and D.S. Page-Dumroese. 1994. Managing coarse woody debris in forests of the Rocky Mountains. Res. Paper INT-RP-477. USDA Forest Service, Intermountain Research Station, Ogden, UT. 12p.

Spies, T.S. and J.F. Franklin. 1991. The structure of natural young, mature, and old-growth Douglas-fir forests in Oregon and Washington. Pages 19-121 in: Ruggiero, L.F., K.B. Aubry, A.B. Carey, M.H. Huff (tech. coords). Wildlife and Vegetation on Unmanaged Douglas-fir Forests. Gen. Tech. Rep. GTR-PNW-285. USDA Forest Service, Pacific Northwest Research Station, Portland, OR.

APPENDIX L

POTENTIAL AND CURRENT CONNECTIVITY BETWEEN LSRS

The Late Successional Reserves (LSRs) in the assessment are not isolated but rather members of a larger reserve system. The reserve system was set up to provide connected habitat across the landscape for late successional species. In this analysis connectivity habitat between LSRs is defined by riparian reserves, special habitats, lakes and their protection buffers; silviculturally unsuitable areas; administratively withdrawn as defined in the resource management plans and the Northwest Forest Plan; and wilderness. Connectivity between LSRs is somewhat linear by design because it is largely dependent on riparian reserves. To assess how well the LSRs are connected as a network, we located the shortest distance between all LSRs through "connected" potential and connected current late successional habitat allocated as a reserve. Because it is not necessary for late successional habitat to be contiguous for late successional species to disperse, we assumed that low-mobility, small-bodied species can travel a maximum of 382 m through non-habitat. Therefore, connected habitat in this analysis is late successional habitat no more than 382 m apart.

Current and potential connectivity conditions were used to identify areas and watersheds where LSR connectivity warrants addressing and to help prioritize where it is most important to address. Potential conditions assume reserved areas will mature into late successional habitat (See Chapters III and IV).

APPENDIX M

FUEL MODEL LAYER

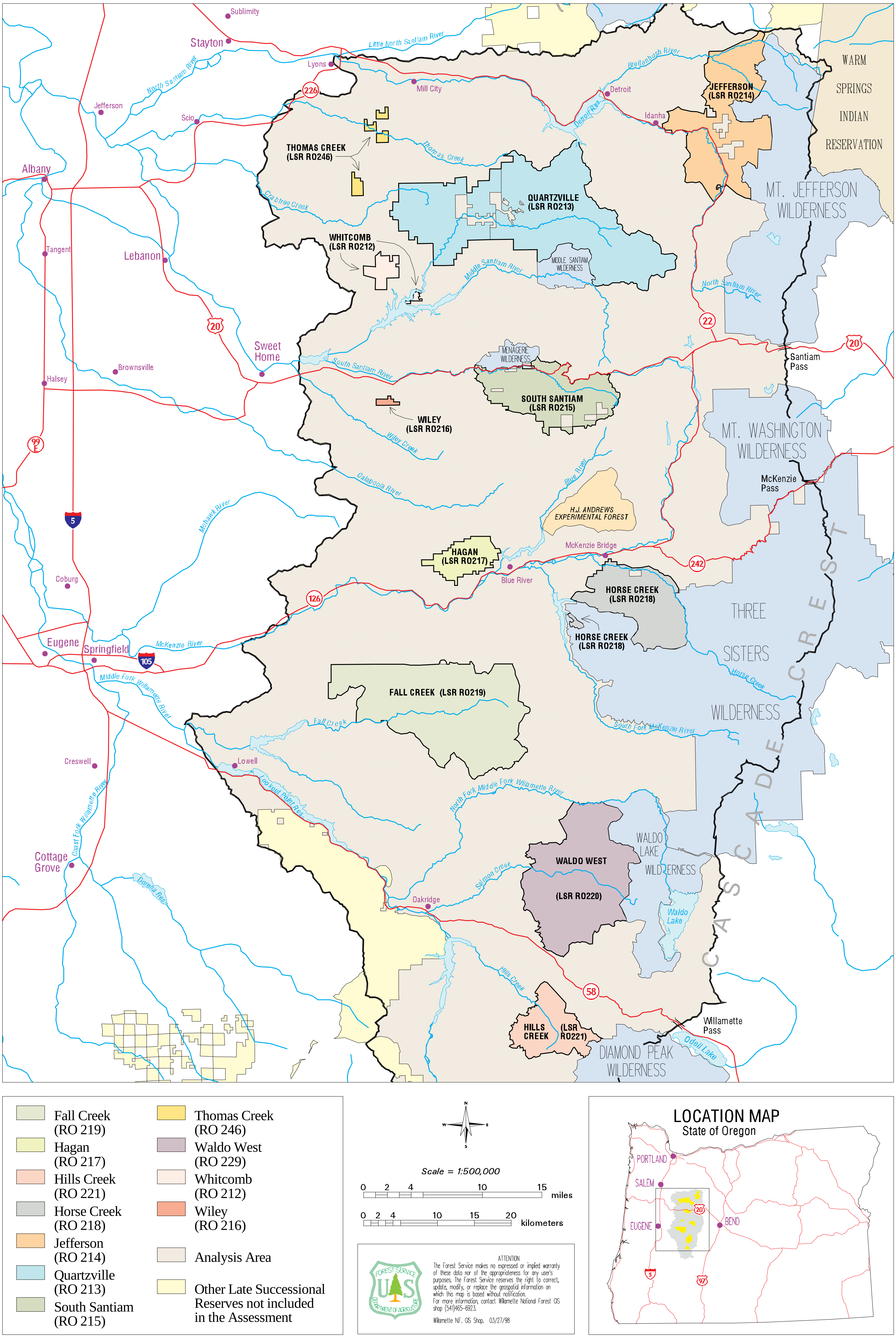
A digital fuel model layer was developed by the Willamette National Forest for use in broad scale planning and modeling of fire behavior potential. This was created by analyzing satellite imagery interpreted and provided by Pacific Meridian Resources of Portland, Oregon. This same method was applied to other lands covered by the LSR Assessment.

The species group, canopy closure and size/structure characteristics of the interpreted imagery were considered in determining the fuel model groups to be assigned to the data.

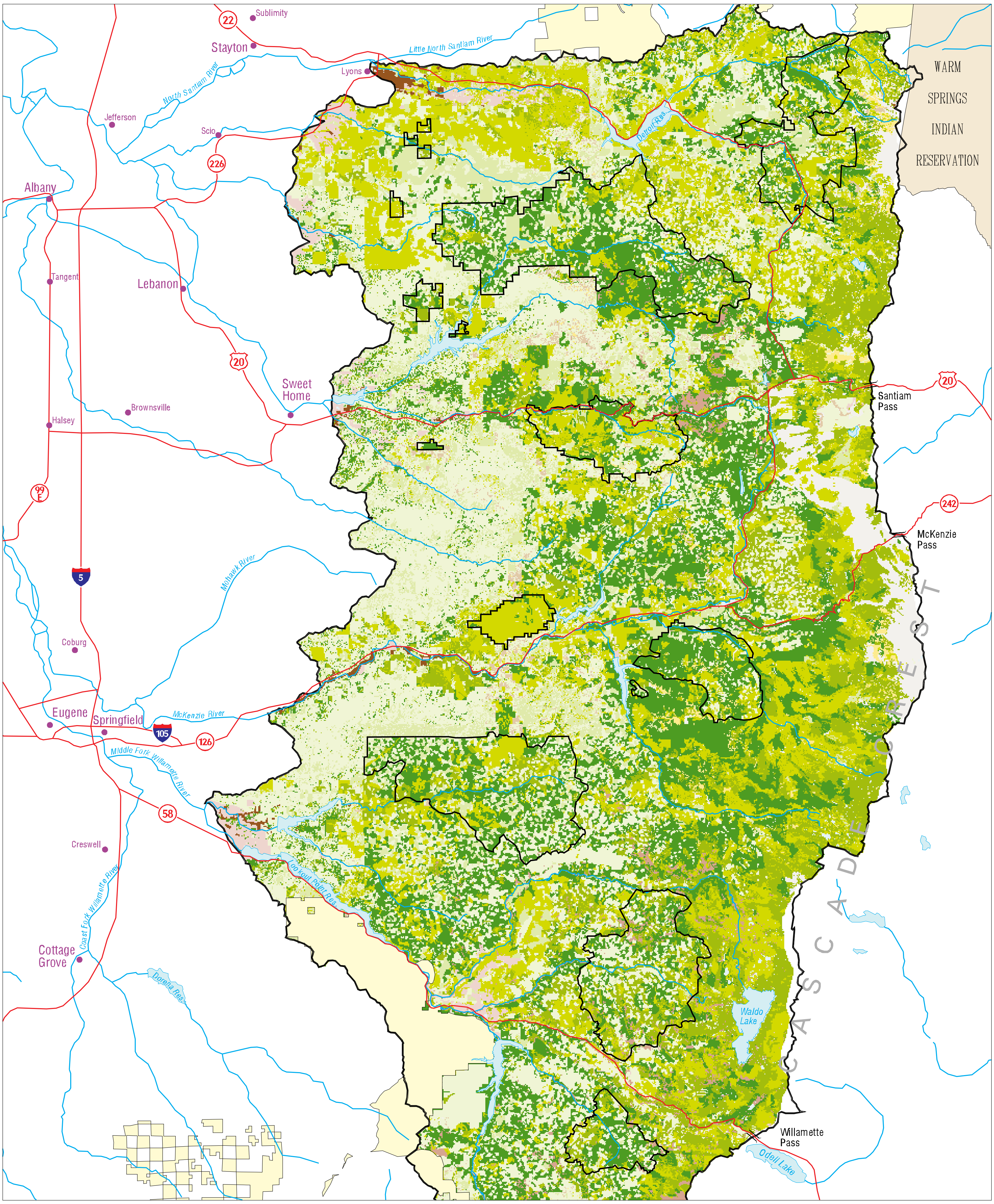
PMR Data to NFFL Fuel Model Conversion Table

PMR Group Number	PMR Extended Species Group	Canopy Closure	Size - Structure	NFFL Fuel Model	Assumptions
1	Water			98	1%
2	Rock Sparse Veg.			0	2%
3	Snow			0	.3%
4	Grass			1	.9%
5	Shrub			5	6% includes recent CC
7	Grand Fir			8	2%
8	PSFir/NFir/SAFir			8	5%
9	Ak. Yellow Cedar			10	.01% associated with old growth
10	Var. Hardwoods			5	1% green forest floor
11	Western Larch	=17		9	(11=.03%) grass and needles, mid to late seral
11	Western Larch	>17		8	shaded
12	Mix Var. Conifer			8	5%
13	Knobcone Pine			8	0% check with Rigdon
14*	Lodgepole Pine	=17	10	8	(14=2%) not dense, saplings
14	Lodgepole Pine	=17	11	11	managed stands, first thinnings
14	Lodgepole Pine	=17	>11	6	shrubs as slash breaks down
14	Lodgepole Pine	>17	10,11	8	closed canopy = unmanaged stands
14	Lodgepole Pine	>17	>11	10	dead and down increases as stand develops
15	W. White Pine			10	0%
16*	Douglas Fir	=17	<14	11	(16=39%) thinned reprod
16*	Douglas Fir	=17	>13	10	
16	Douglas Fir	>17		10	
17	DFir/PSFir			10	5% upper mid elevation
18	DFir/Incense Cedar			8	.2% dry sites
19*	Dfir/ W. Hemlock	=17	<14	11	(19=9%) thinned reprod
19*	Dfir/ W. Hemlock	=17	>13	10	(
19	Dfir/ W. Hemlock	>17		10	
20	Western Hemlock			10	3% similar to Douglas Fir with large woody
21	Mountain Hemlock			8	9% high elevation, large woody deficient
22	<25% any species			99	9% using 99 will allow flexibility in fuel models
23	Ponderosa Pine			9	.4%

Map 1: LATE SUCCESSIONAL RESERVES INCLUDED IN ASSESSMENT

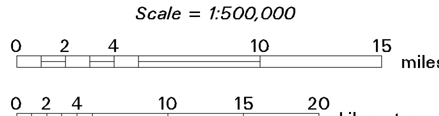


Map 2: SERAL STAGES



Early	Grass / Forb / Herb
Early-Mid	Shrub
Mid	Other Nonforest
Late-Mature	Barren / Rock
Late-OG	
Agricultural / Developed / Administrative	
Aquatic / Special Habitats	
Other Late Successional Reserves not included in the Assessment	

Scale = 1:500,000

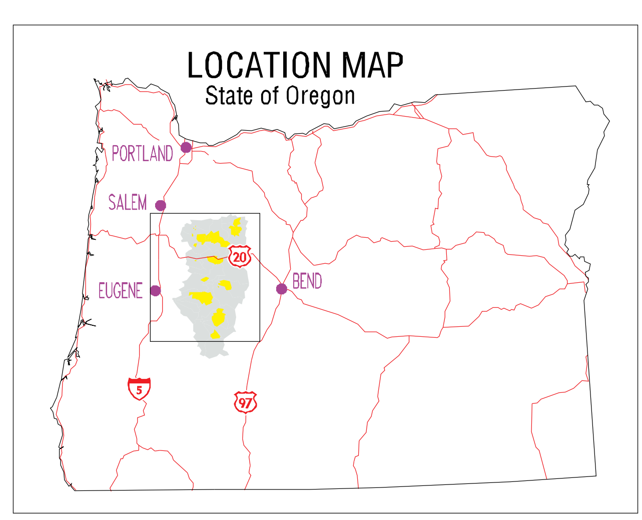


ATTENTION

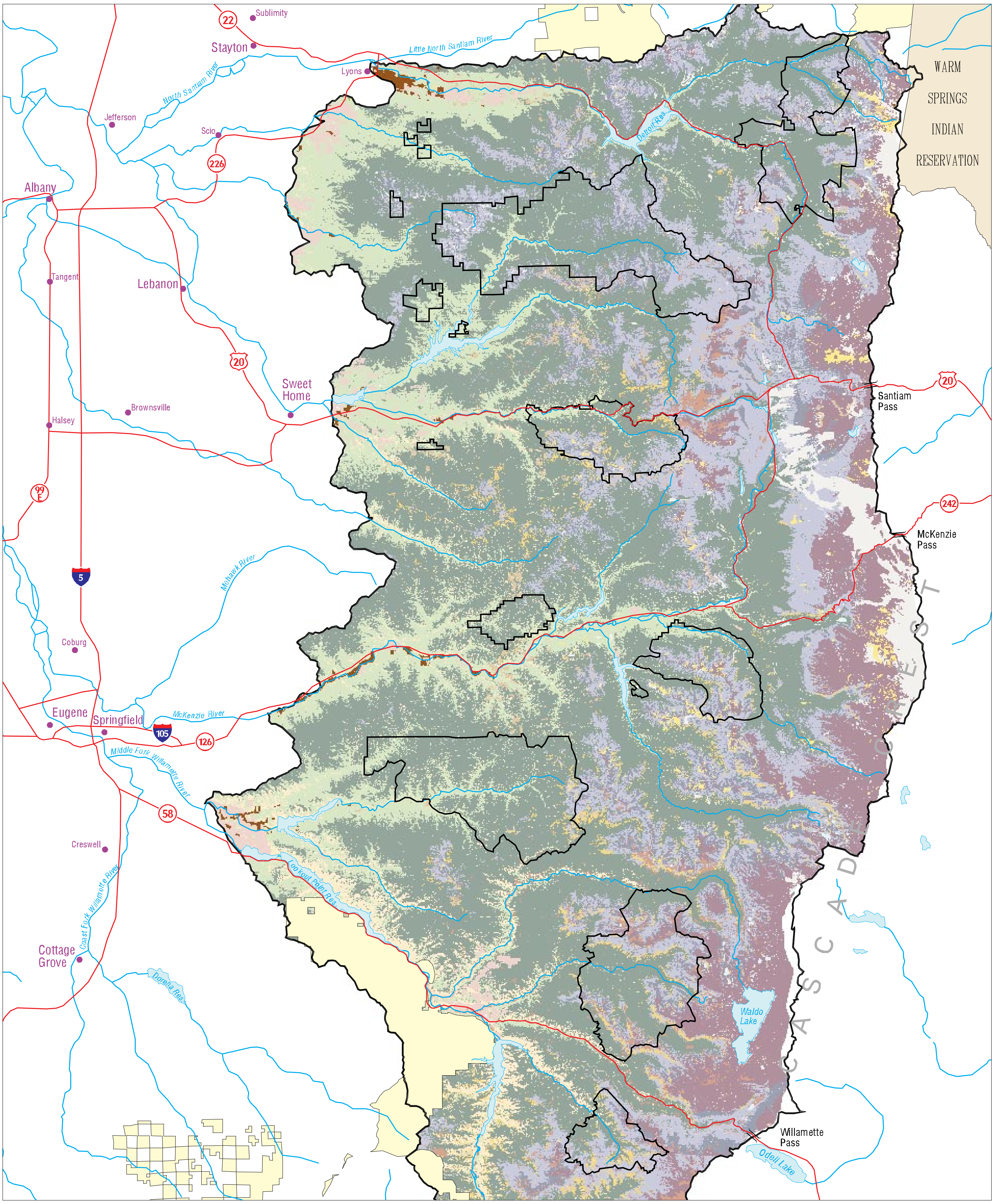
The Forest Service makes no expressed or implied warranty of these data nor of the appropriateness for any user's purposes. The Forest Service reserves the right to correct, update, modify, or replace the geospatial information on which this map is based without notification.

For more information, contact Willamette National Forest GIS shop (541)465-6923.

Willamette N.F. GIS Shop. 03/24/98



Map 3: SERIES or SUPER PLANT ASSOCIATION GROUP



- Douglas Fir Series
- Grand Fir Series
- Warm and Moist Western Hemlock
- Well-Drained, Dry Western Hemlock
- Moderate Pacific Silver Fir
- Cold Pacific Silver Fir
- Mountain Hemlock
- Other Late Successional Reserves not included in the Assessment
- Agricultural/ Developed/ Administrative
- Grass/Forb/Herb
- Shrub
- Other Nonforest
- Barren/Rock
- Aquatic/ Special Habitats
- Water

Note: Plant Association Groups displayed were built using a GIS model developed by Dr. Jan Henderson. This model is not field verified and should not replace field collected data. See Chapter II, Potential Vegetation section.

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

ATTENTION

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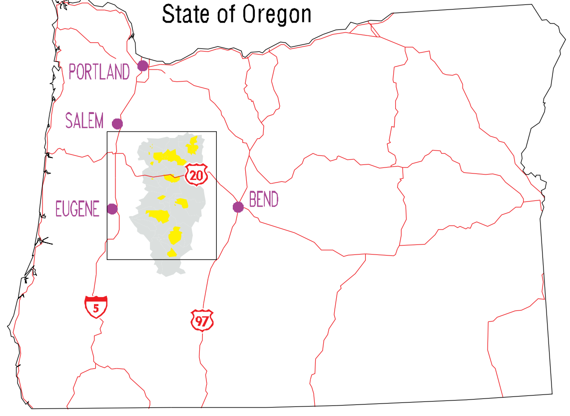
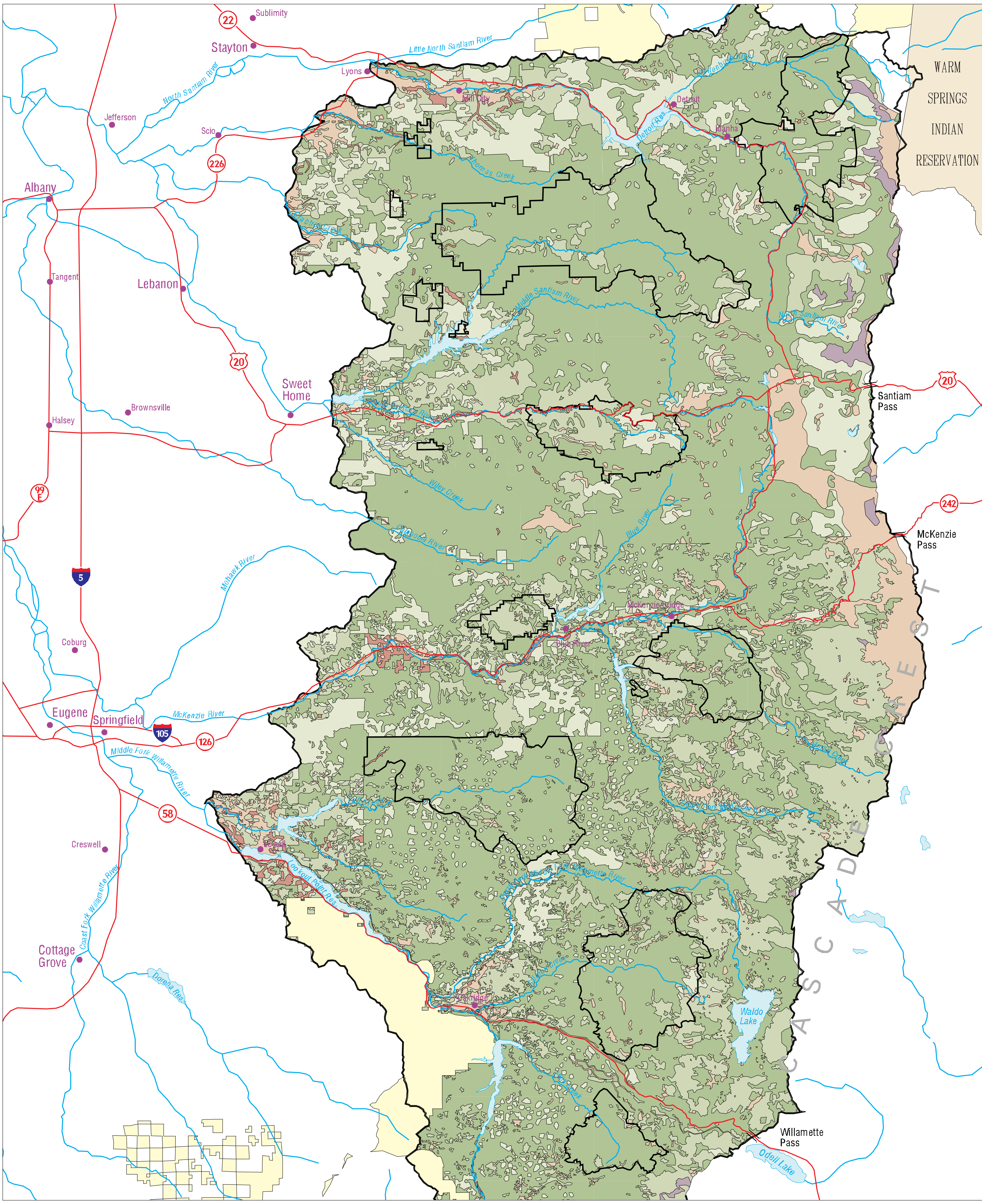
Willamette N.F. GIS Shop. 03/18/98

LOCATION MAP

State of Oregon



Map 4: HISTORIC SERAL STAGES −Mid 1900’s



Early	Subalpine
Mid	Nonforest
Late	Unknown
Hardwoods	

Other Late Successional Reserves not included in the Assessment

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

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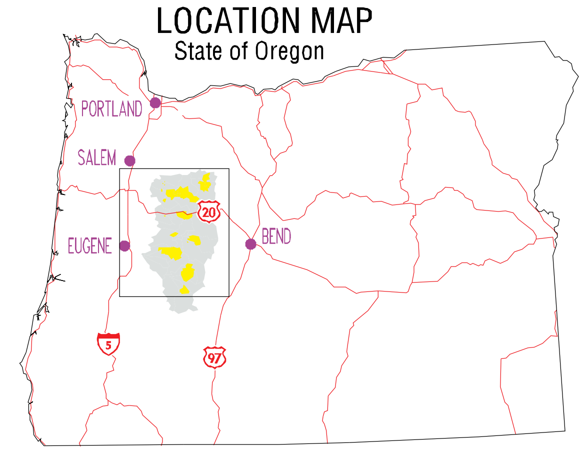
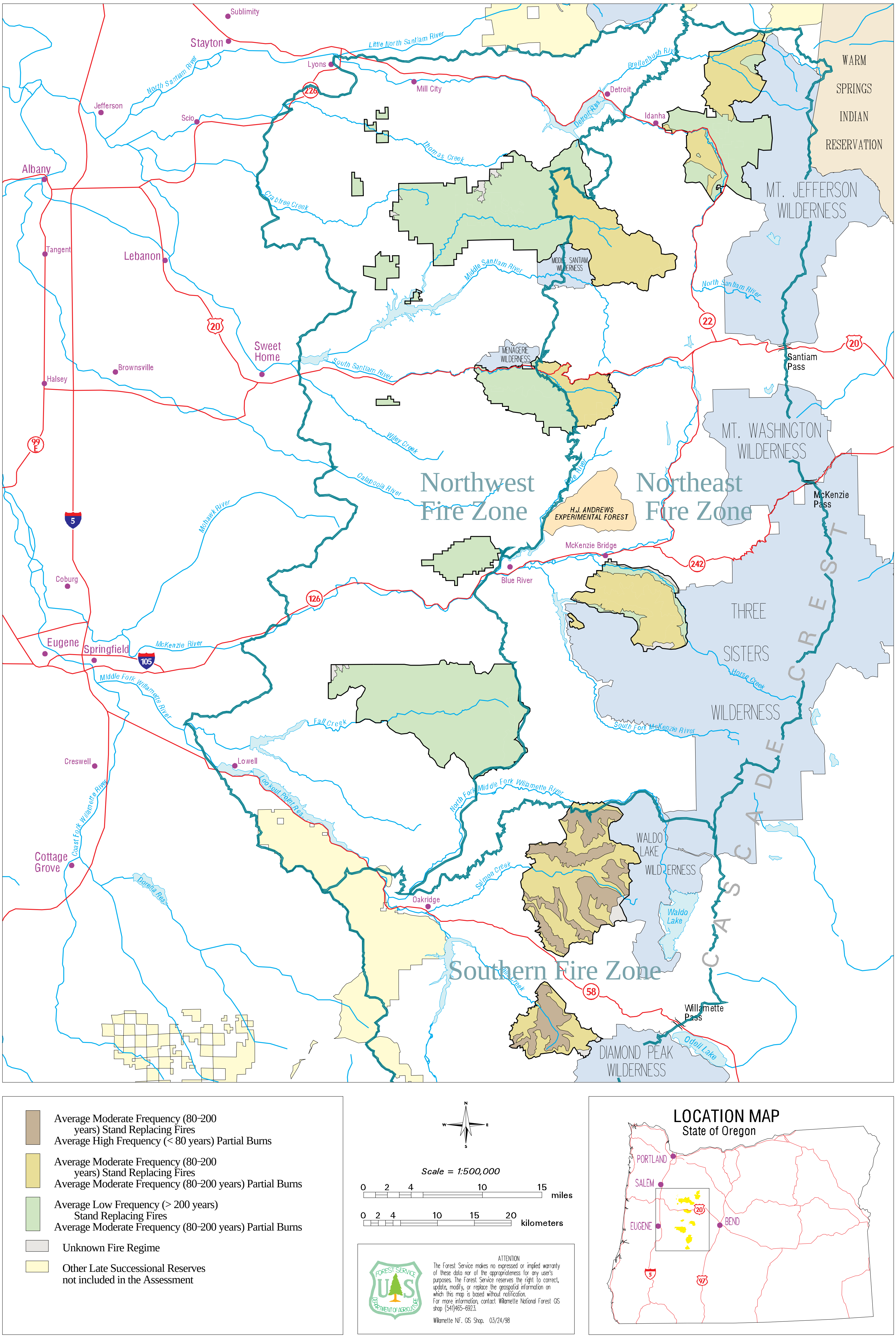
LOCATION MAP

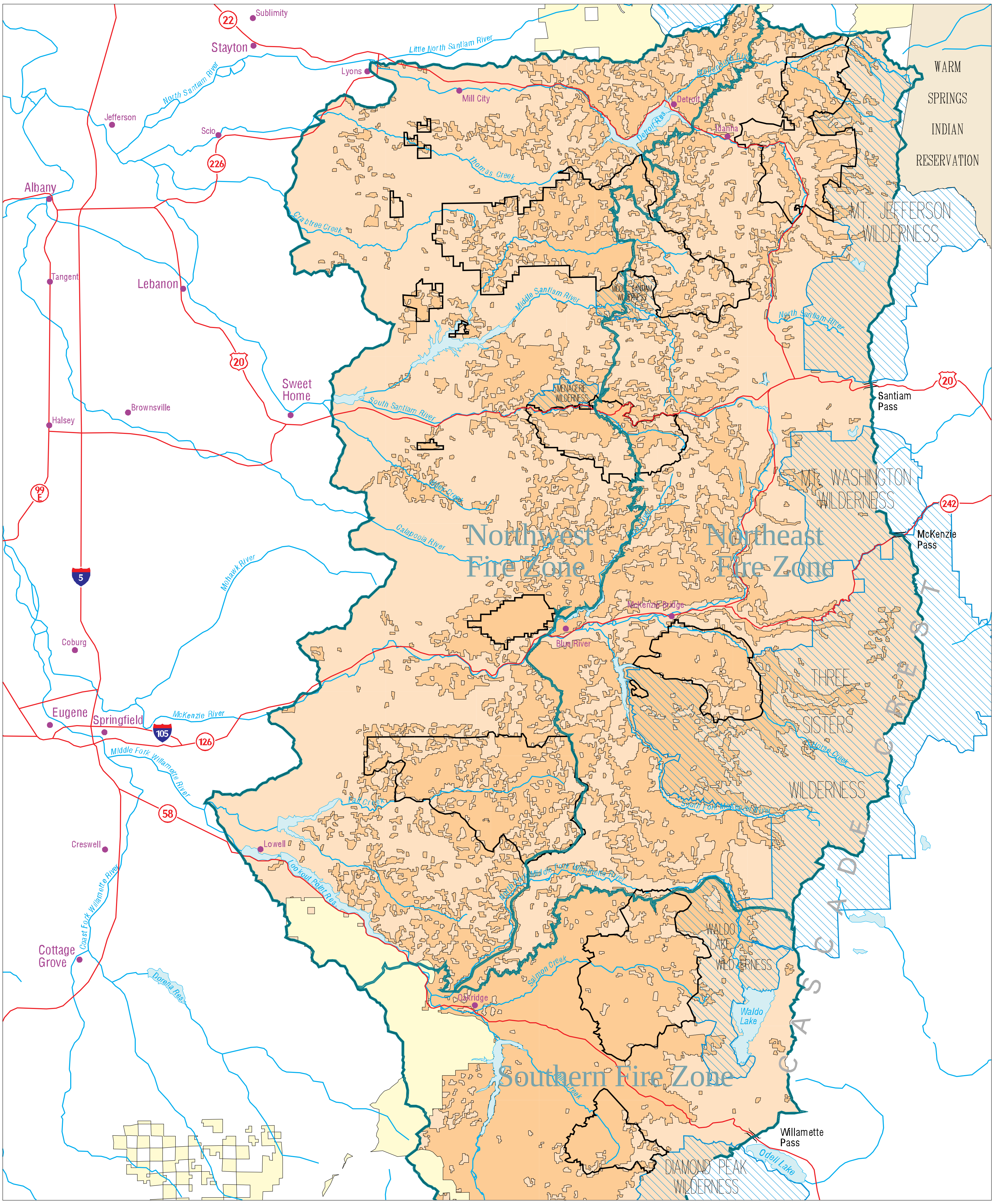
State of Oregon



Map 5: FIRE REGIMES



Map 6: FIRE BEHAVIOR RISK



Low Fire Behavior Risk

Moderate Fire Behavior Risk

Other Late Successional Reserves not included in the Assessment

N

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

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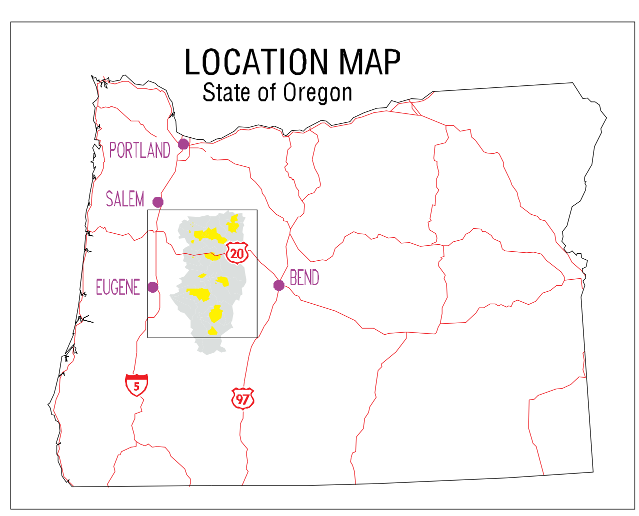
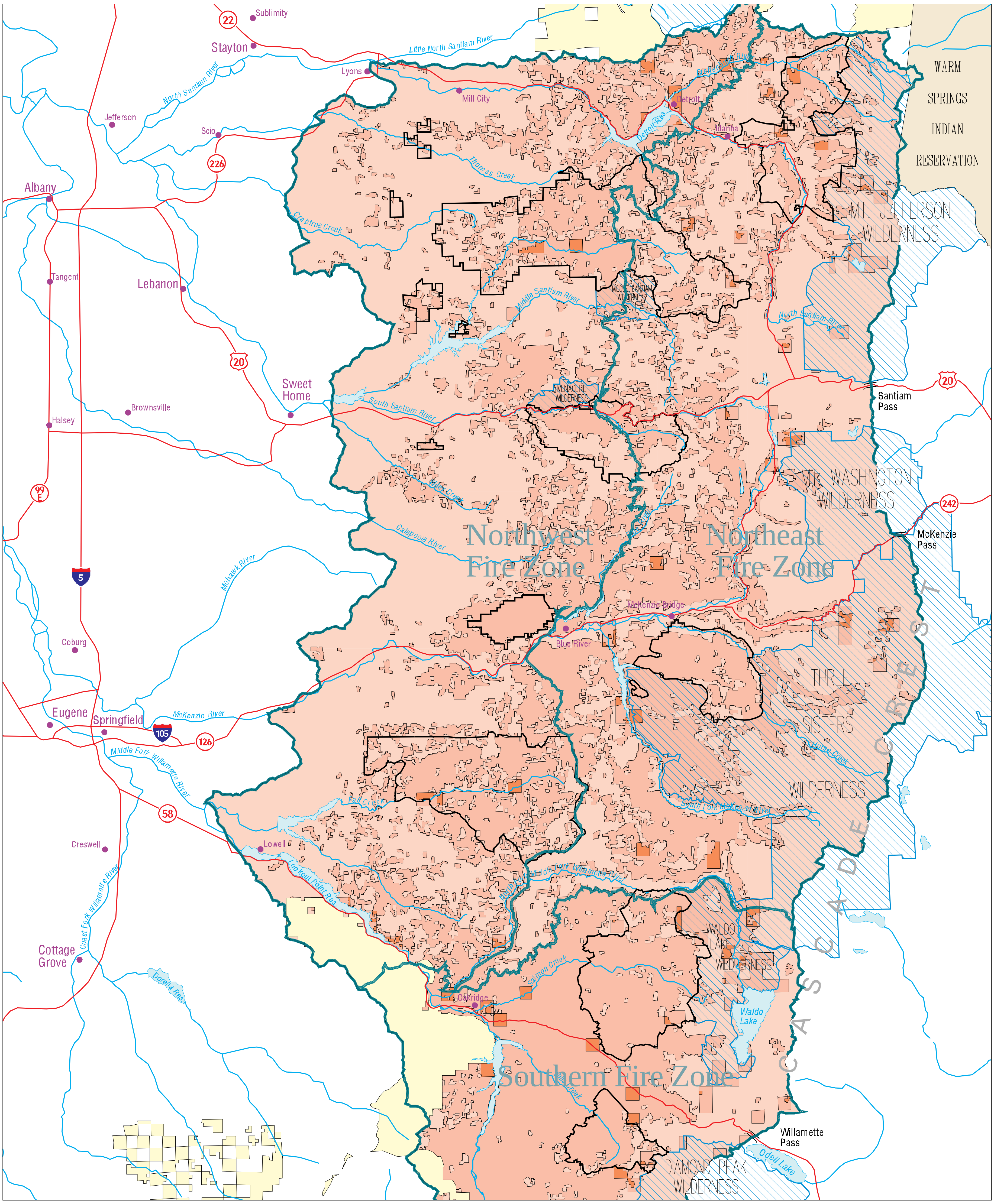


Map 8: TOTAL FIRE RISK



Low Fire Risk

Moderate Fire Risk

High Fire Risk

Other Late Successional Reserves not included in the Assessment

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

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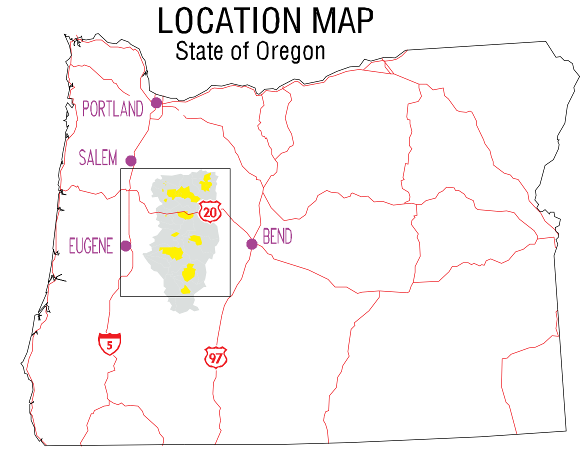
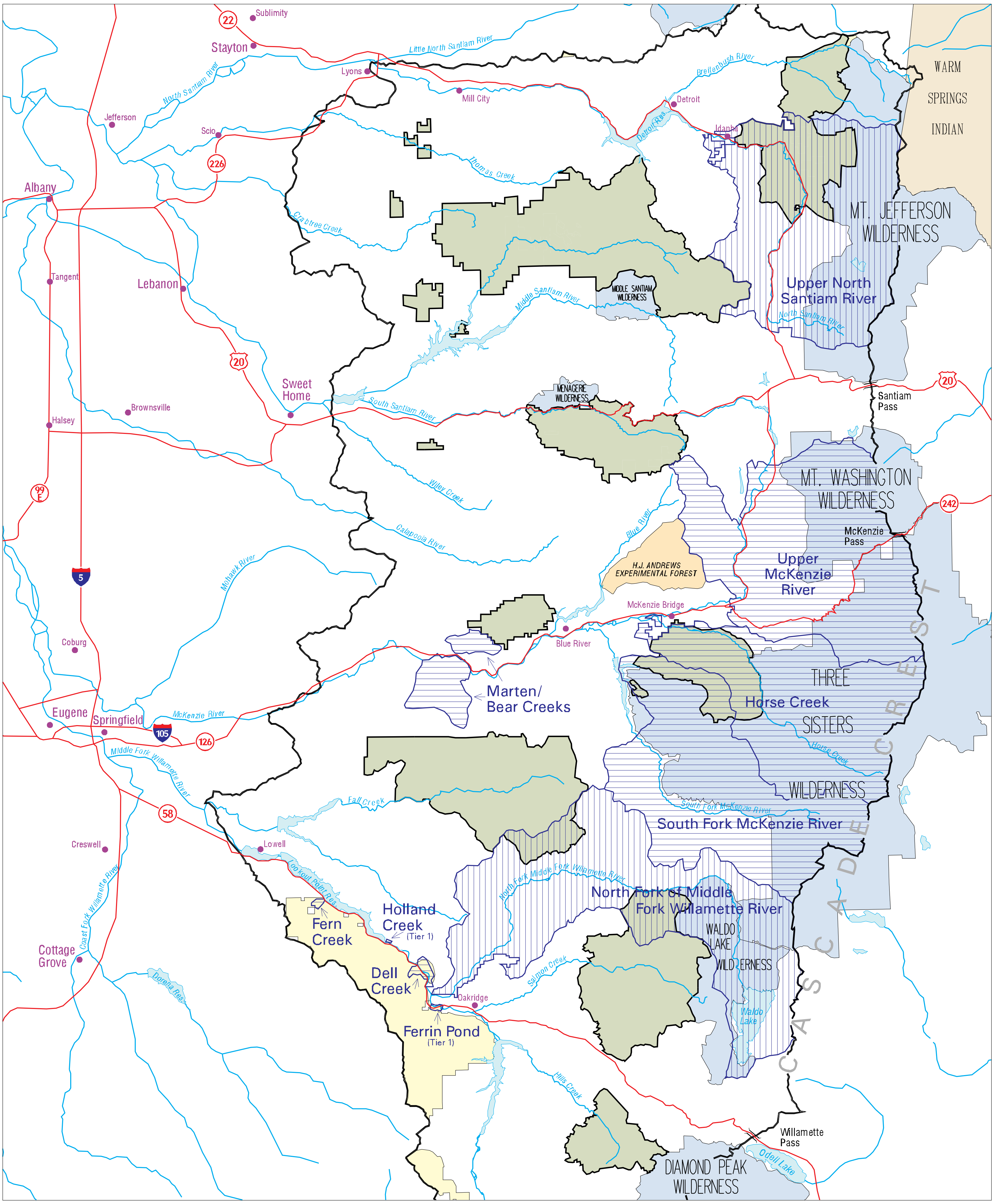


Map 9: KEY WATERSHEDS



Tier 1 Key Watersheds

Tier 2 Key Watersheds

Late Successional Reserves included in the Assessment

Other Late Successional Reserves not included in the Assessment

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

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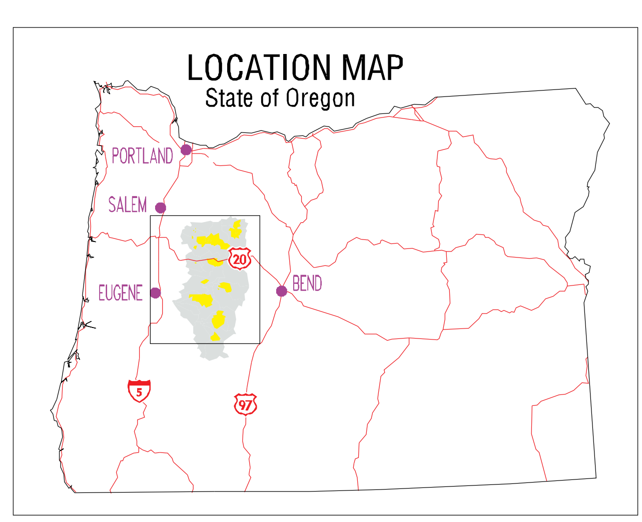
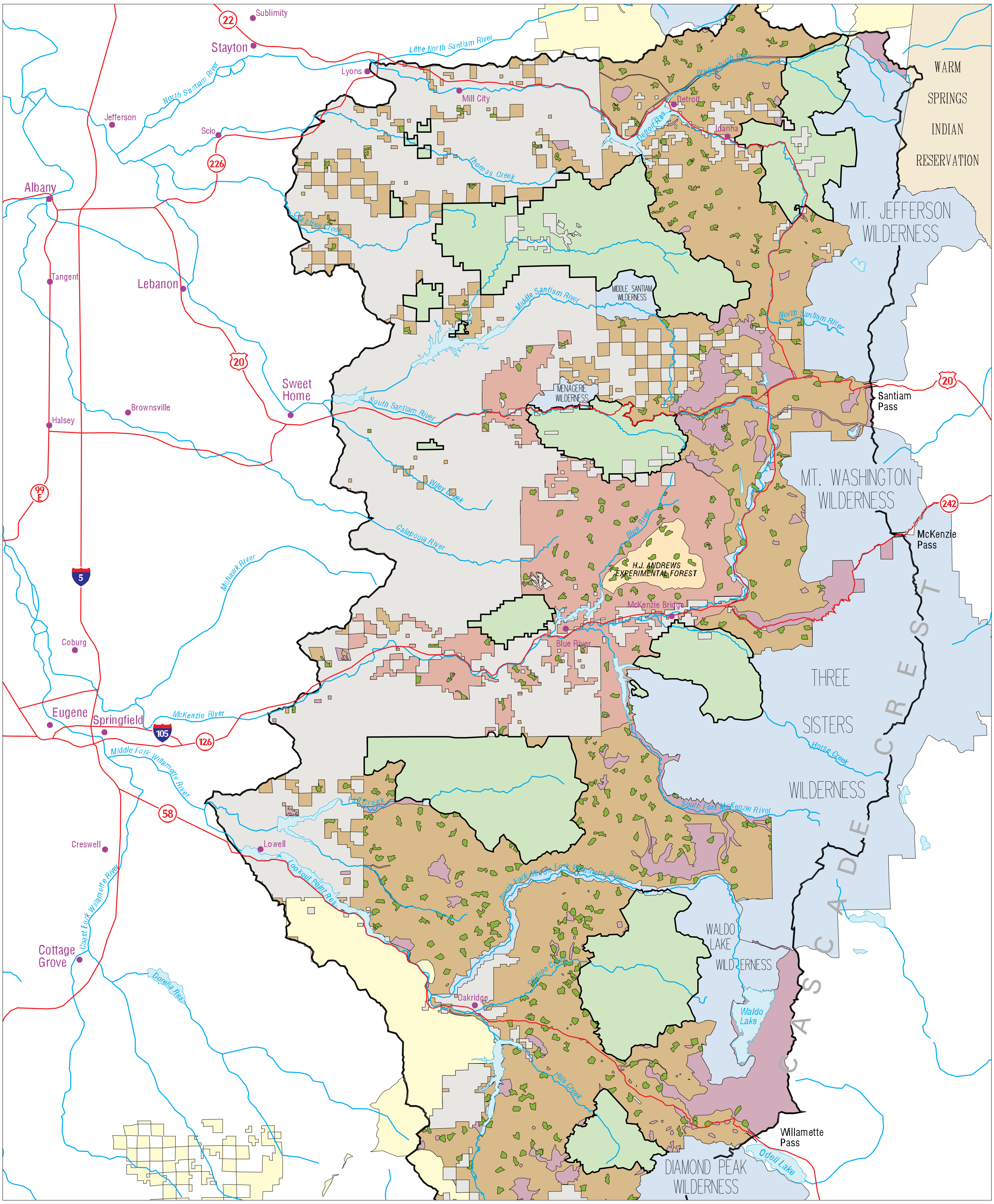
Willamette N.F. GIS Shop. 03/25/98



Map 10: NORTHWEST FOREST PLAN ALLOCATIONS



- Congressionally Withdrawn
- Late Successional Reserve
- Core Late Successional Reserve
- Administratively Withdrawn
- H.J. Andrews Experimental Forest
- Adaptive Management Area
- Matrix
- Other Ownerships
- Other Late Successional Reserves not included in the Assessment

N
W E
S

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

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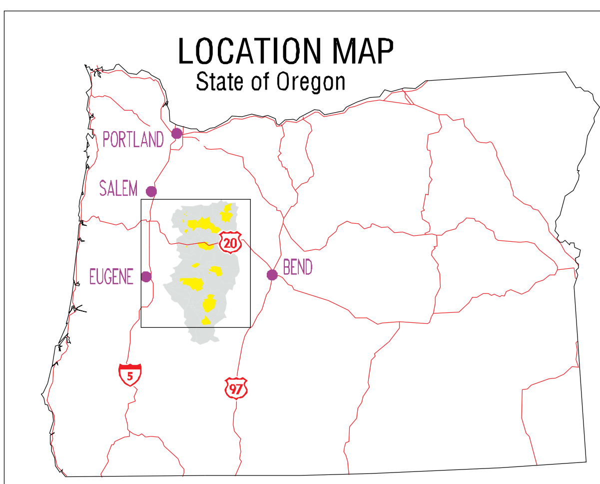
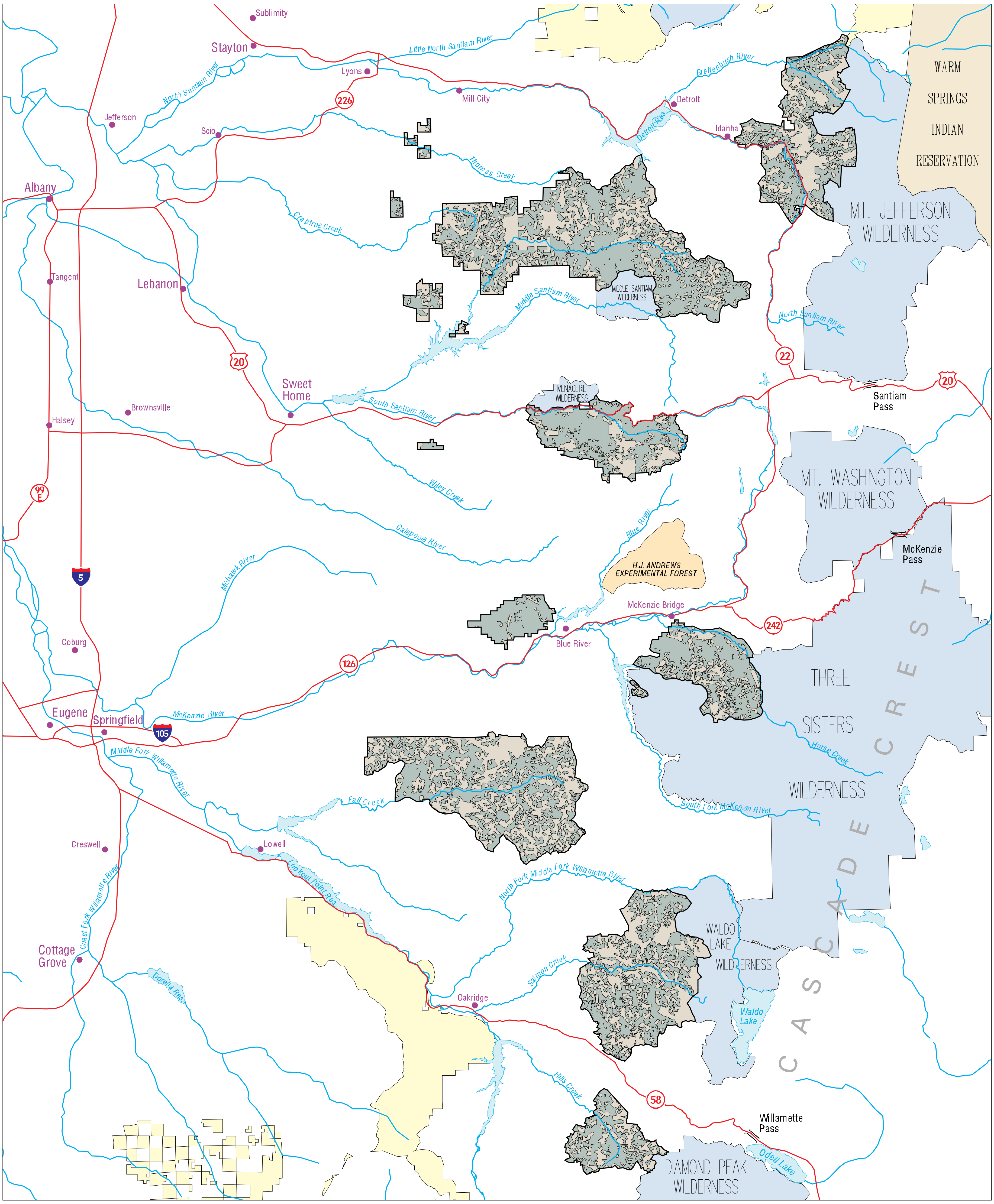


Map 11: SUITABLE SPOTTED OWL HABITAT



Suitable Spotted Owl Habitat

Unsuitable Spotted Owl Habitat

Other Late Successional Reserves not included in the Assessment

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

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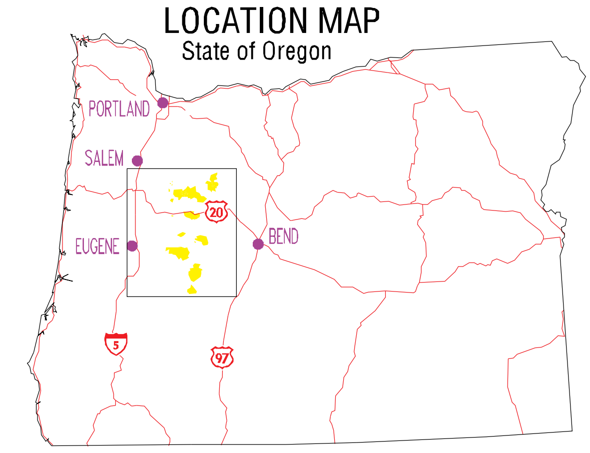
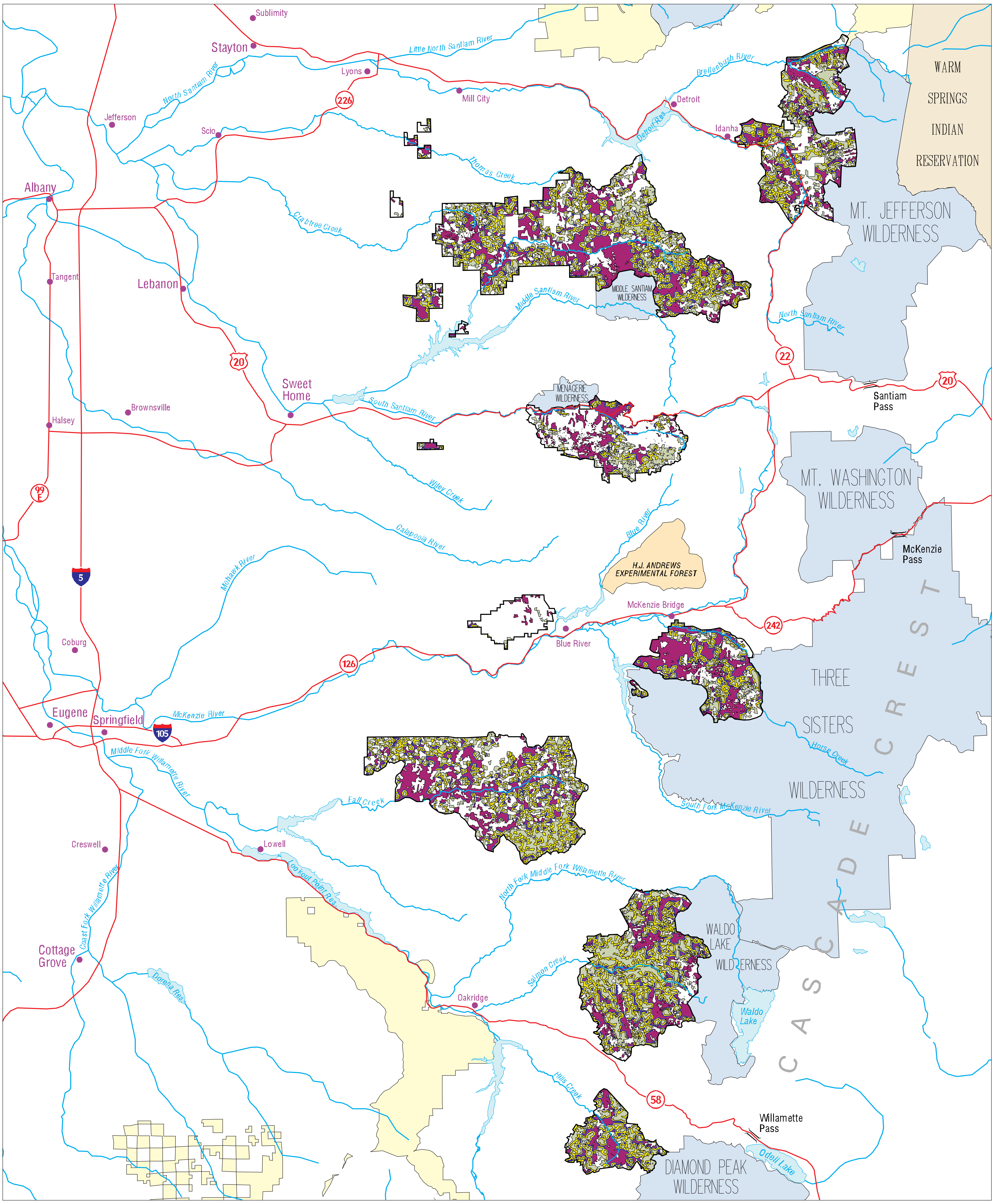


Map 12: LATE SUCCESSIONAL INTERIOR FOREST



- 0 –120 meters from early seral patches > 4 acres
- 120 –240 meters from early seral patches > 4 acres
- Forest Interior (> 240 meters from early seral patches > 4 acres)
- Early Seral Patches > 4 acres
- Other Late Successional Reserves not included in the Assessment

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

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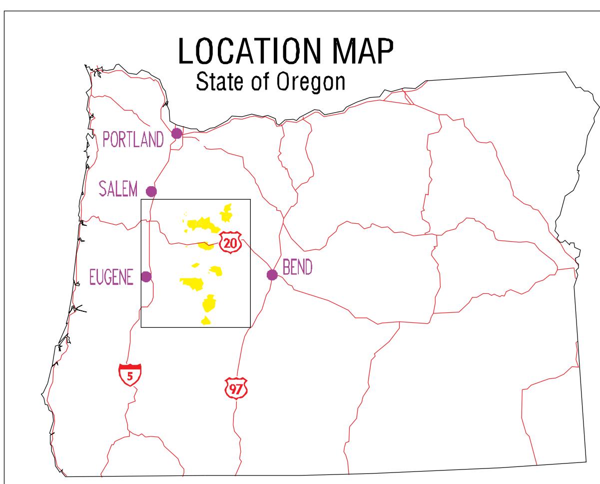
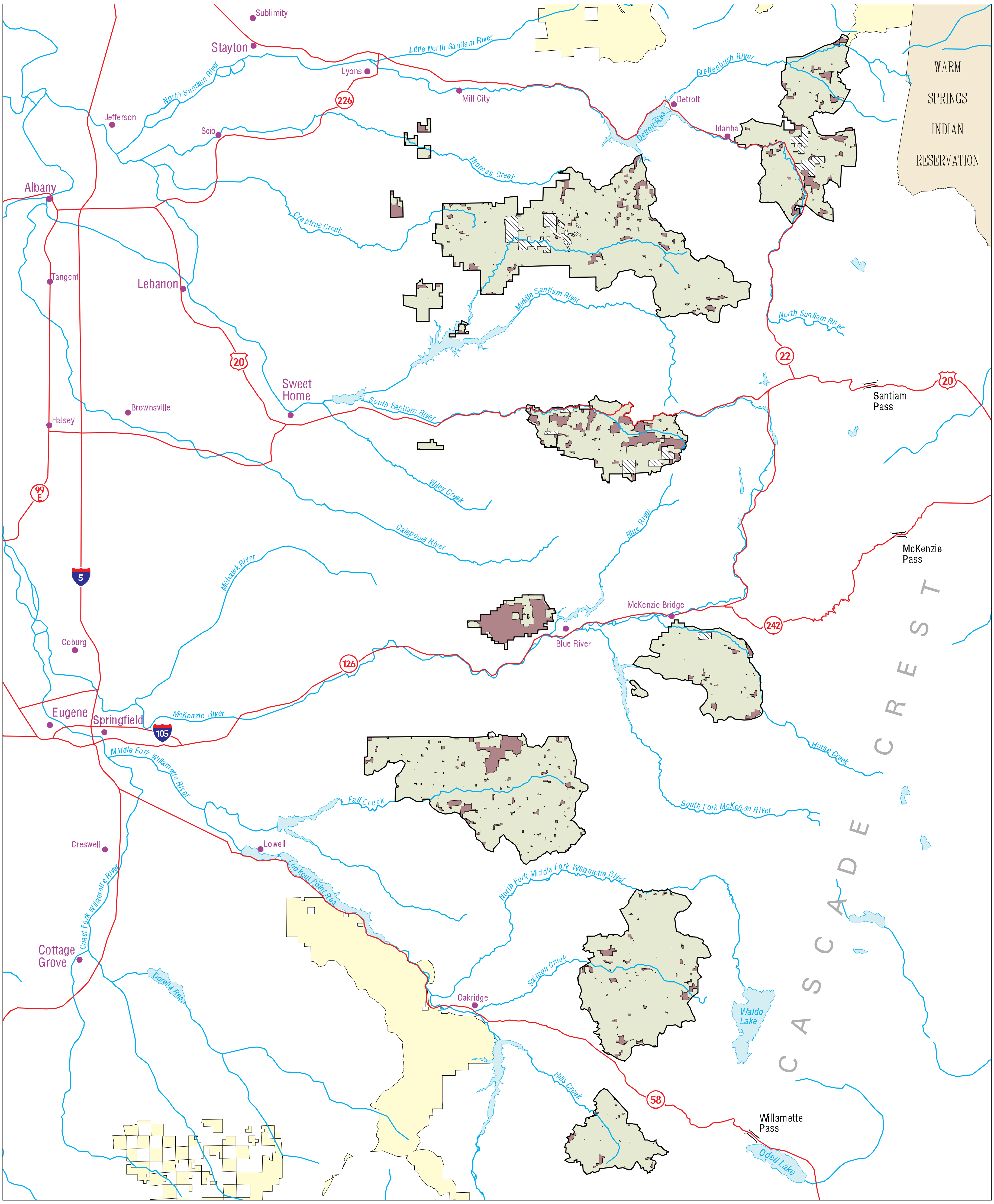


Map 13: LATE SUCCESSIONAL CONNECTIVITY WITHIN LATE SUCCESSIONAL RESERVES



Connected Late Successional Habitat

Breaks in Late Successional Habitat Connectivity

Non-Federal Ownership

Other Late Successional Reserves not included in the Assessment

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

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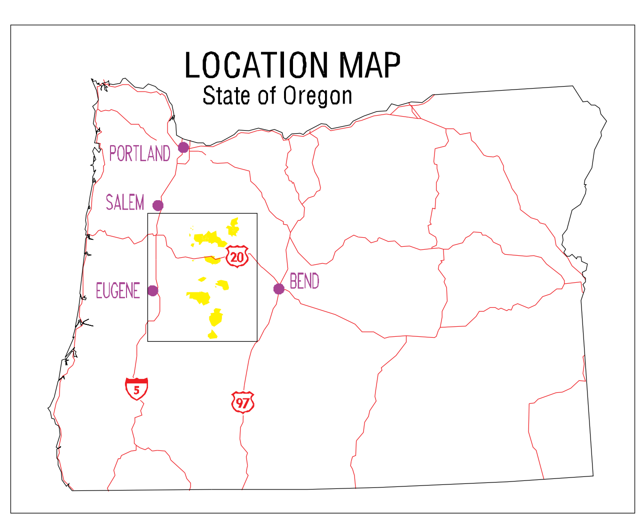
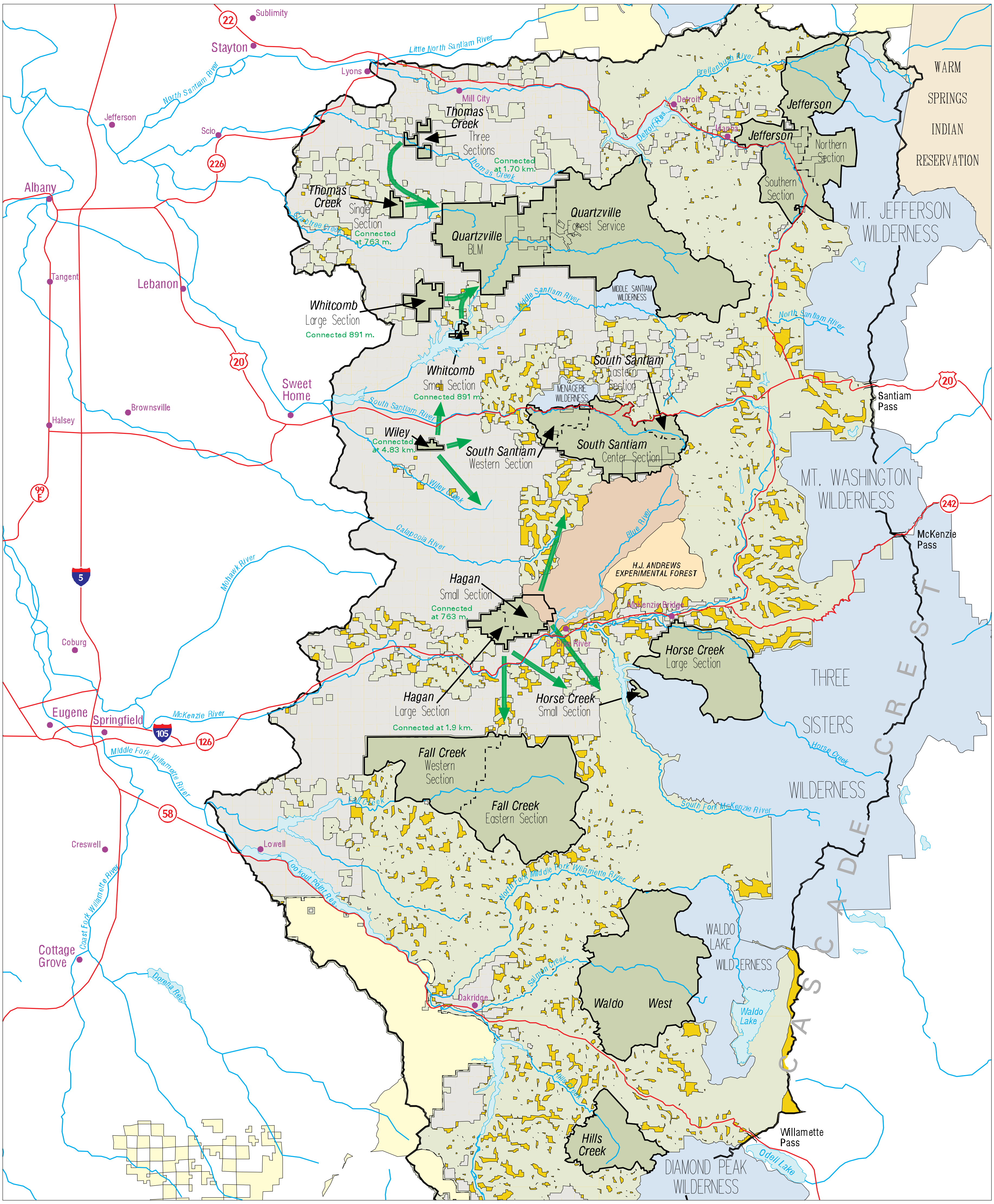


Map 14: POTENTIAL LATE SUCCESSIONAL CONNECTIVITY of RESERVE HABITAT BETWEEN LATE SUCCESSIONAL RESERVES



Potential Late Successional Connectivity (Large Reserves)

- Late Successional Reserves included in the Assessment
- Other Late Successional Reserves not included in the Assessment
- Wilderness
- Potential Late Successional Connectivity between Late Successional Reserves connected at 382 m
- Potential Late Suceessional Connectivity provided through the Blue River Landscape Plan
- Breaks in Potential Late Successional Connectivity
- Non-Federal Ownership
- Direction of Shortest Paths between Late Successional Reserves through Potential Late Successional Habitat Connected at > 382 meters.

Includes 100 acre LSRs, riparian, administative withdrawn, and congressional designations regardless of seral stage. See Chapter III, Connectivity section.

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

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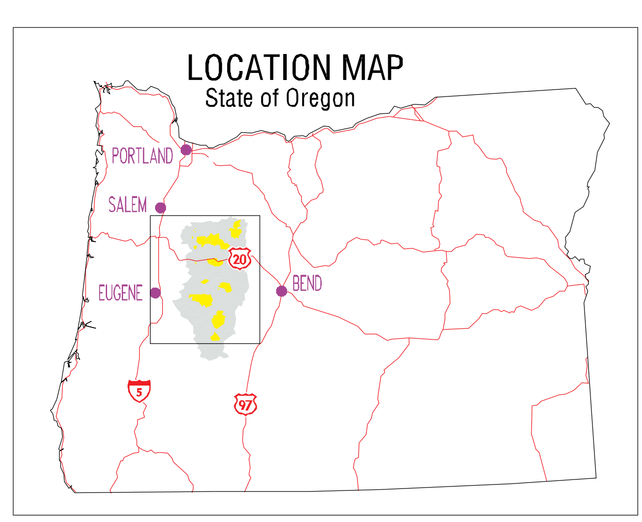
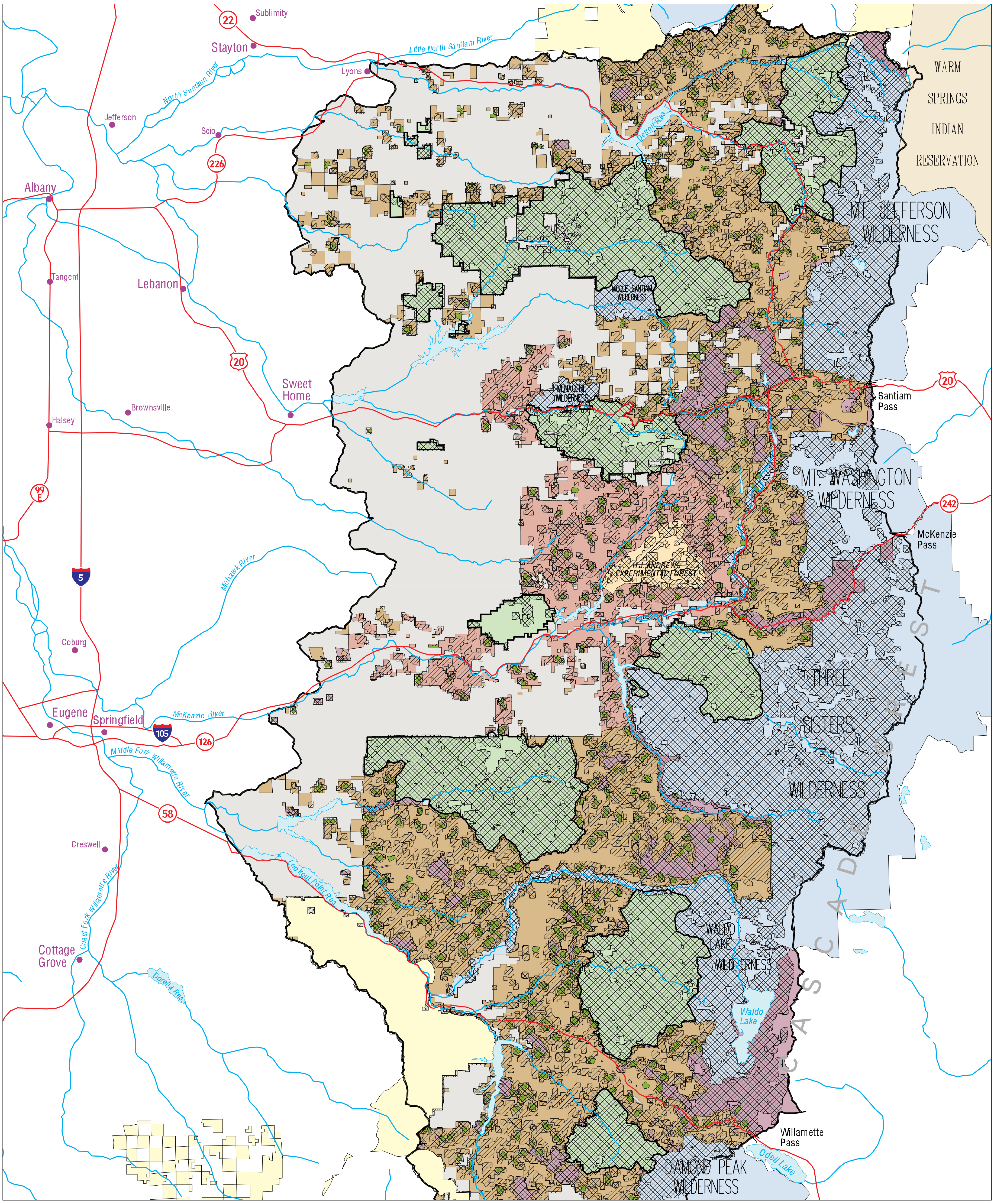


Map 15: CURRENT LATE SUCCESSIONAL CONNECTIVITY of RESERVE HABITAT BETWEEN LATE SUCCESSIONAL RESERVES



Northwest Forest Plan Allocations

- Congressional Withdrawn
- Late Successional Reserve
- Core Late Successional Reserve
- Administratively Withdrawn
- H.J. Andrews Experimental Forest
- Adaptive Management Area
- Matrix
- Other Ownerships
- Other Late Successional Reserves not included in the Assessment

Current Late Successional Connectivity [1]

- Connectivity within mapped Riparian Reserves & Special Habitats (382 m)
- Connectivity within Non-riparian Reserves (382 m)

[1] Late Successional Patches on reserved Federal lands connected at 382 meters apart. See Chaper IIII, Connectivity Section.

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

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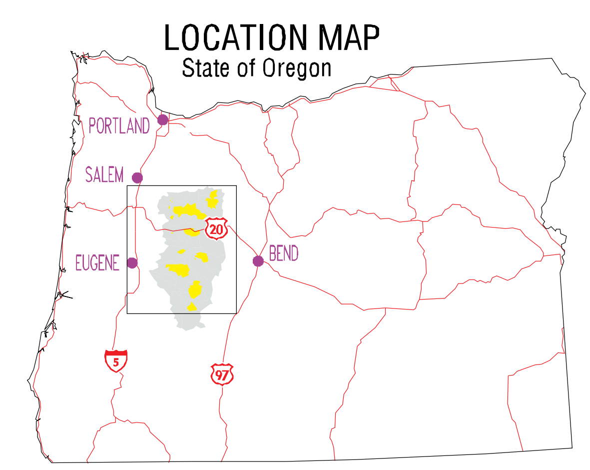
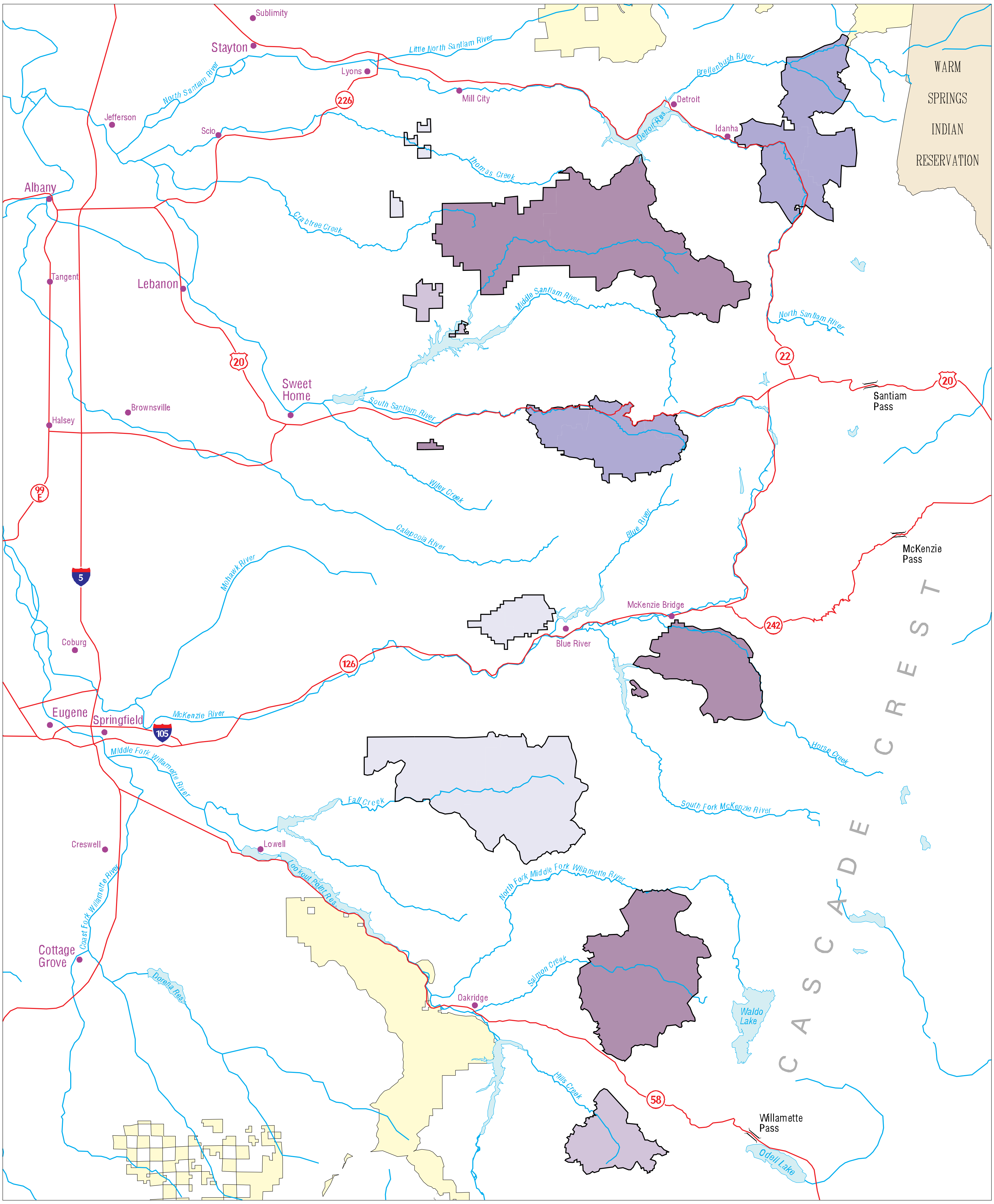


Map 16: COMPOSITE VALUES for RELATIVE COMPARISON of LATE SUCCESSIONAL RESERVES



Lower Quantile (0 −25%)

Lower Middle Quantile (25 −50%)

Upper Middle Quantile (50 −75%)

Upper Quantile (75 −100%)

Other Late Successional Reserves not included in the Assessment

Scale = 1:500,000

0 2 4 10 15 miles

0 2 4 10 15 20 kilometers

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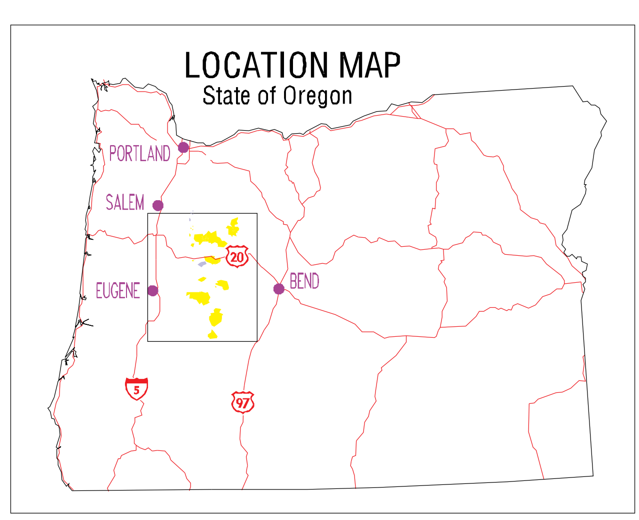
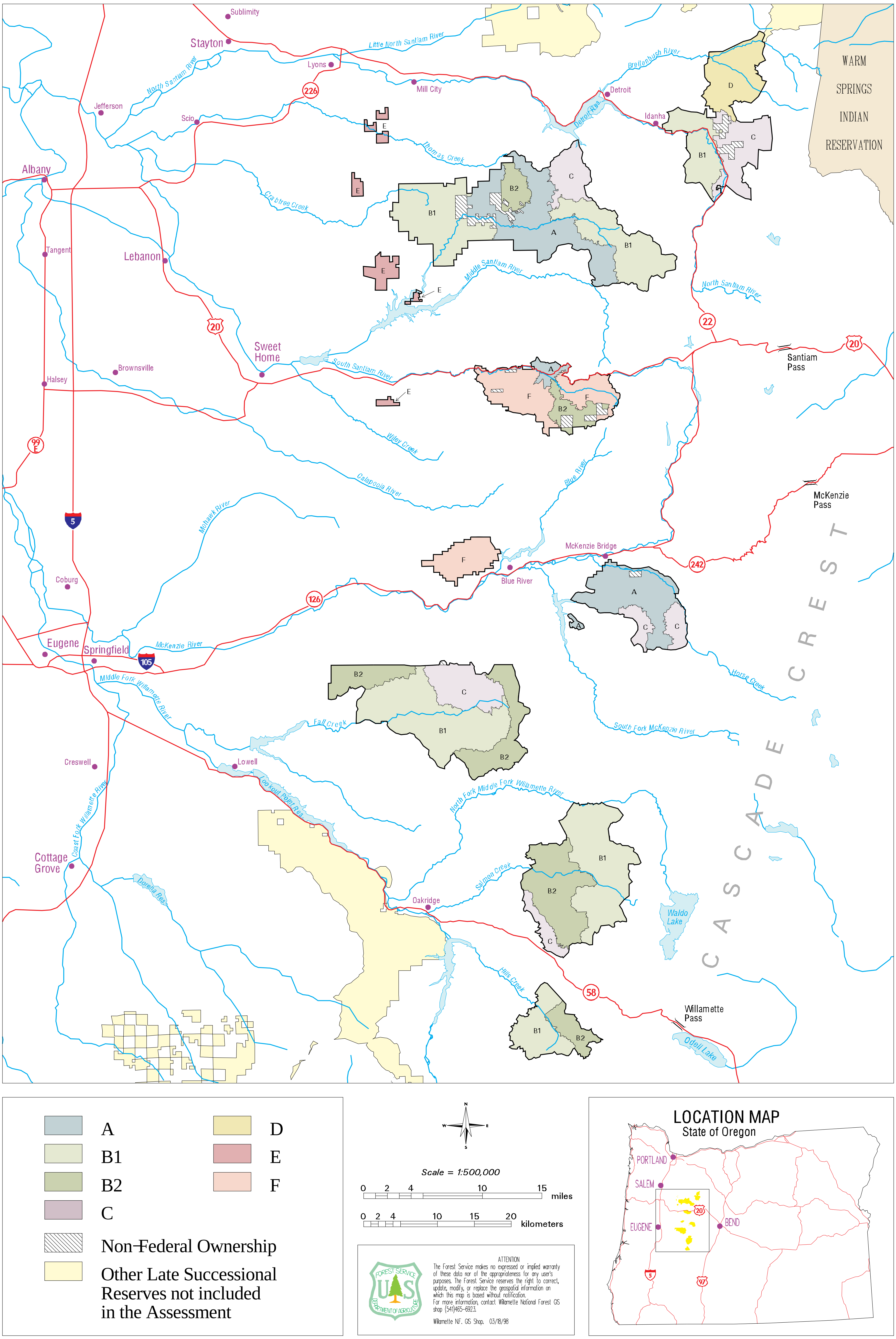


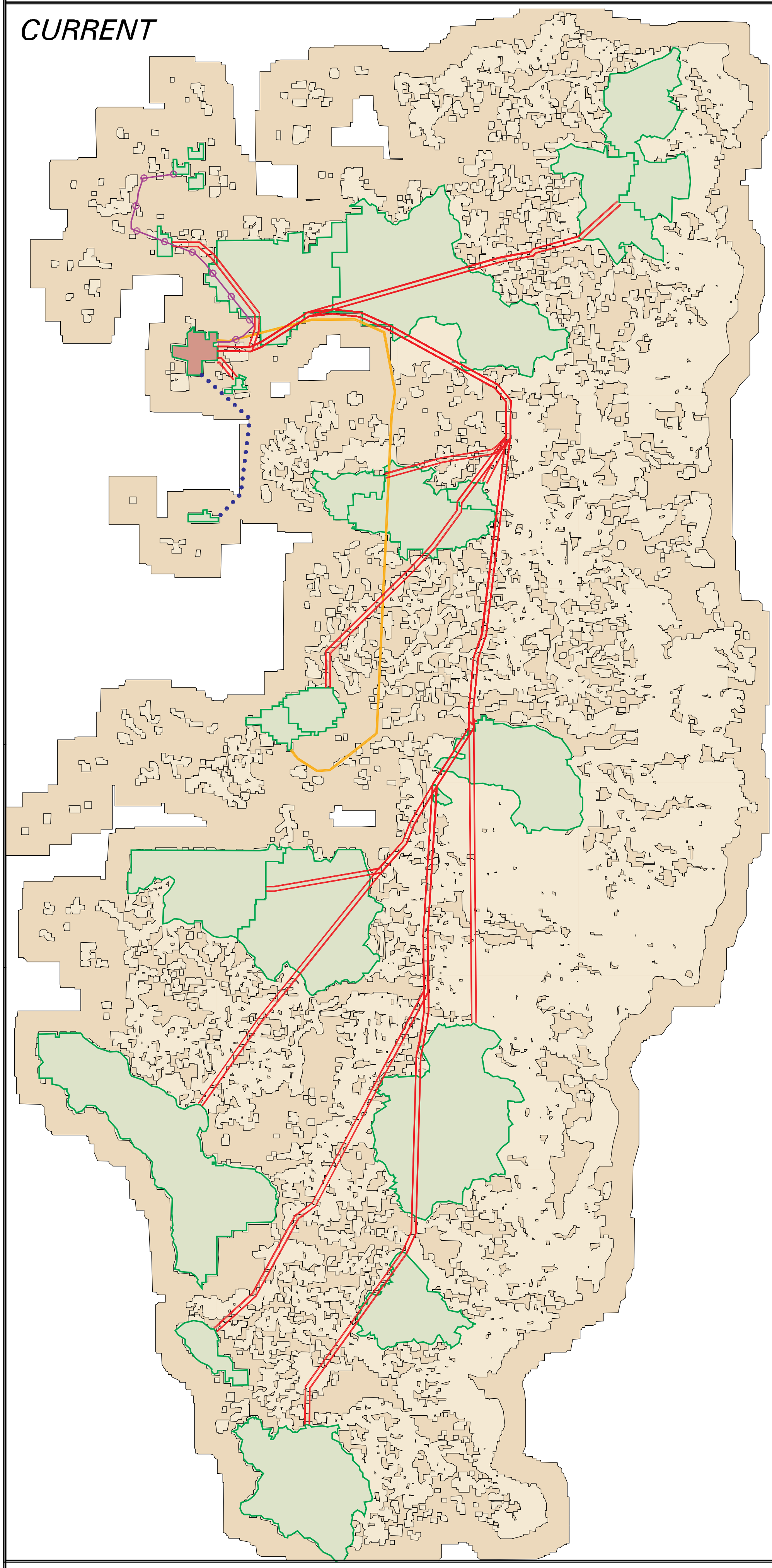
Map 17: LANDSCAPE BLOCKS



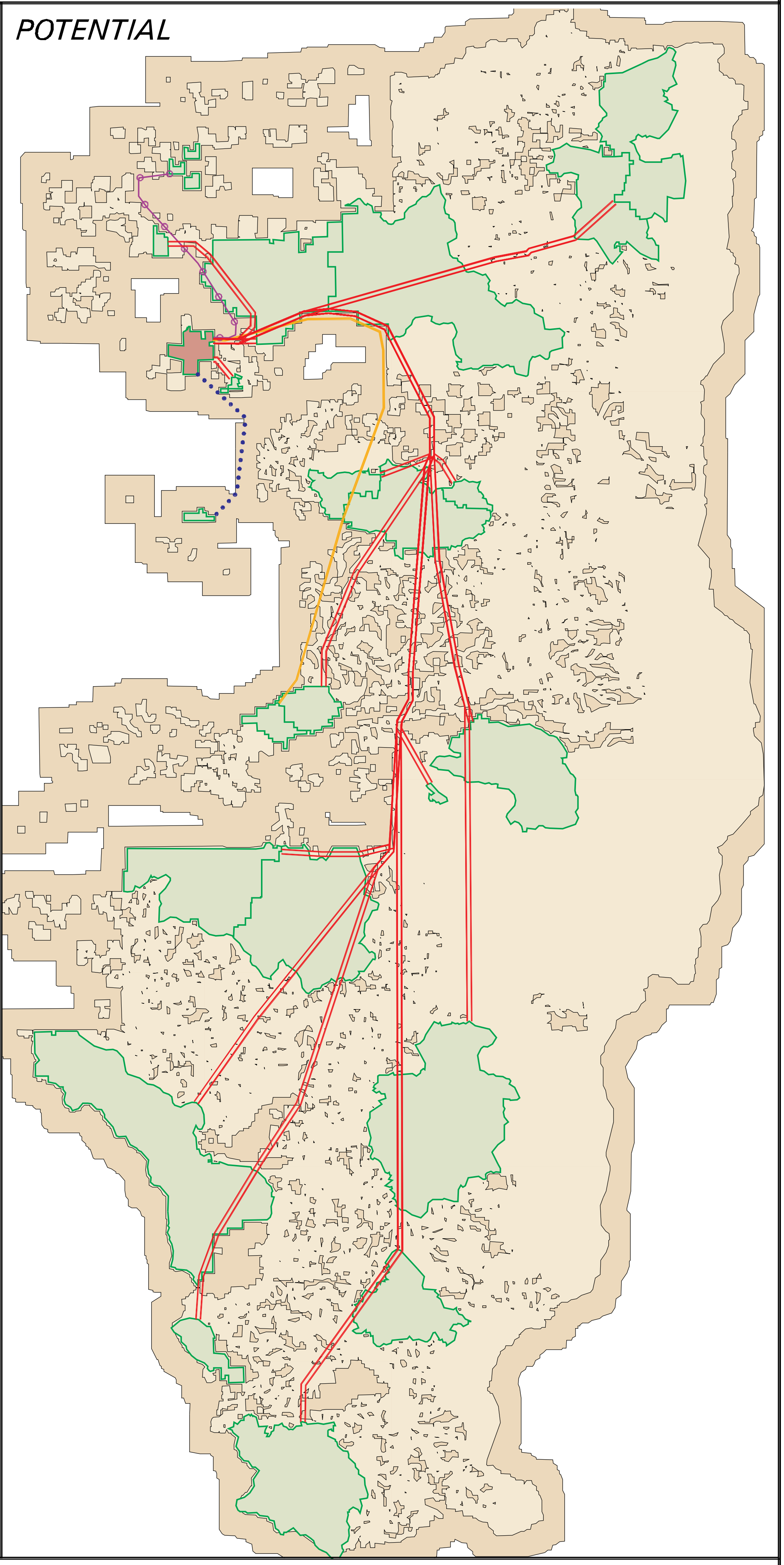
Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 212: WHITCOMB, Large Section

CURRENT

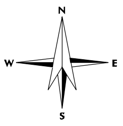


POTENTIAL



Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

Late Successional Habitat connected at 382 meters.
Late Successional Habitat connected at 4.83 kilometers.



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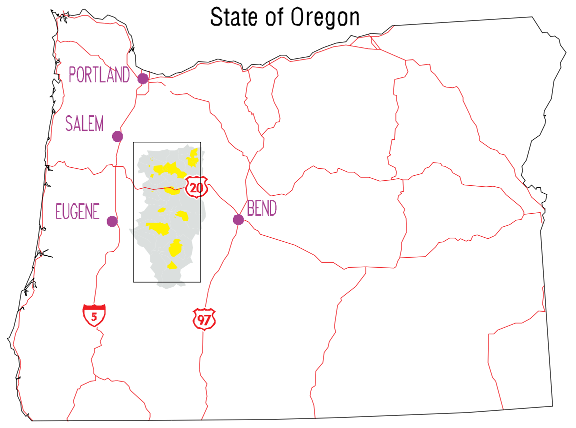
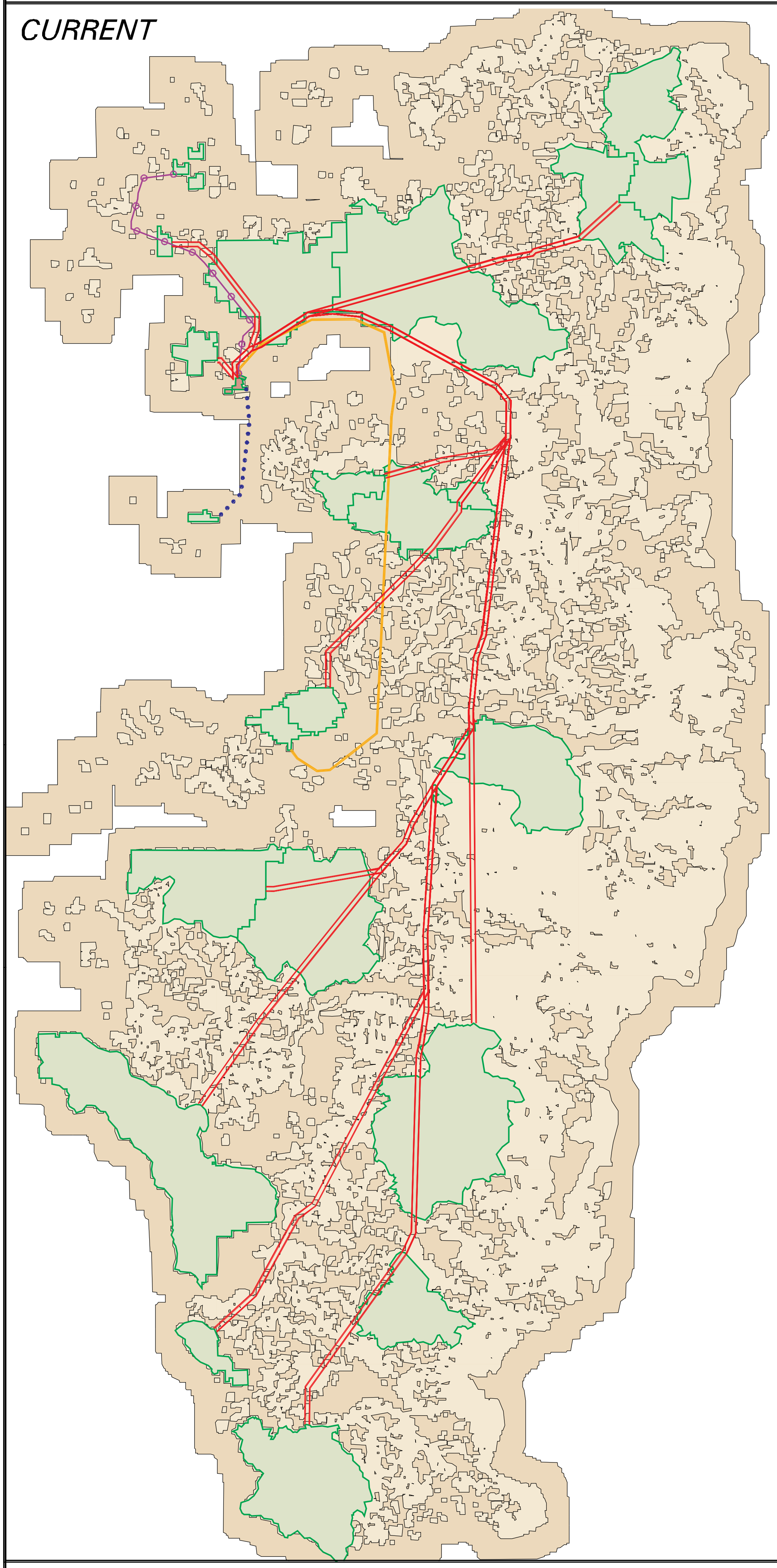
Willamette N.F. GIS Shop. 04/14/98

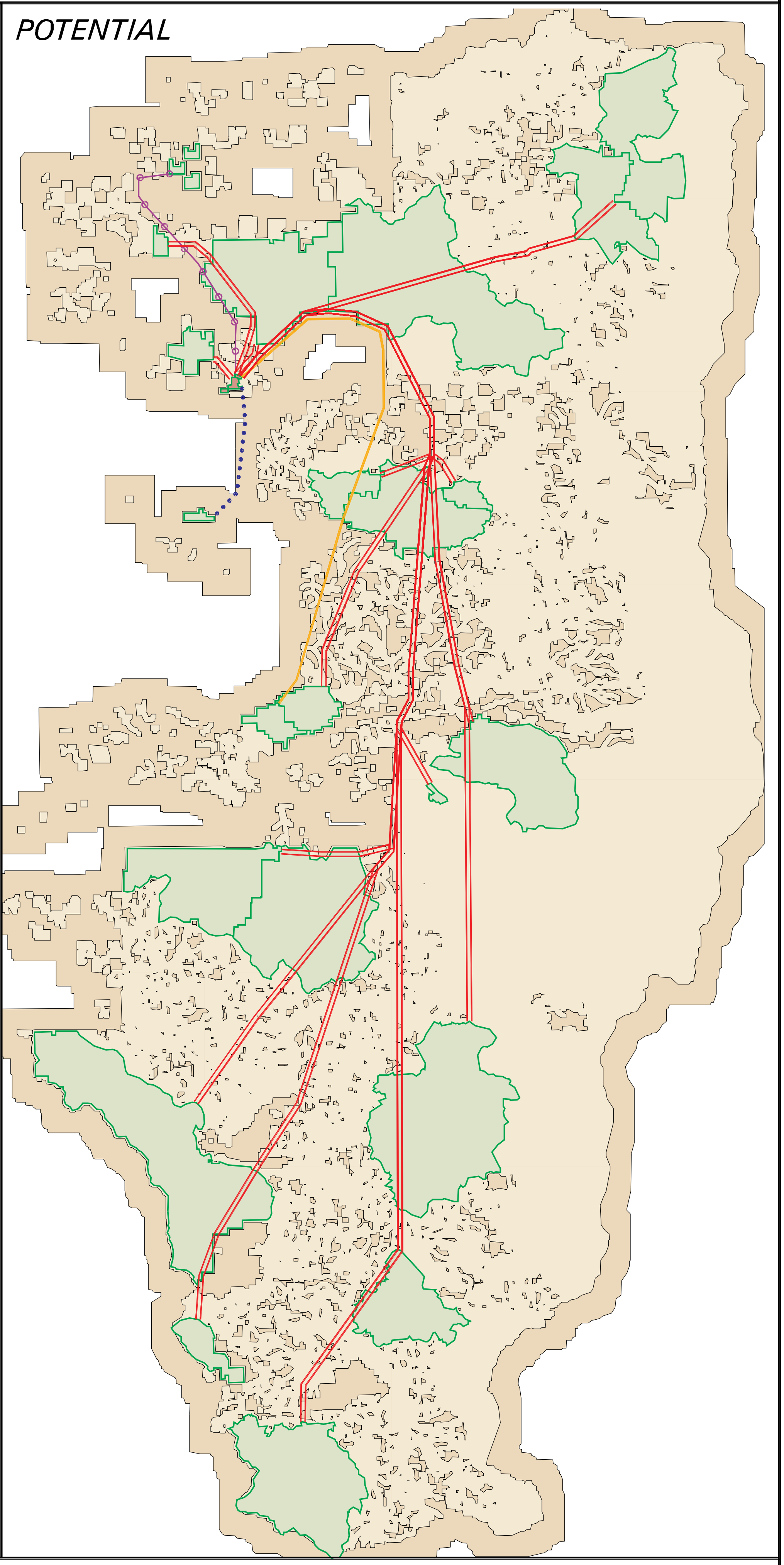
LOCATION MAP
State of Oregon



Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

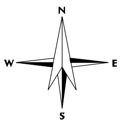
RO 212: WHITCOMB, Small Section





Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

Late Successional Habitat connected at 382 meters.
Late Successional Habitat connected at 4.83 kilometers.



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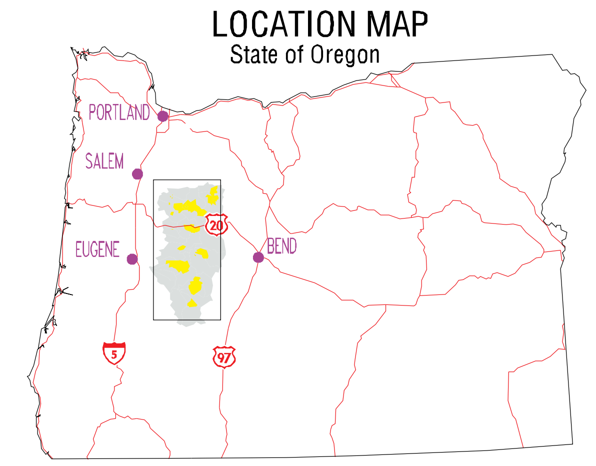
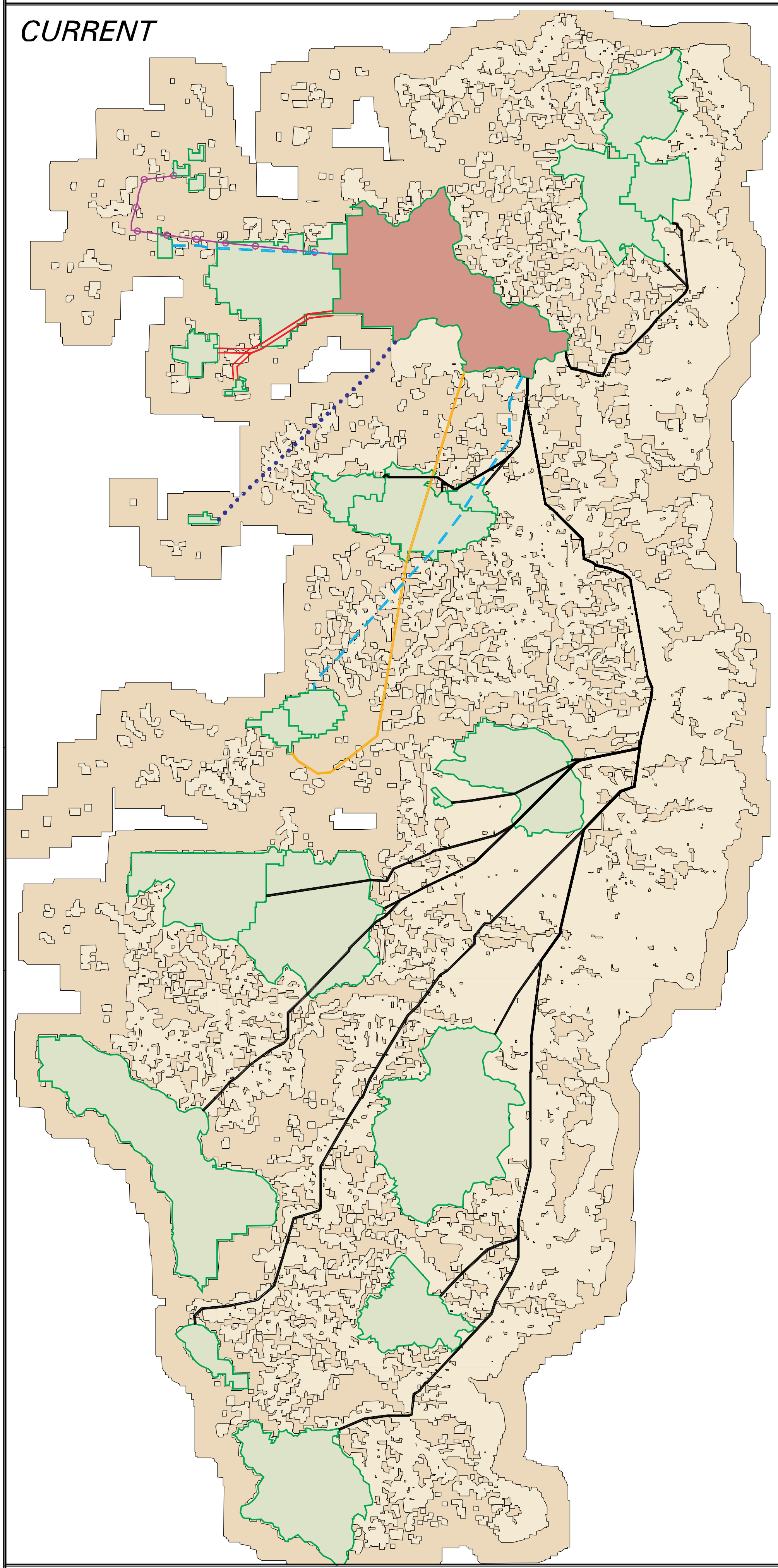
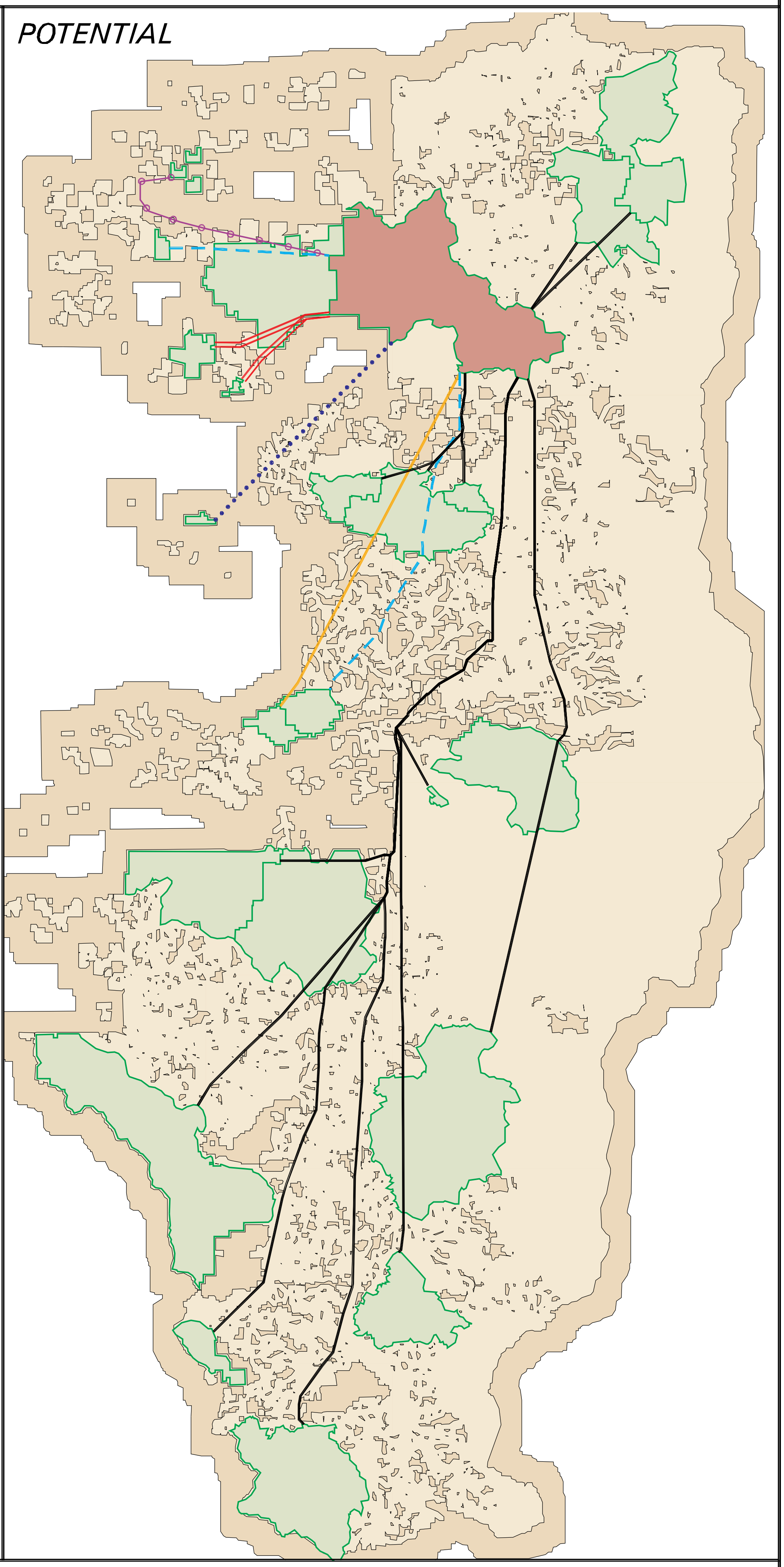


Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 213: QUARTZVILLE, Forest Service





- Connectivity at 382 meters.
- Connectivity at 763 meters.
- Connectivity at 891 meters.
- Connectivity at 1.65 kilometers.
- Connectivity at 1.91 kilometers.
- Connectivity at 4.83 kilometers.
- Late Successional Habitat connected at 382 meters.
- Late Successional Habitat connected at 4.83 kilometers.

N W E S

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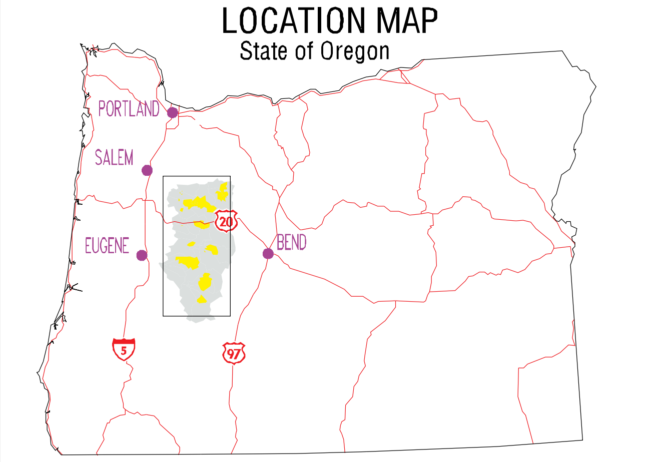
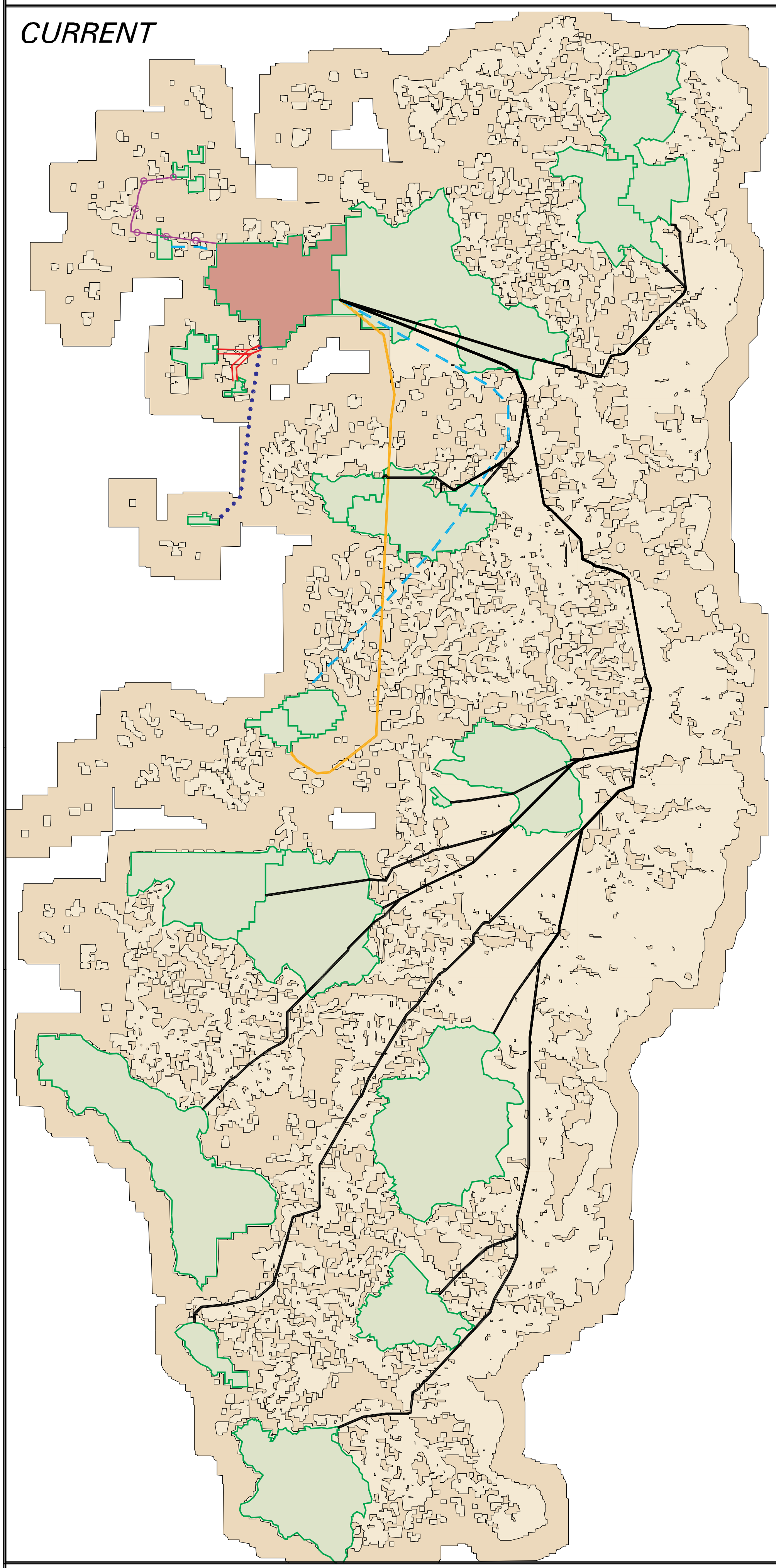
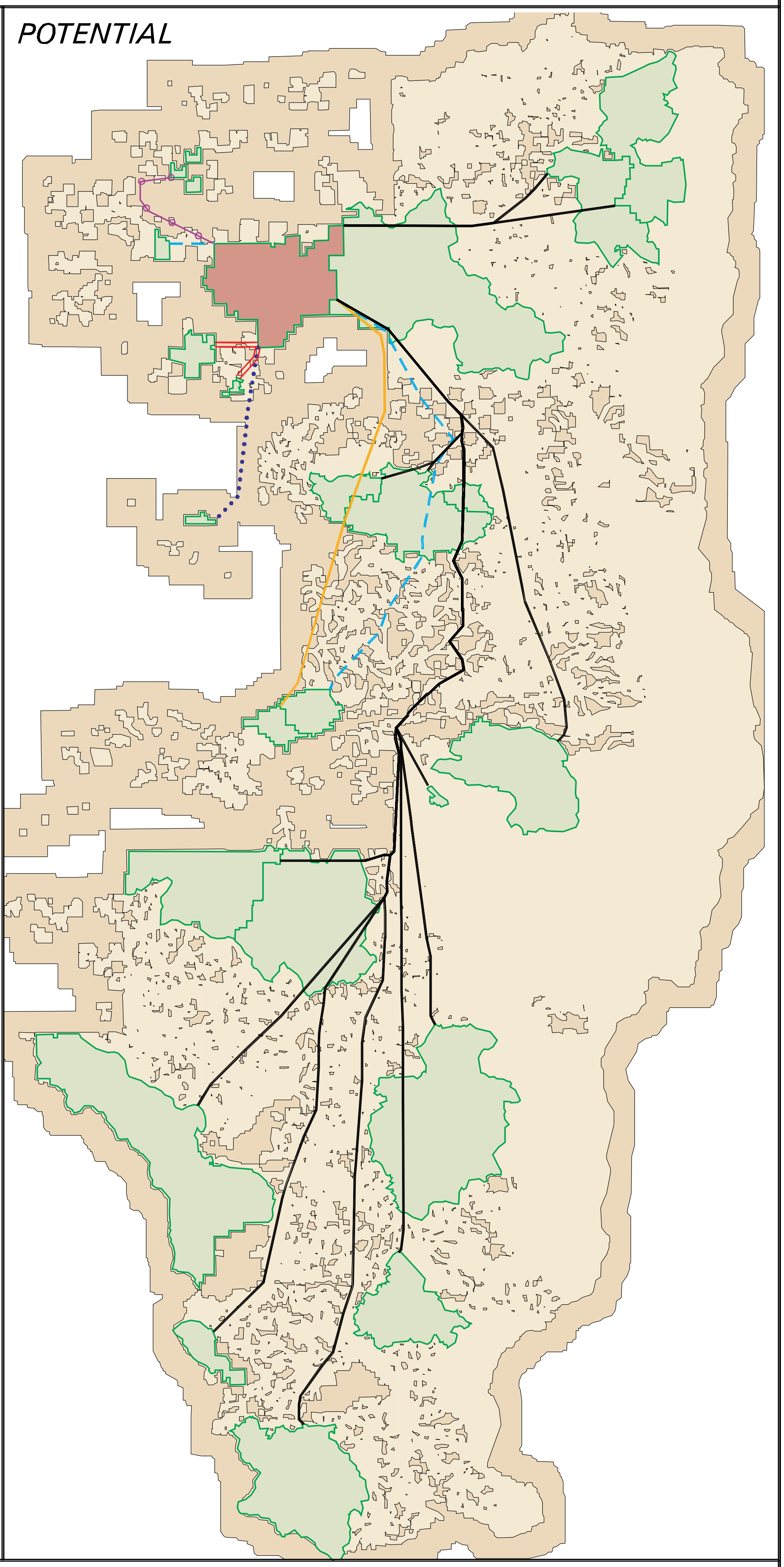


Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

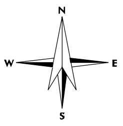
RO 213: QUARTZVILLE, BLM



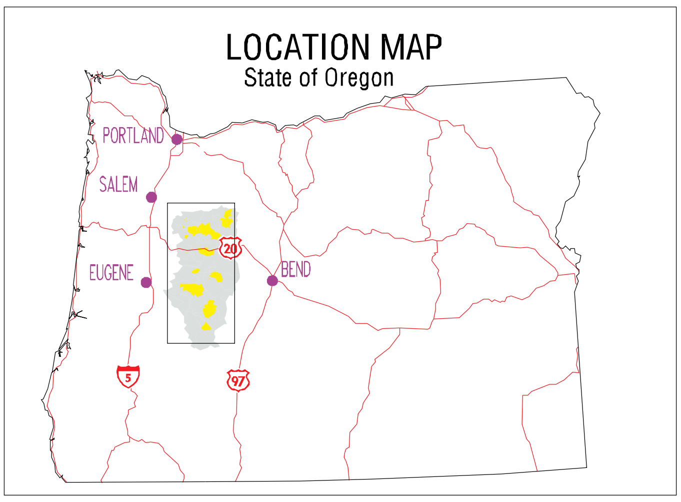


Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

Late Successional Habitat connected at 382 meters.
Late Successional Habitat connected at 4.83 kilometers.

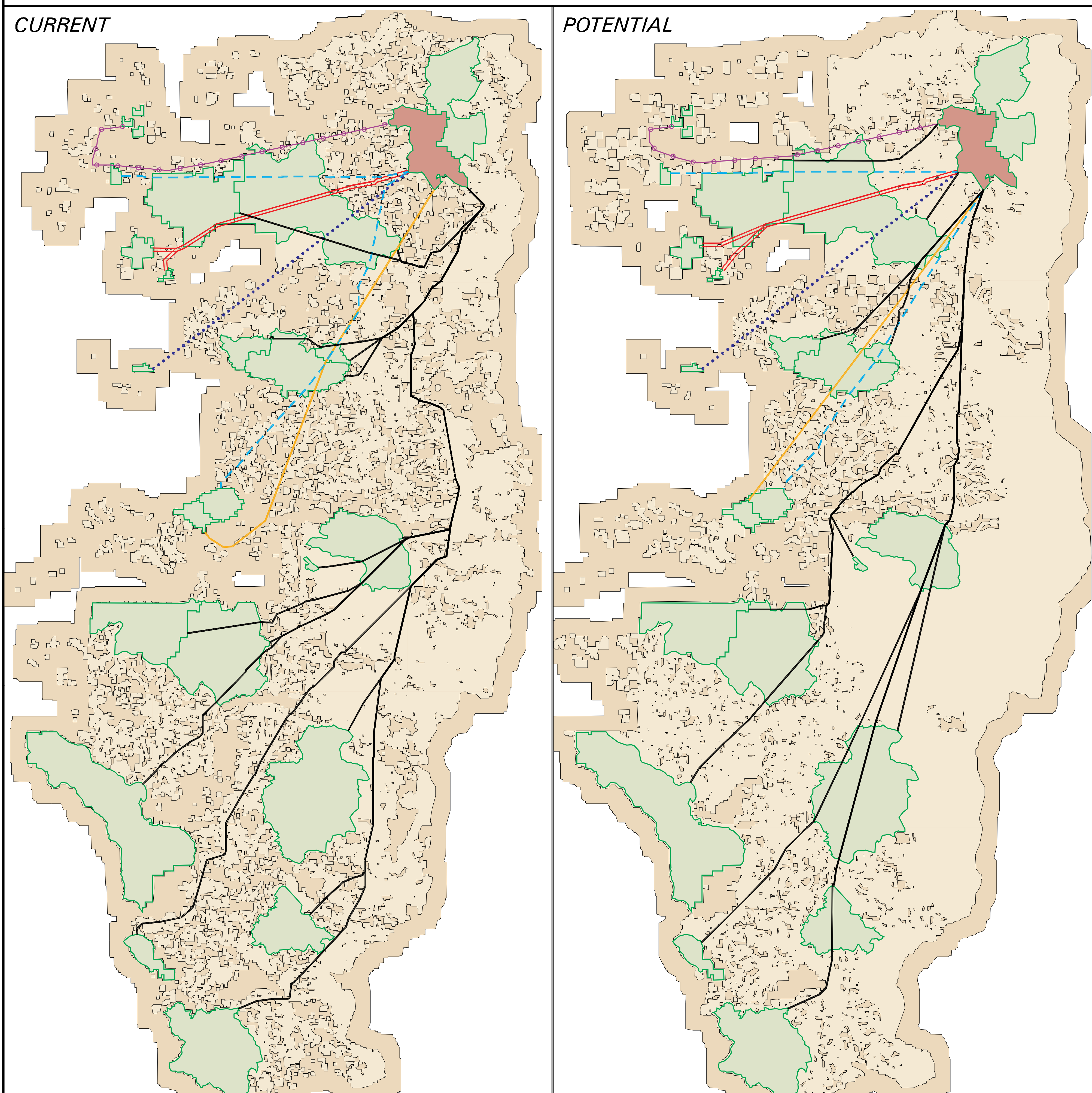


Willamette N.F. GIS Shop. 03/30/98



Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 214: JEFFERSON, Southern Section



	Connectivity at 382 meters.
	Connectivity at 763 meters.
	Connectivity at 891 meters.
	Connectivity at 1.65 kilometers.
	Connectivity at 1.91 kilometers.
	Connectivity at 4.83 kilometers.
	Late Successional Habitat connected at 382 meters.
	Late Successional Habitat connected at 4.83 kilometers.

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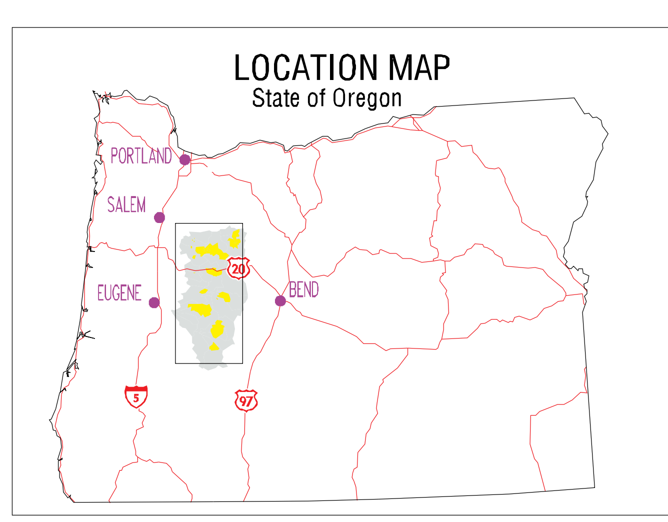
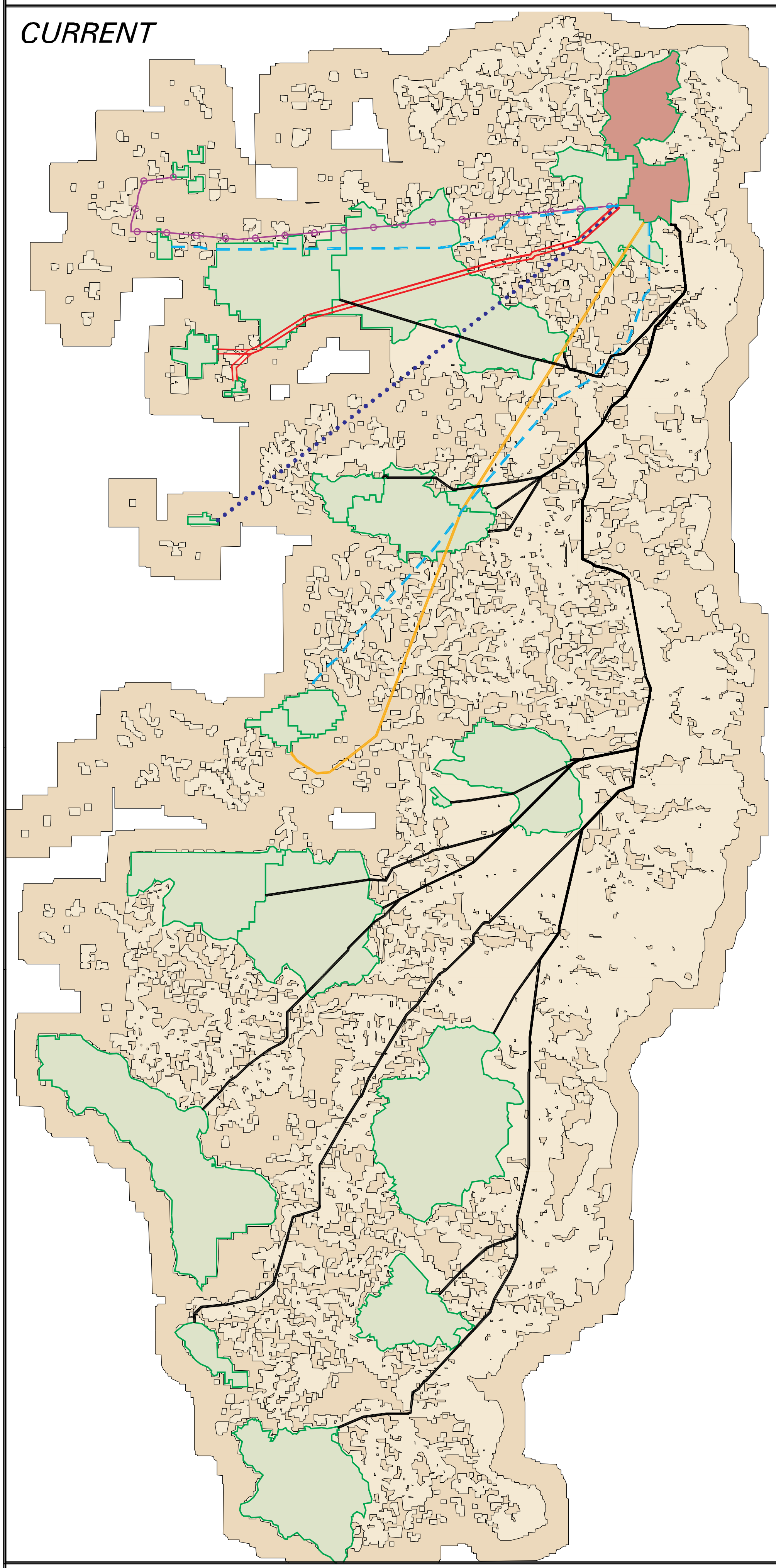
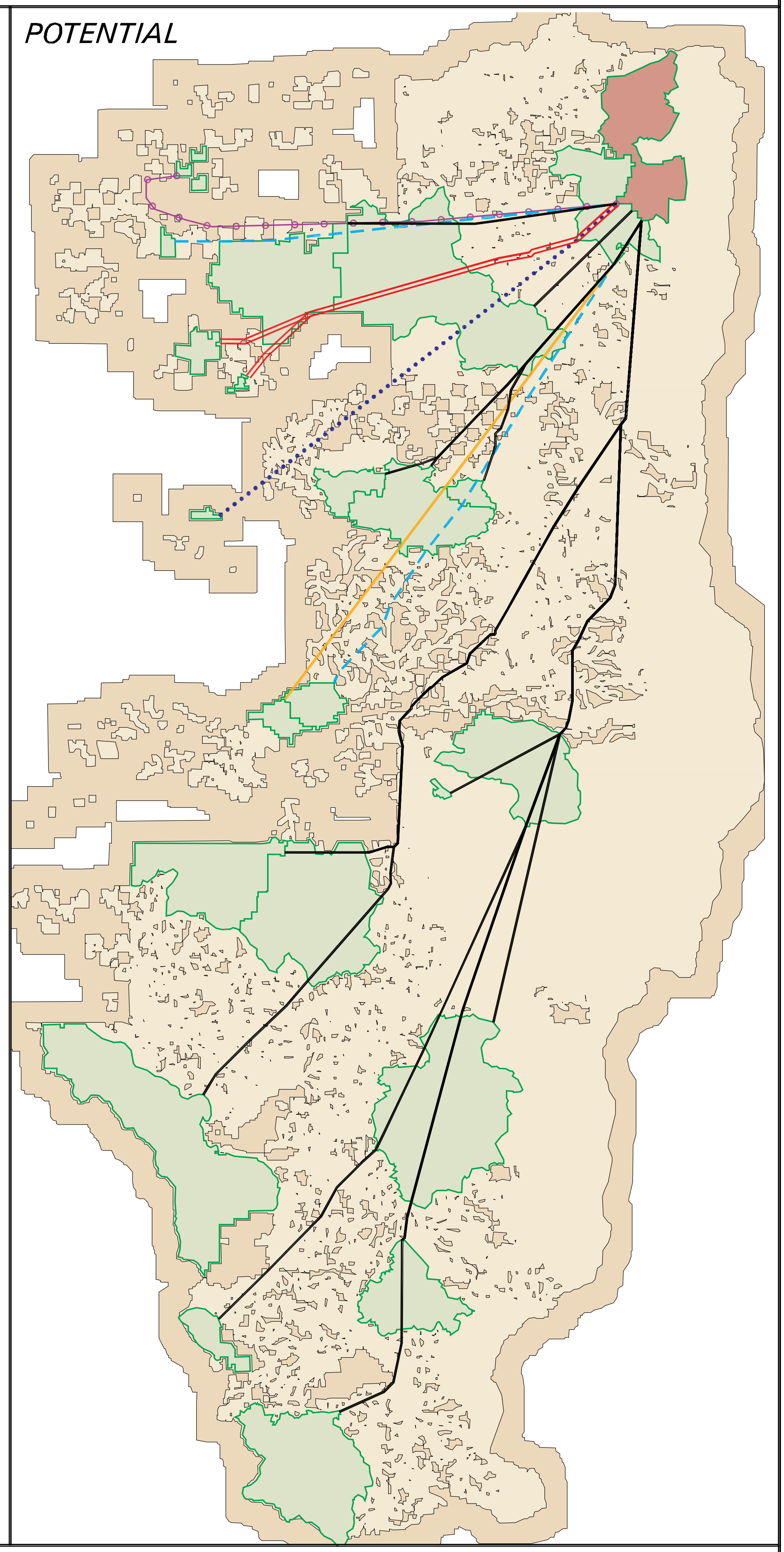


Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

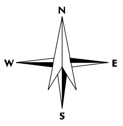
RO 214: JEFFERSON, Northern Section





Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

Late Successional Habitat connected at 382 meters.
Late Successional Habitat connected at 4.83 kilometers.



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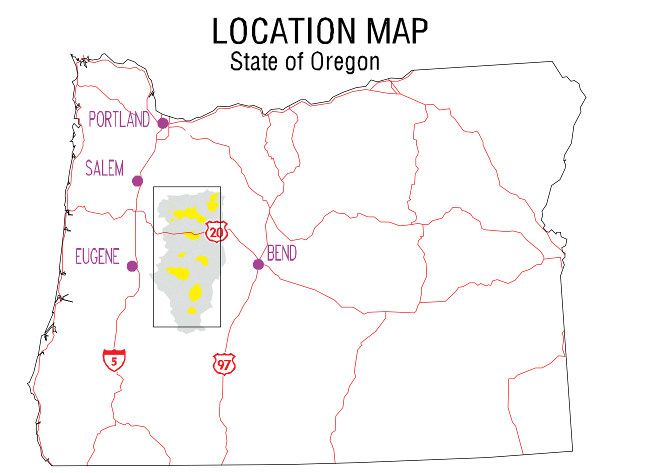
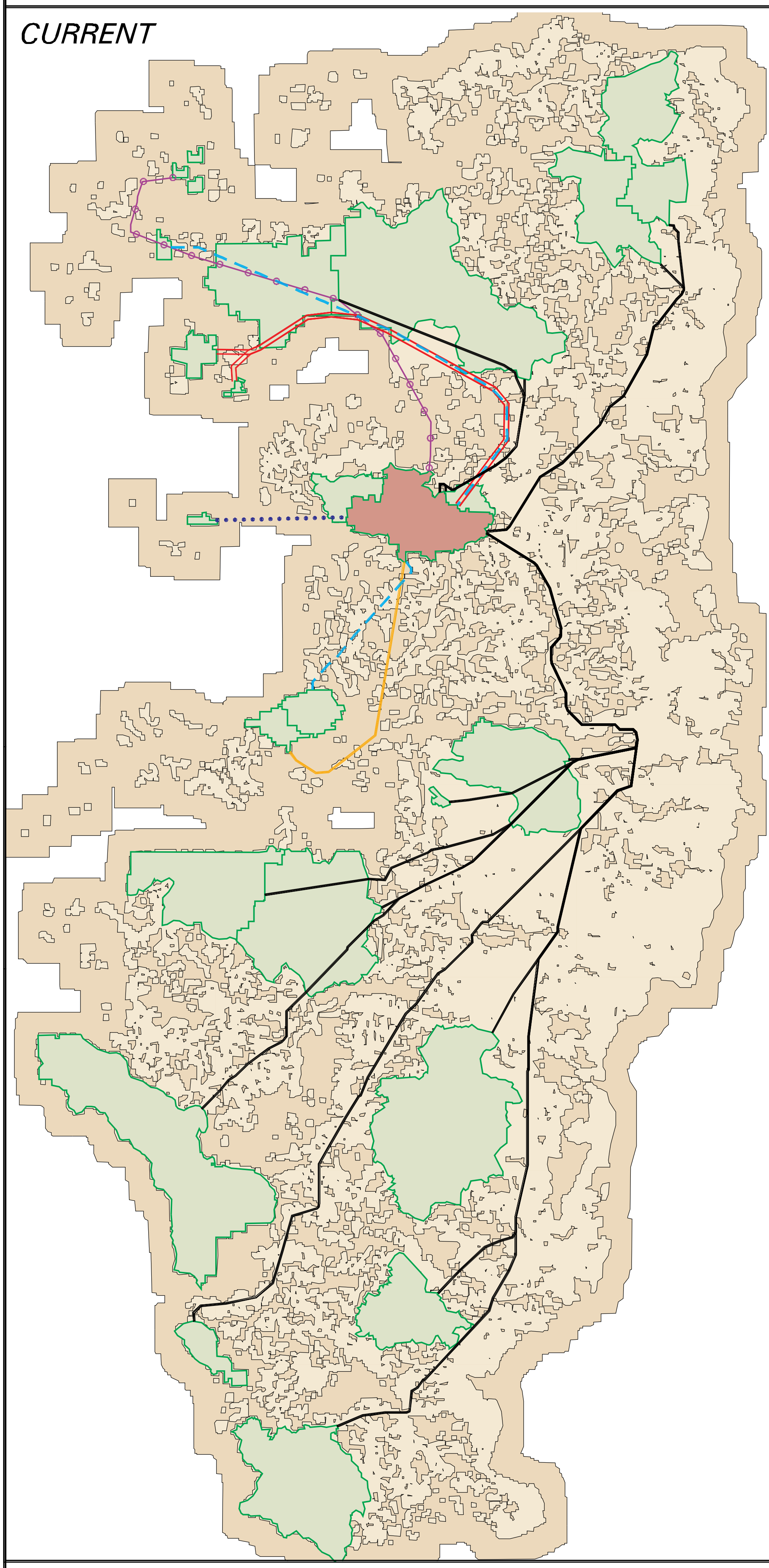


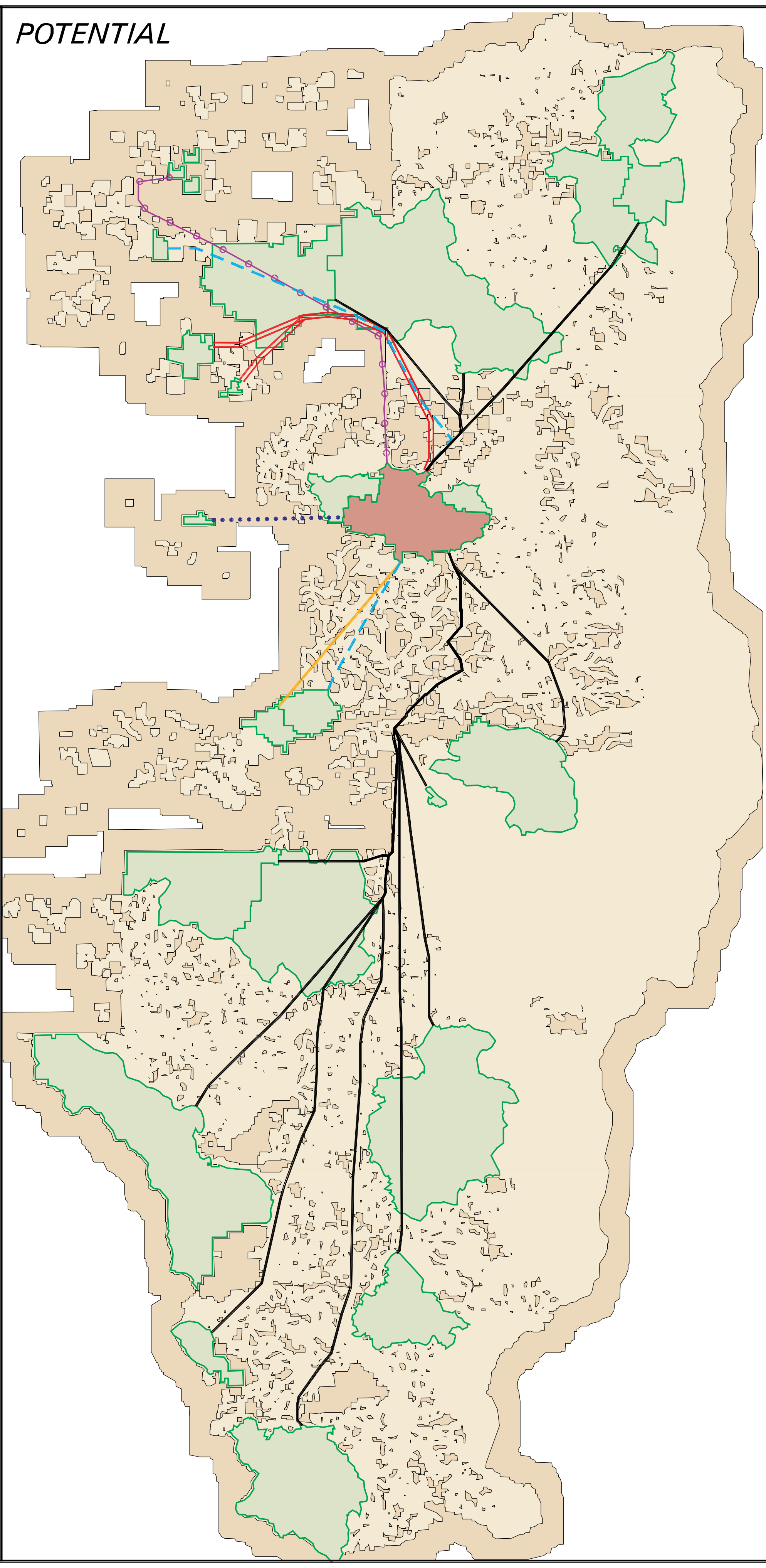
Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 215: SOUTH SANTIAM, Center Section

CURRENT

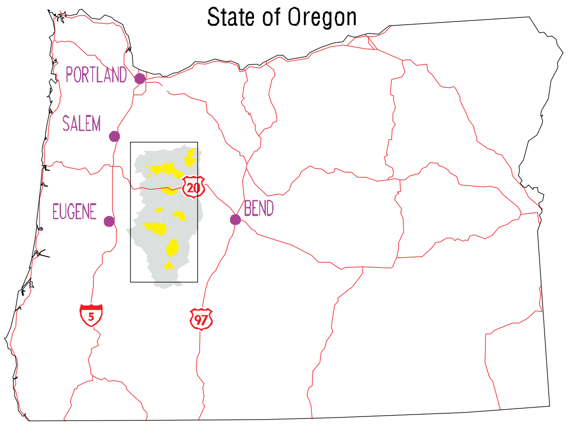


POTENTIAL



- Connectivity at 382 meters.
- Connectivity at 763 meters.
- Connectivity at 891 meters.
- Connectivity at 1.65 kilometers.
- Connectivity at 1.91 kilometers.
- Connectivity at 4.83 kilometers.
- Late Successional Habitat connected at 382 meters.
- Late Successional Habitat connected at 4.83 kilometers.

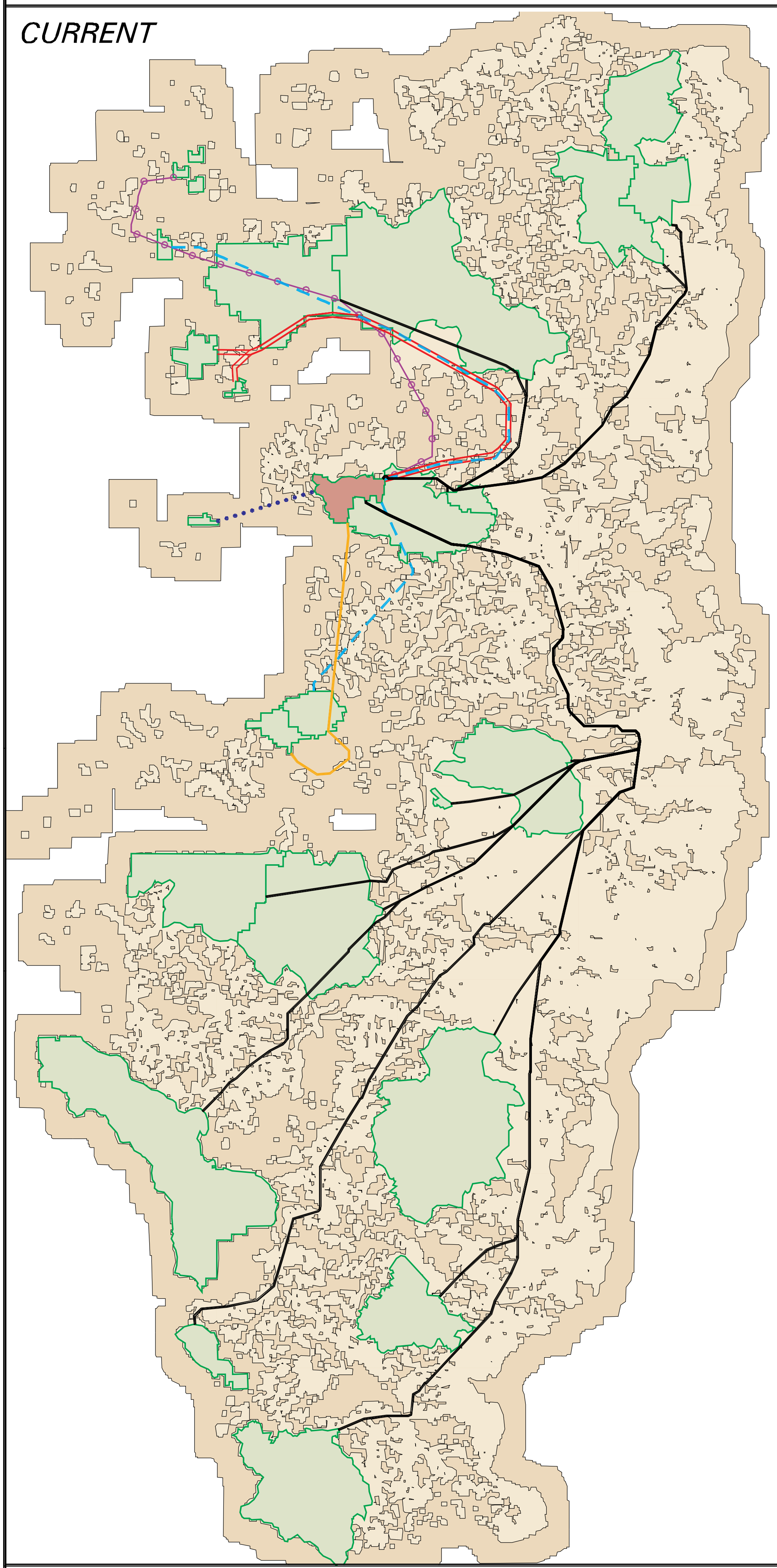
LOCATION MAP
State of Oregon



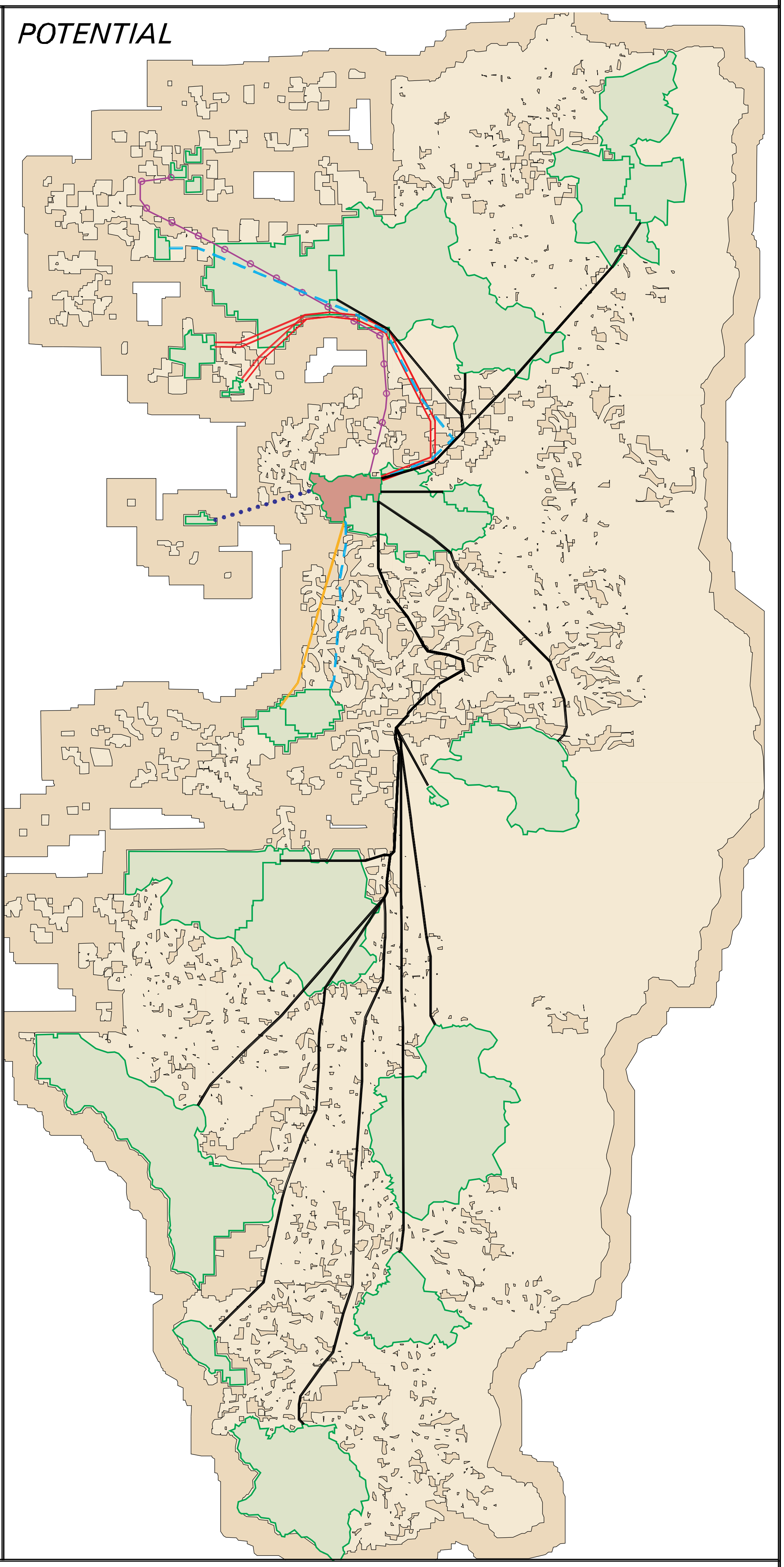
Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

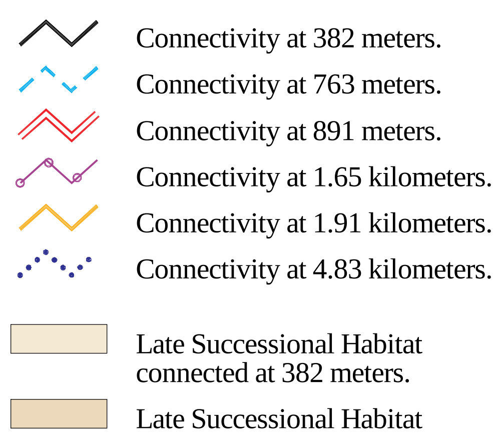
RO 215: SOUTH SANTIAM, Western Section

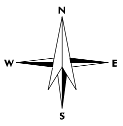
CURRENT



POTENTIAL







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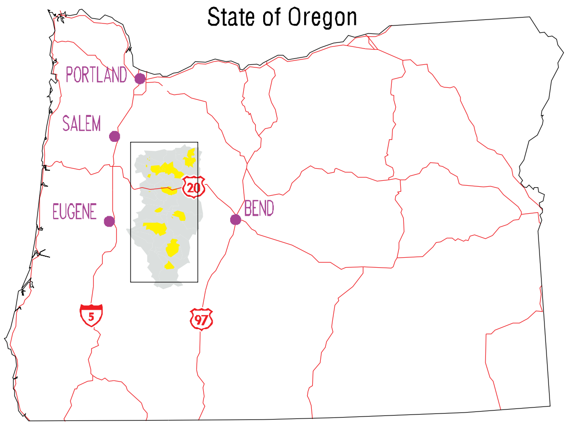
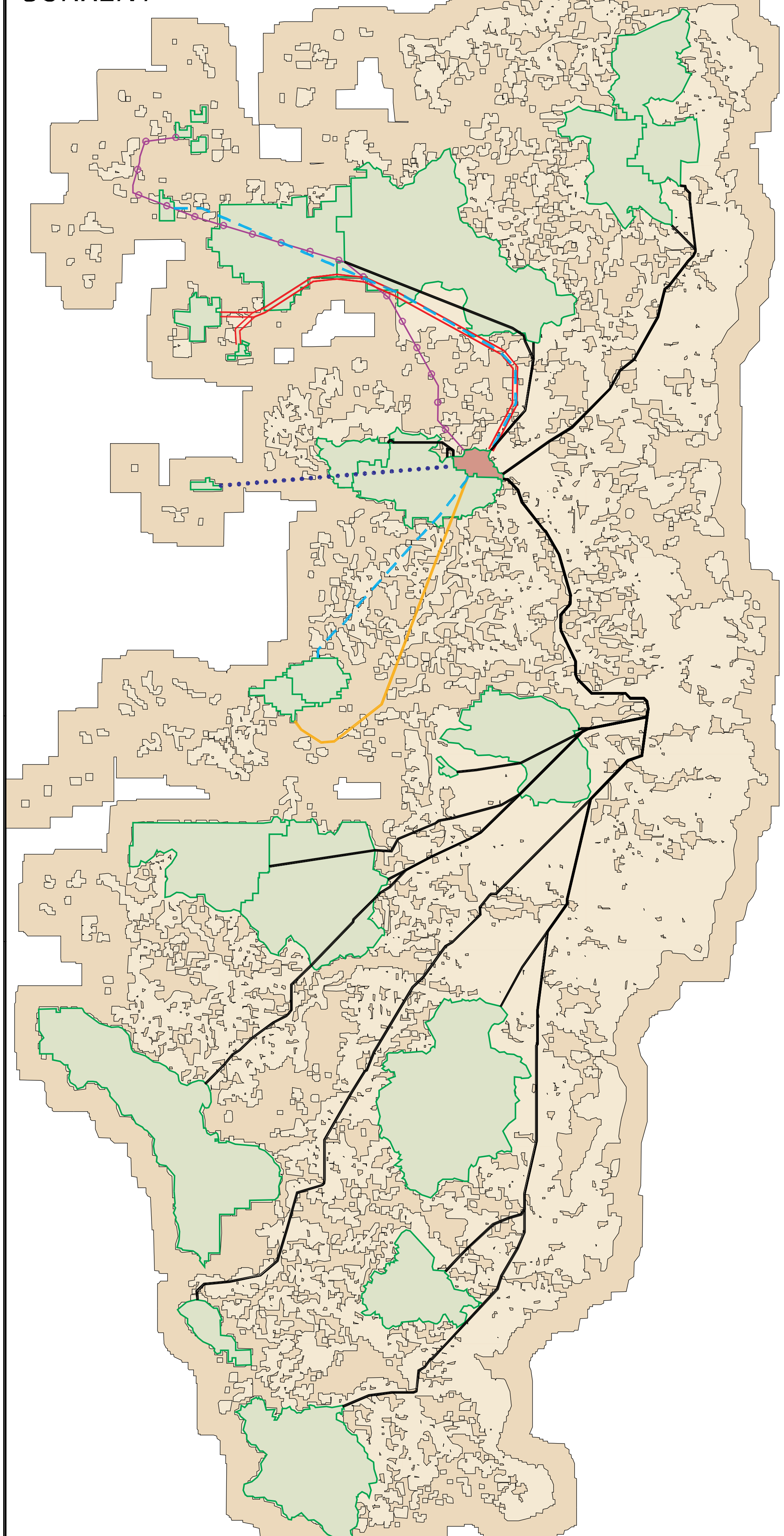
LOCATION MAP
State of Oregon



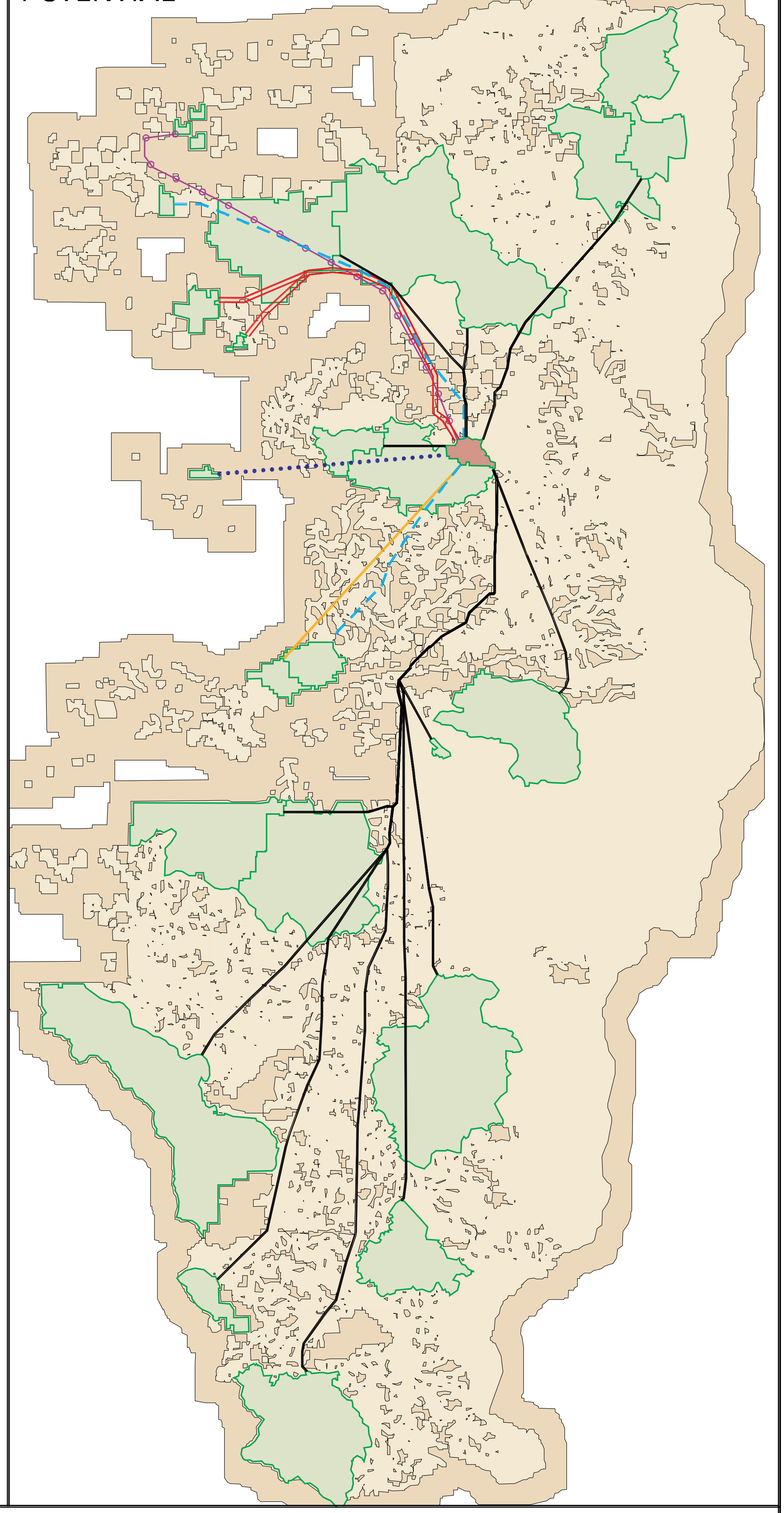
Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 215: SOUTH SANTIAM, Eastern Section

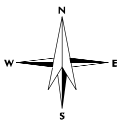
CURRENT



POTENTIAL



- Connectivity at 382 meters.
- Connectivity at 763 meters.
- Connectivity at 891 meters.
- Connectivity at 1.65 kilometers.
- Connectivity at 1.91 kilometers.
- Connectivity at 4.83 kilometers.
- Late Successional Habitat connected at 382 meters.
- Late Successional Habitat connected at 4.83 kilometers.



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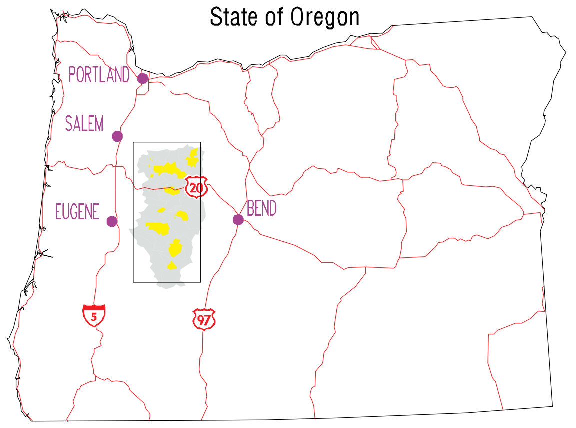
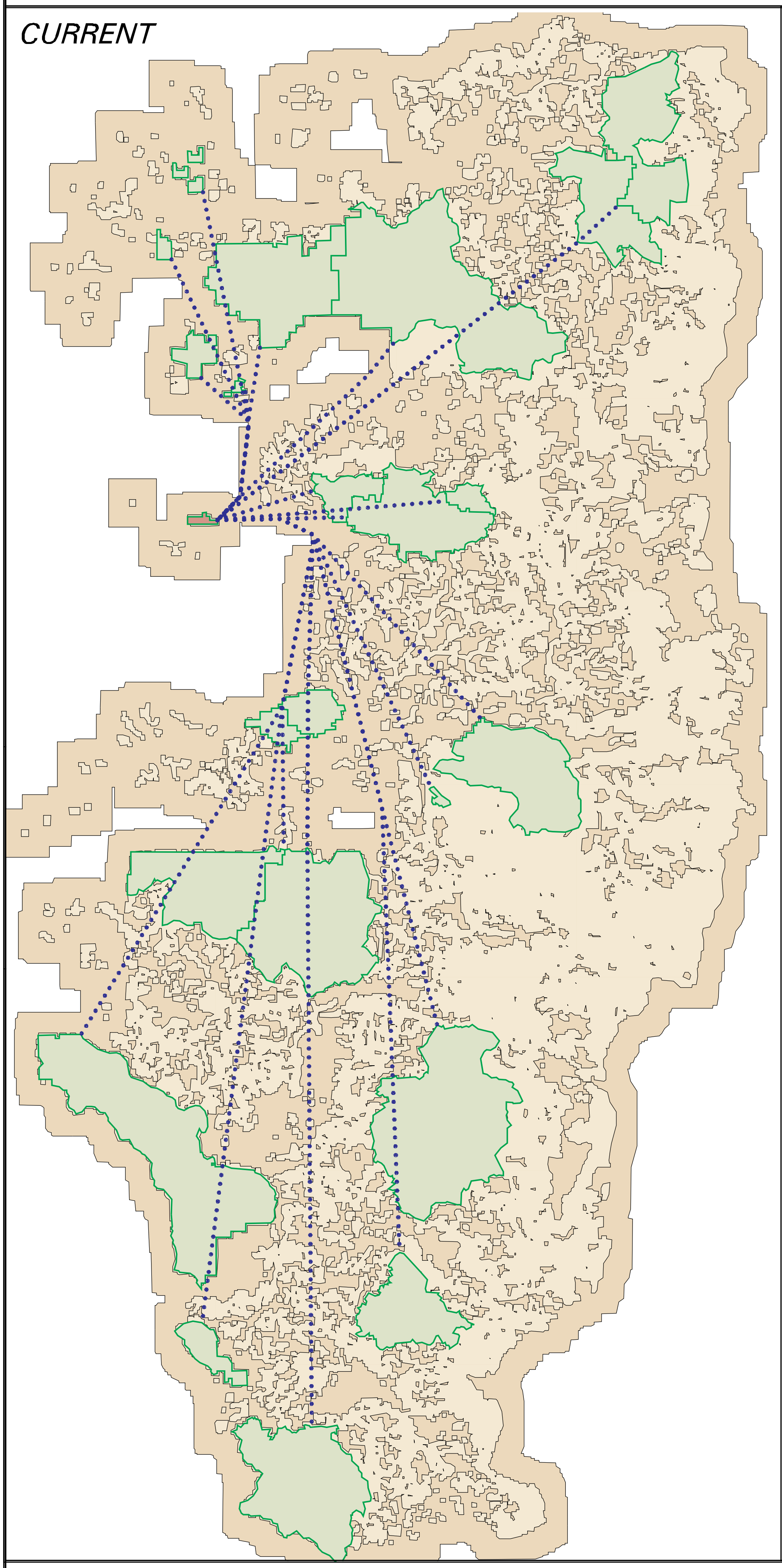
LOCATION MAP

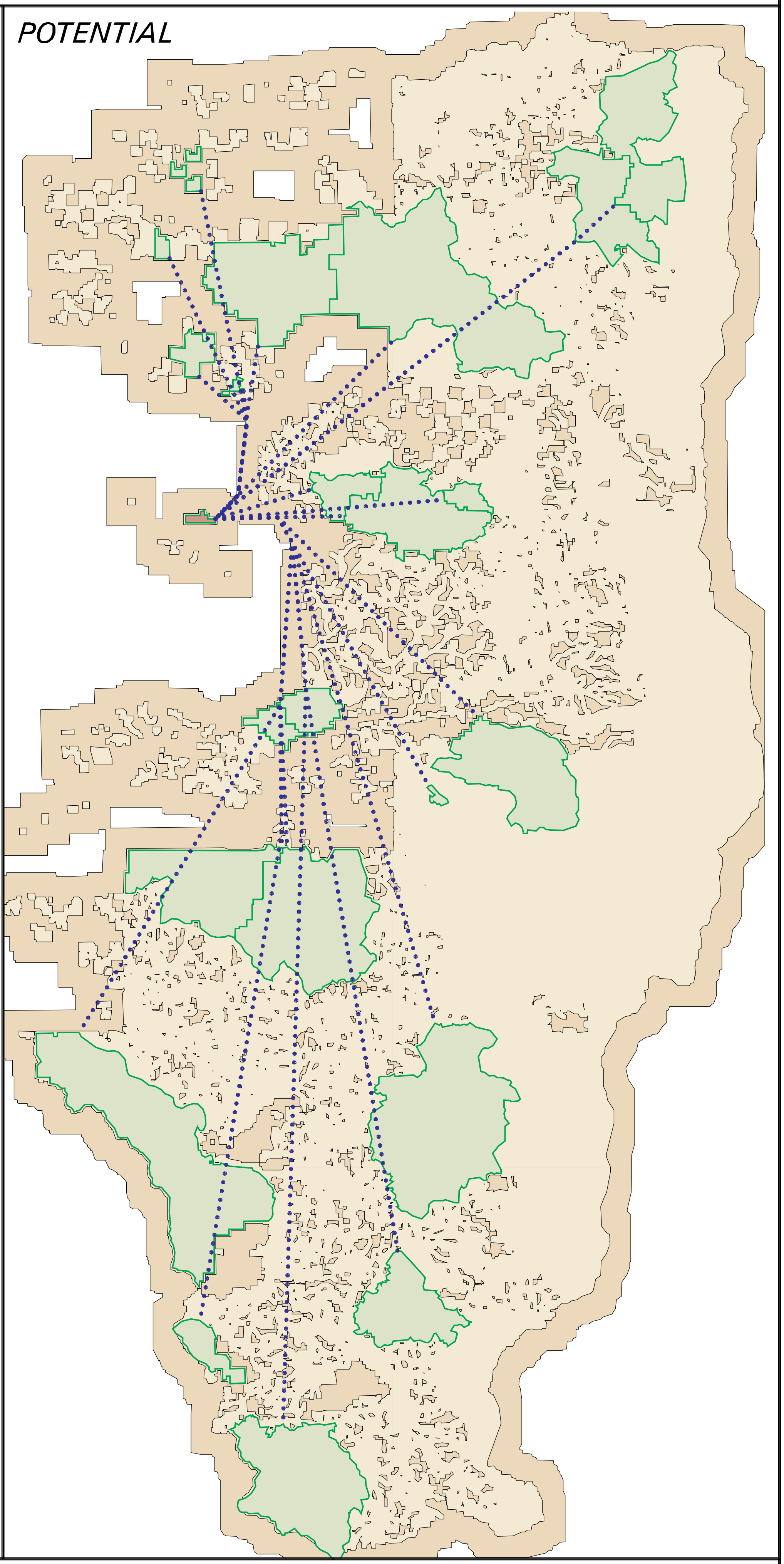
State of Oregon



Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 216: WILEY





Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

Late Successional Habitat connected at 382 meters.
Late Successional Habitat connected at 4.83 kilometers.

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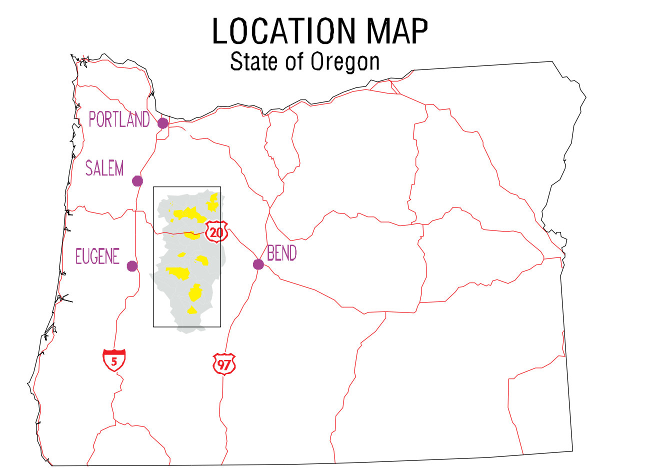
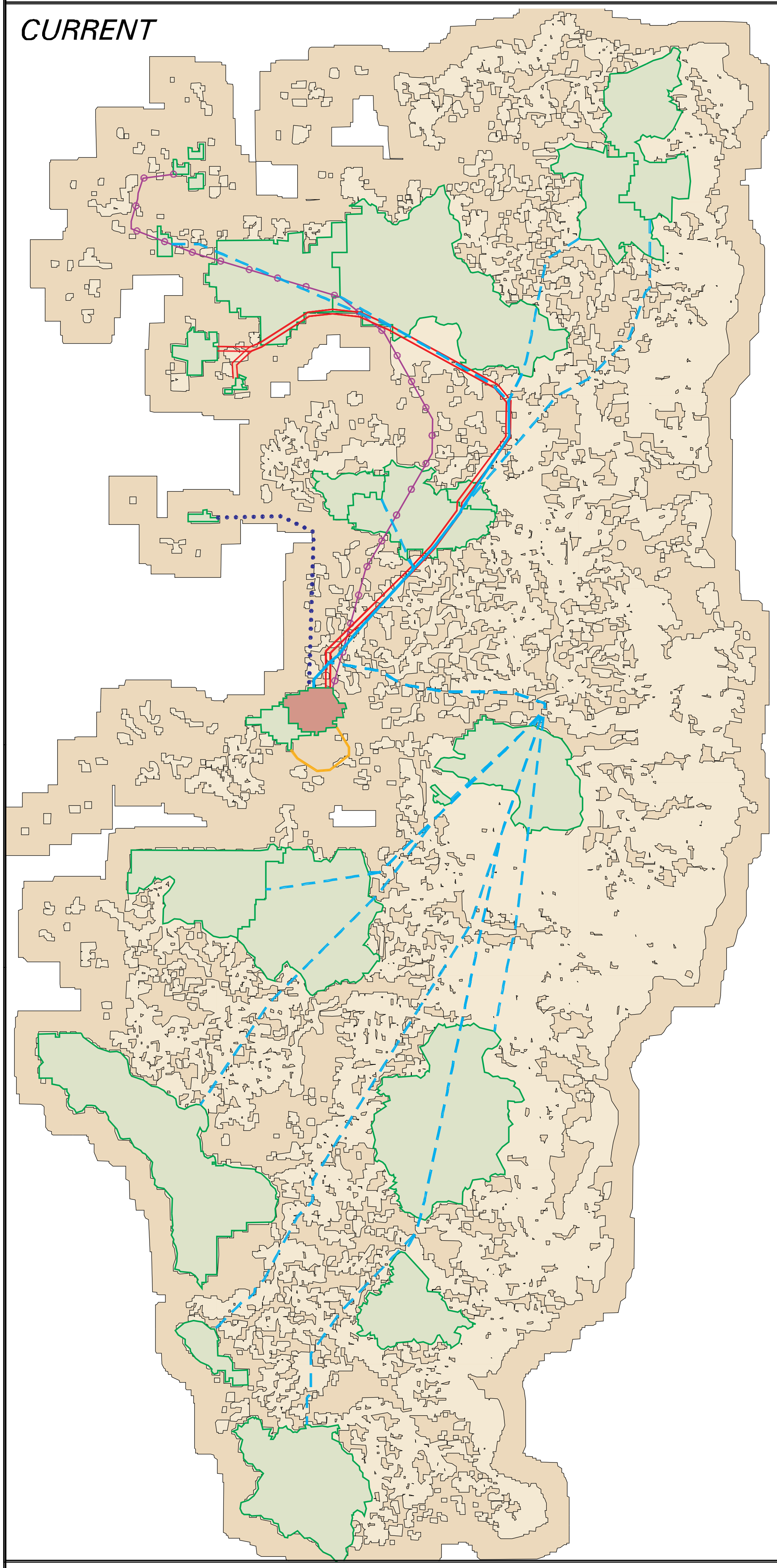


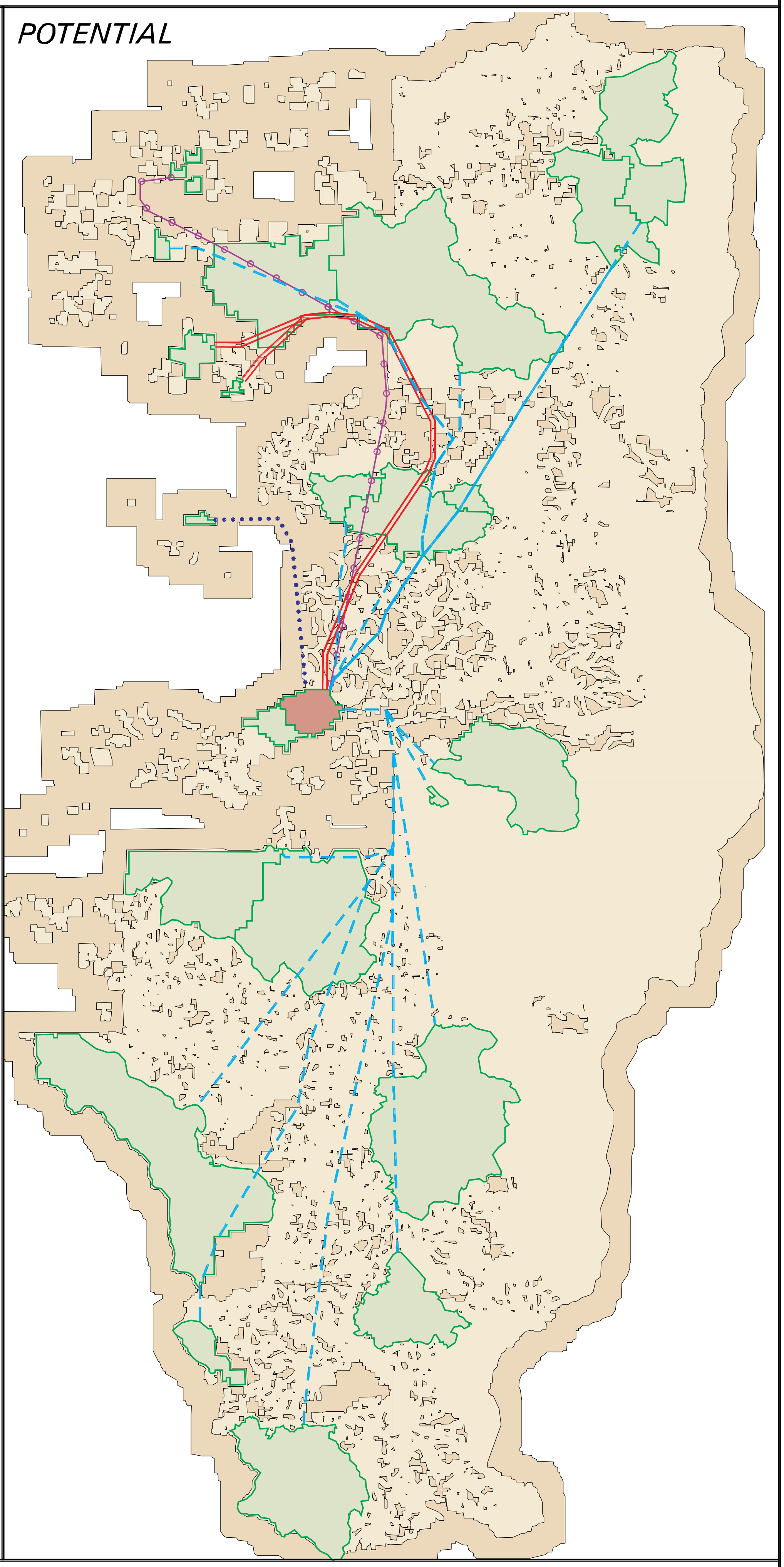
Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 217: HAGAN, Eastern Section

CURRENT

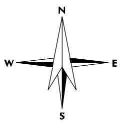


POTENTIAL



Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

Late Successional Habitat connected at 382 meters.
Late Successional Habitat connected at 4.83 kilometers.



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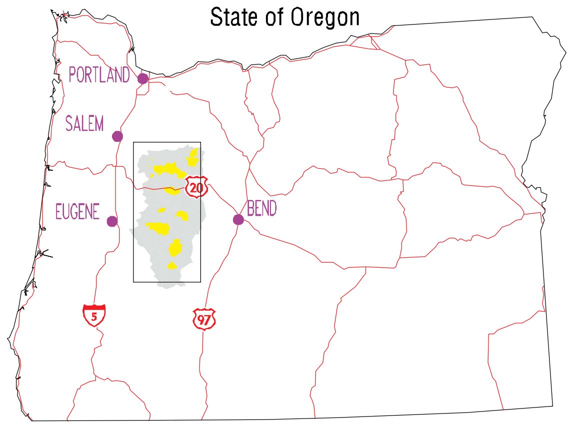
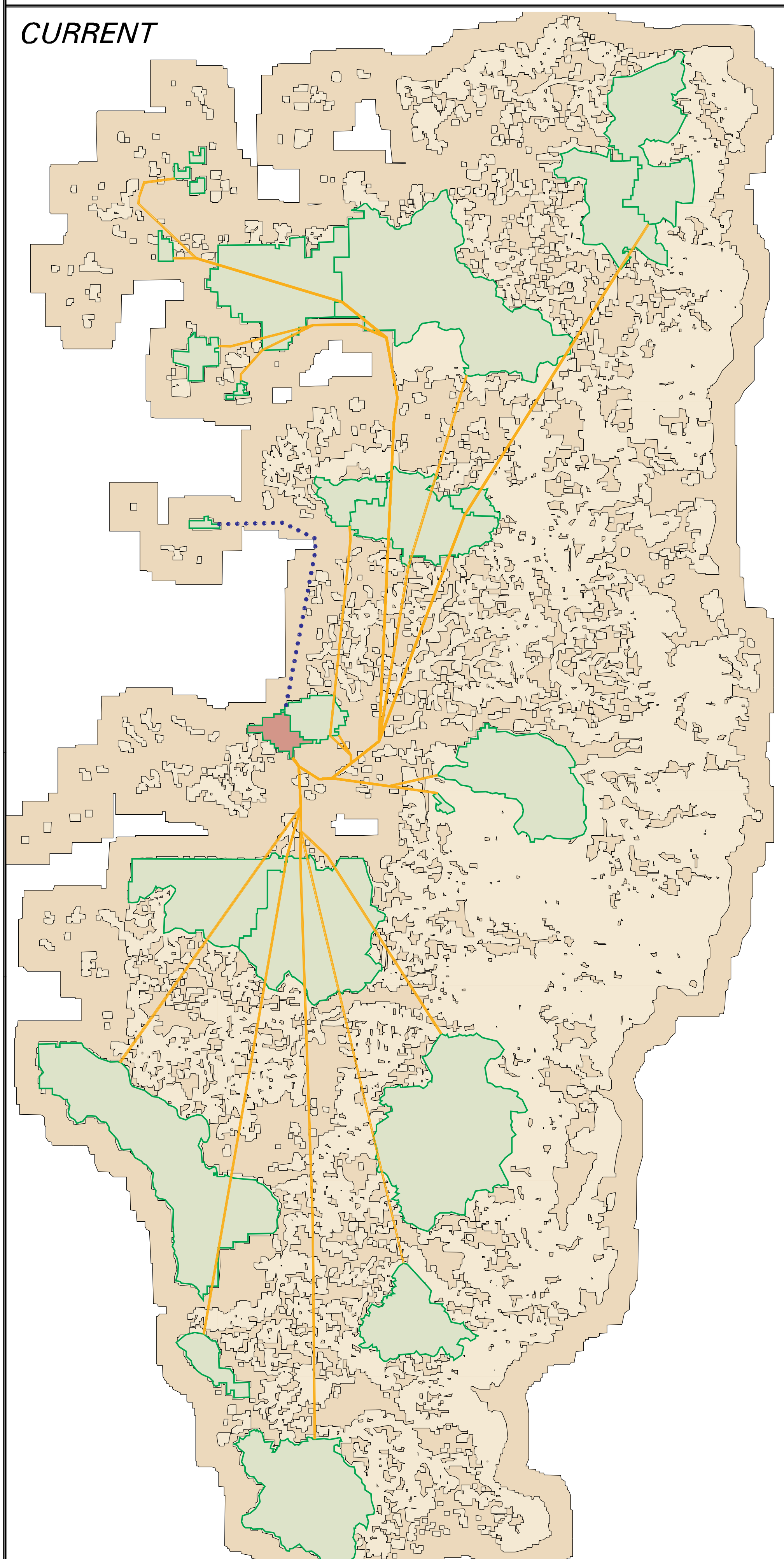
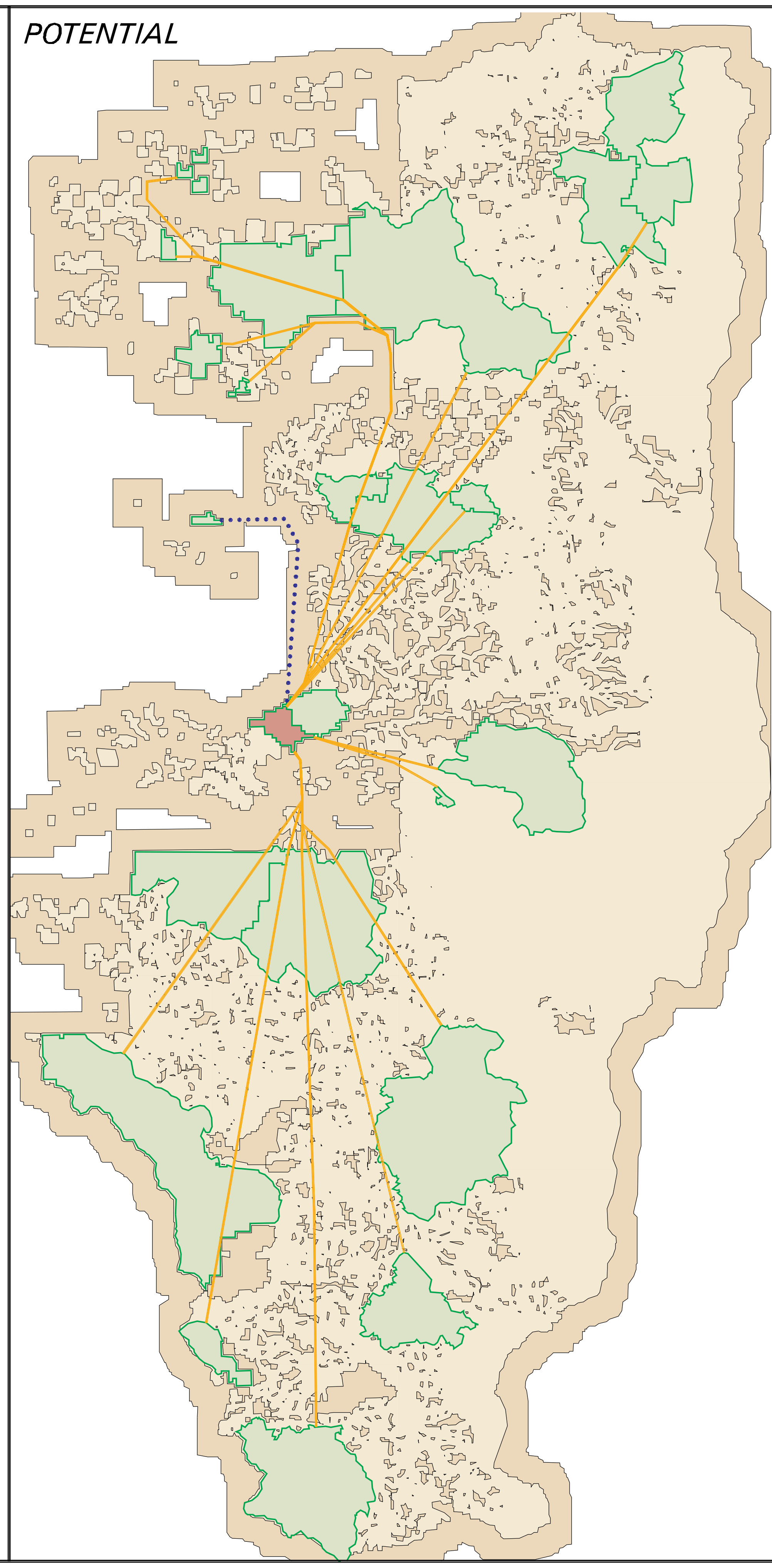
LOCATION MAP
State of Oregon



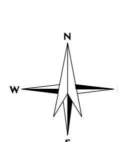
Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 217: HAGAN, Western Section





- Connectivity at 382 meters.
- Connectivity at 763 meters.
- Connectivity at 891 meters.
- Connectivity at 1.65 kilometers.
- Connectivity at 1.91 kilometers.
- Connectivity at 4.83 kilometers.
- Late Successional Habitat connected at 382 meters.
- Late Successional Habitat connected at 4.83 kilometers.



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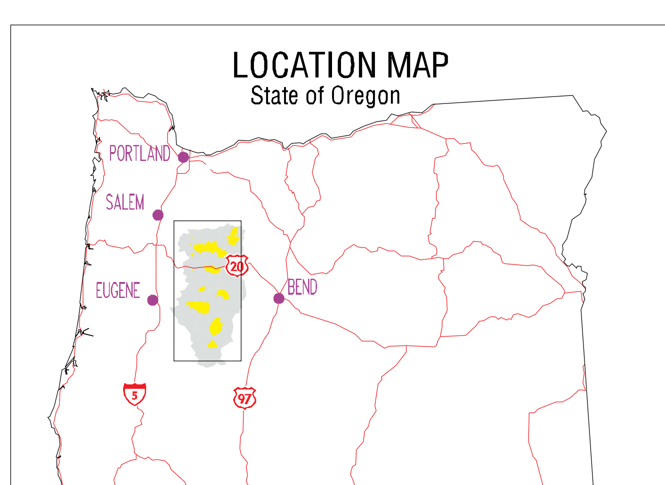
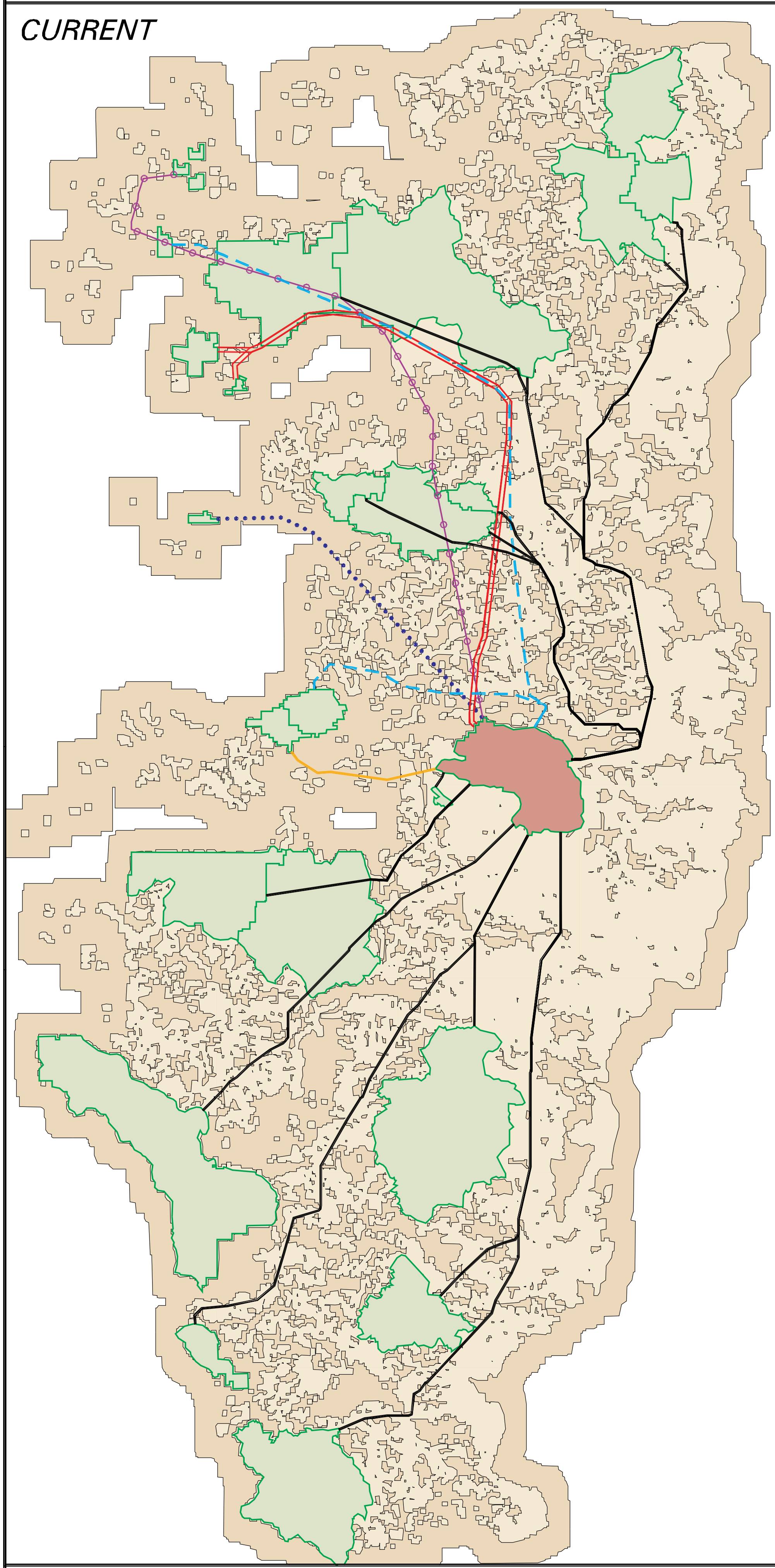
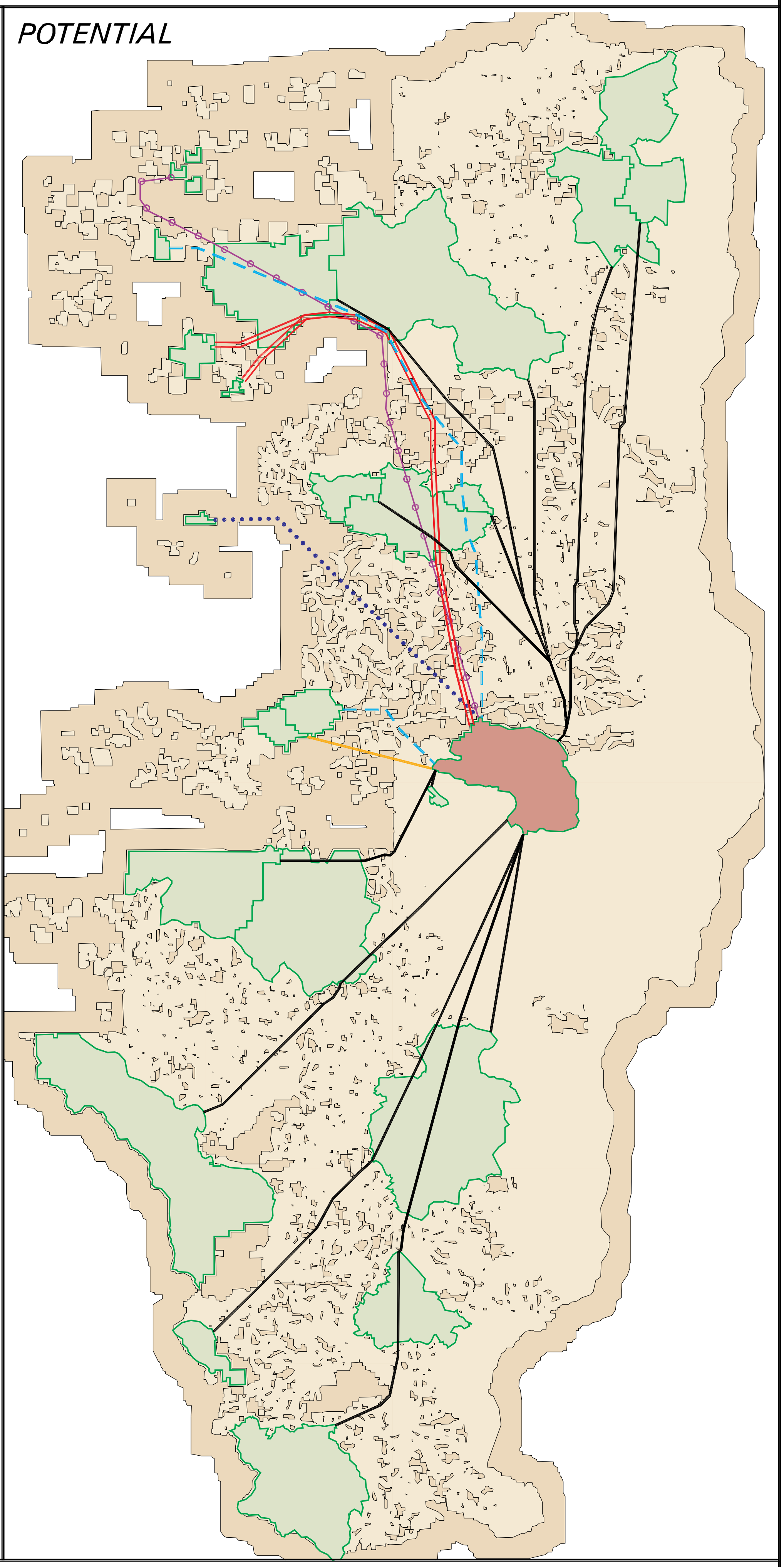


Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 218: HORSE CREEK, Large Section





Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

Late Successional Habitat connected at 382 meters.

Late Successional Habitat connected at 4.83 kilometers.

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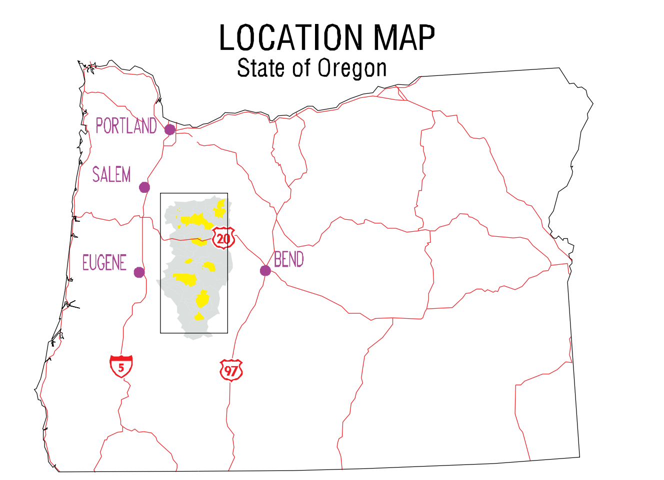
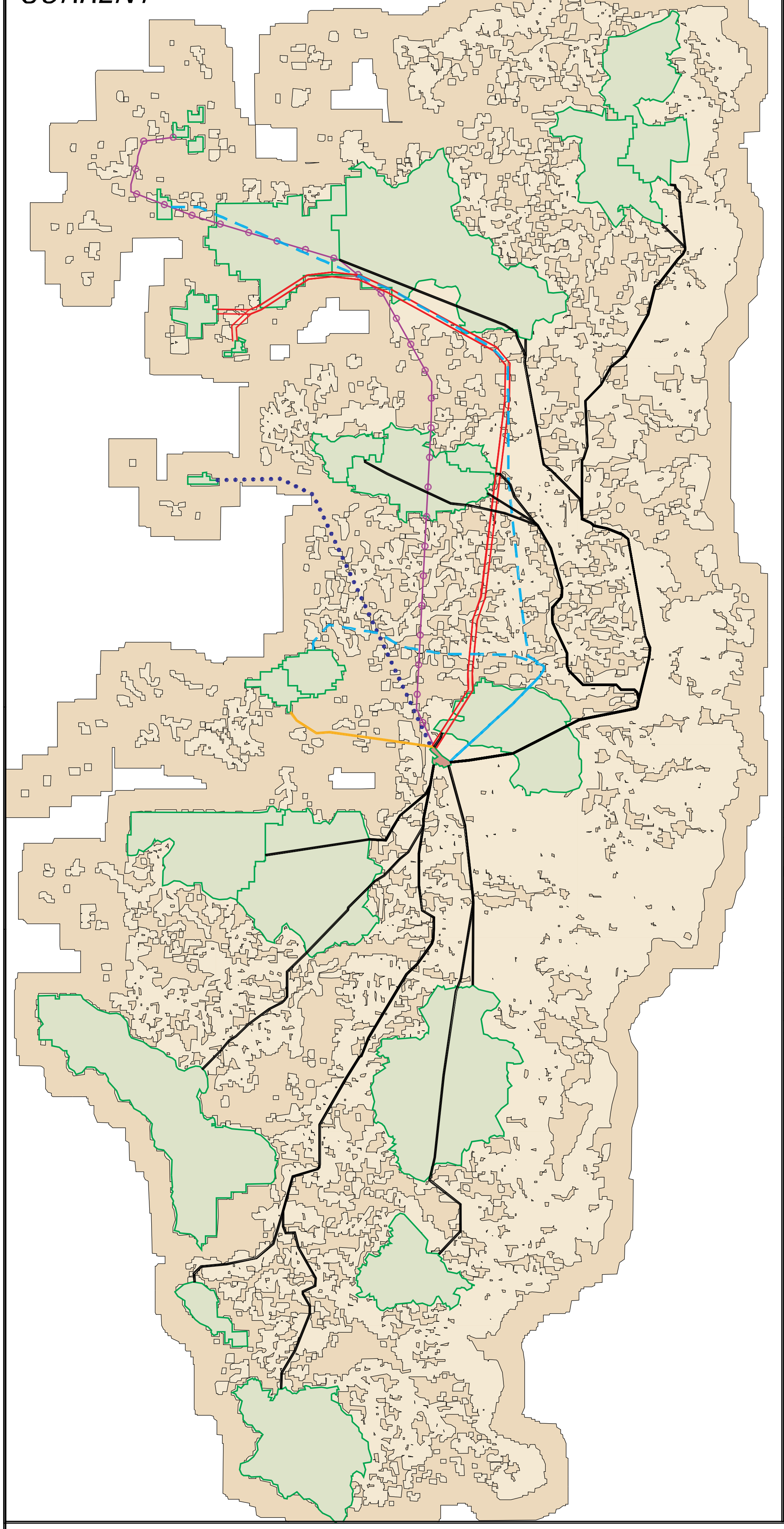


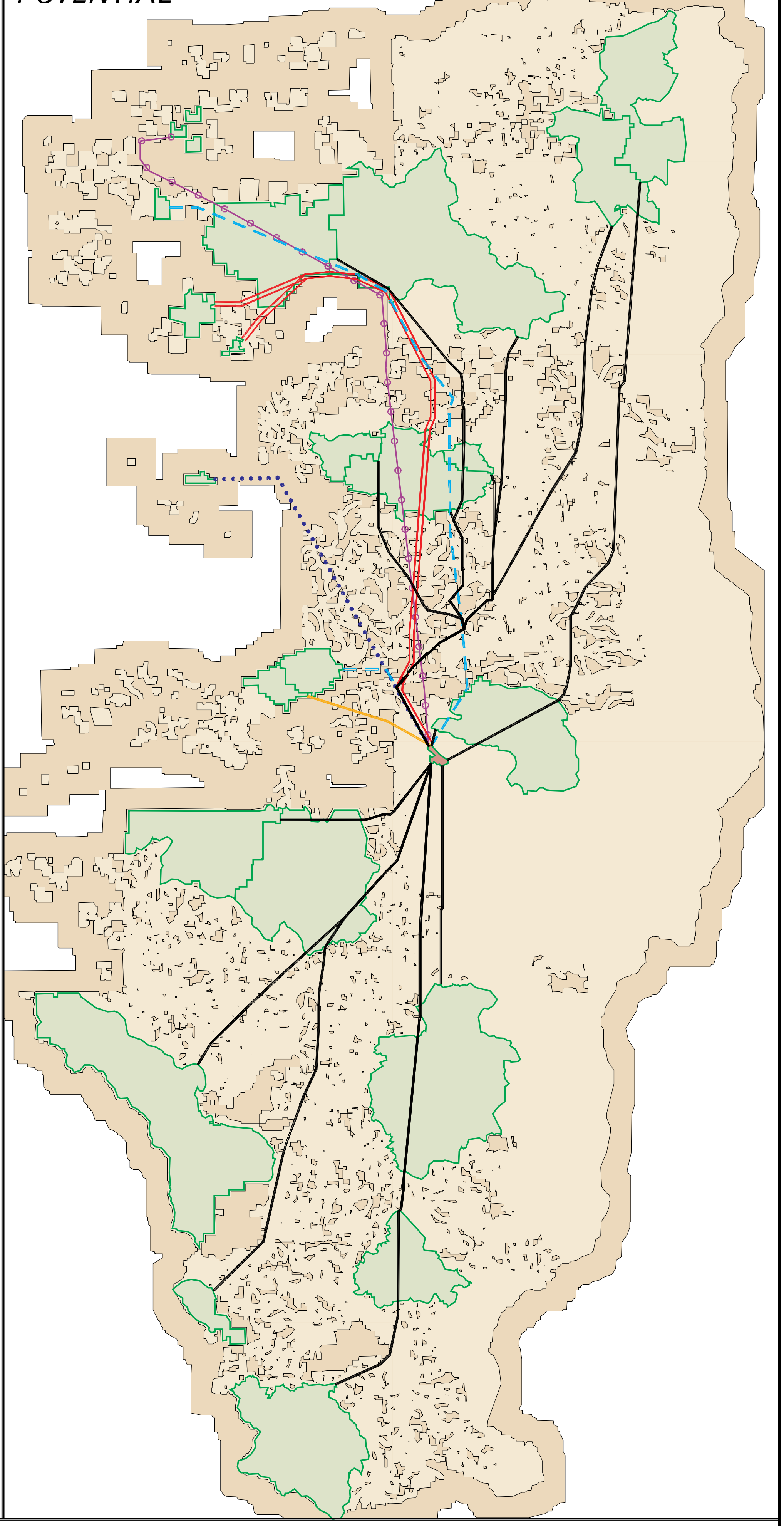
Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 218: HORSE CREEK, Small Section

CURRENT



POTENTIAL



Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

Late Successional Habitat connected at 382 meters.
Late Successional Habitat connected at 4.83 kilometers.

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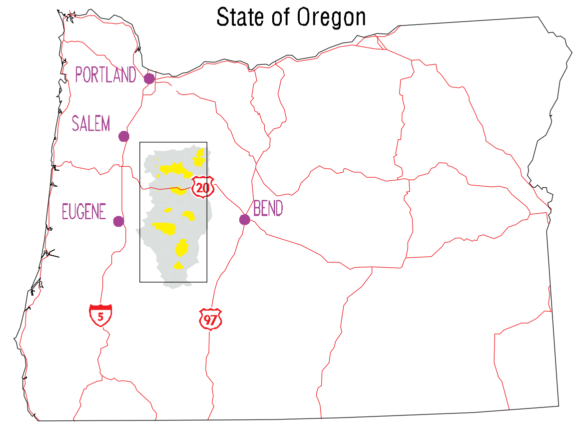
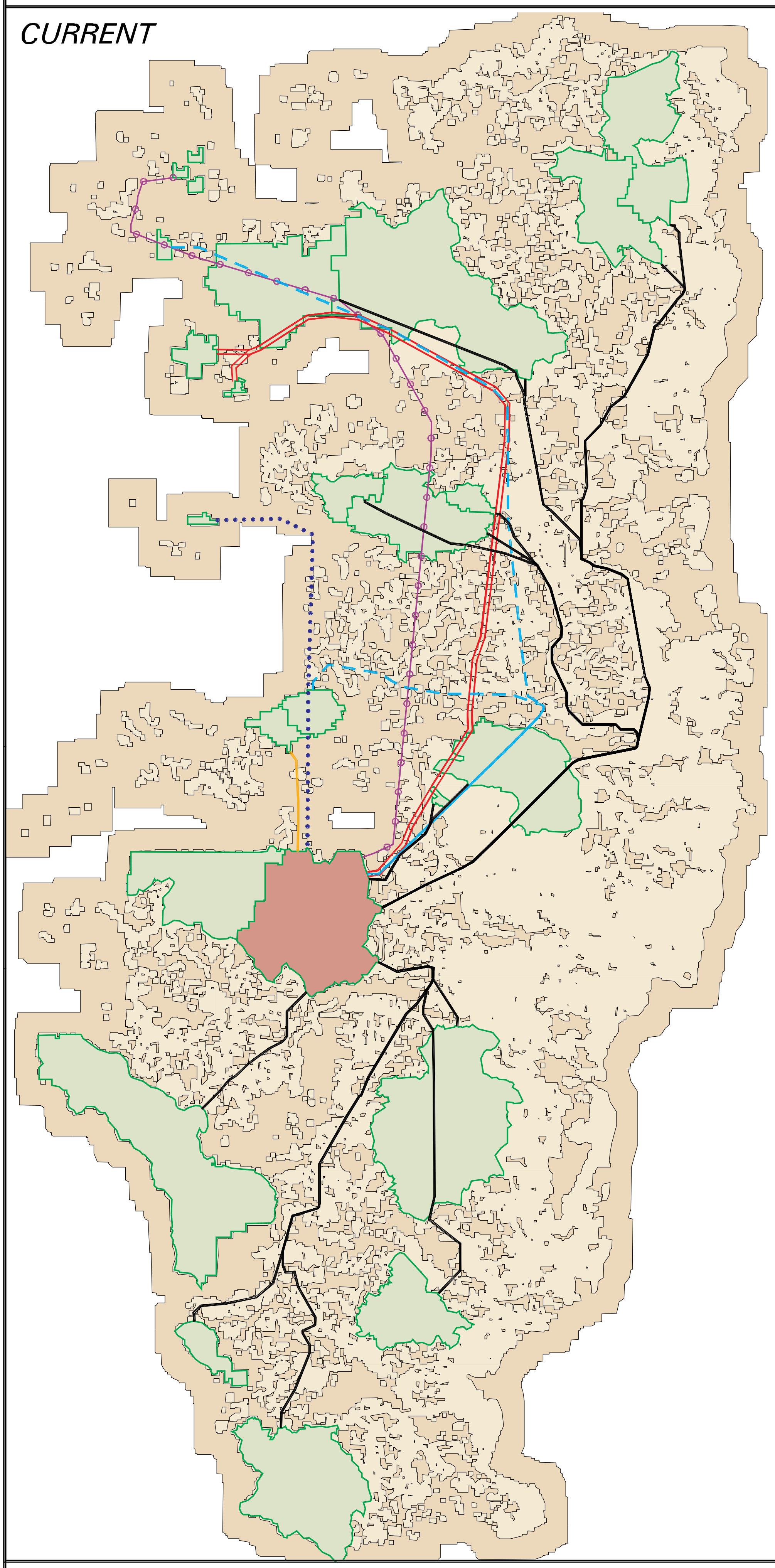
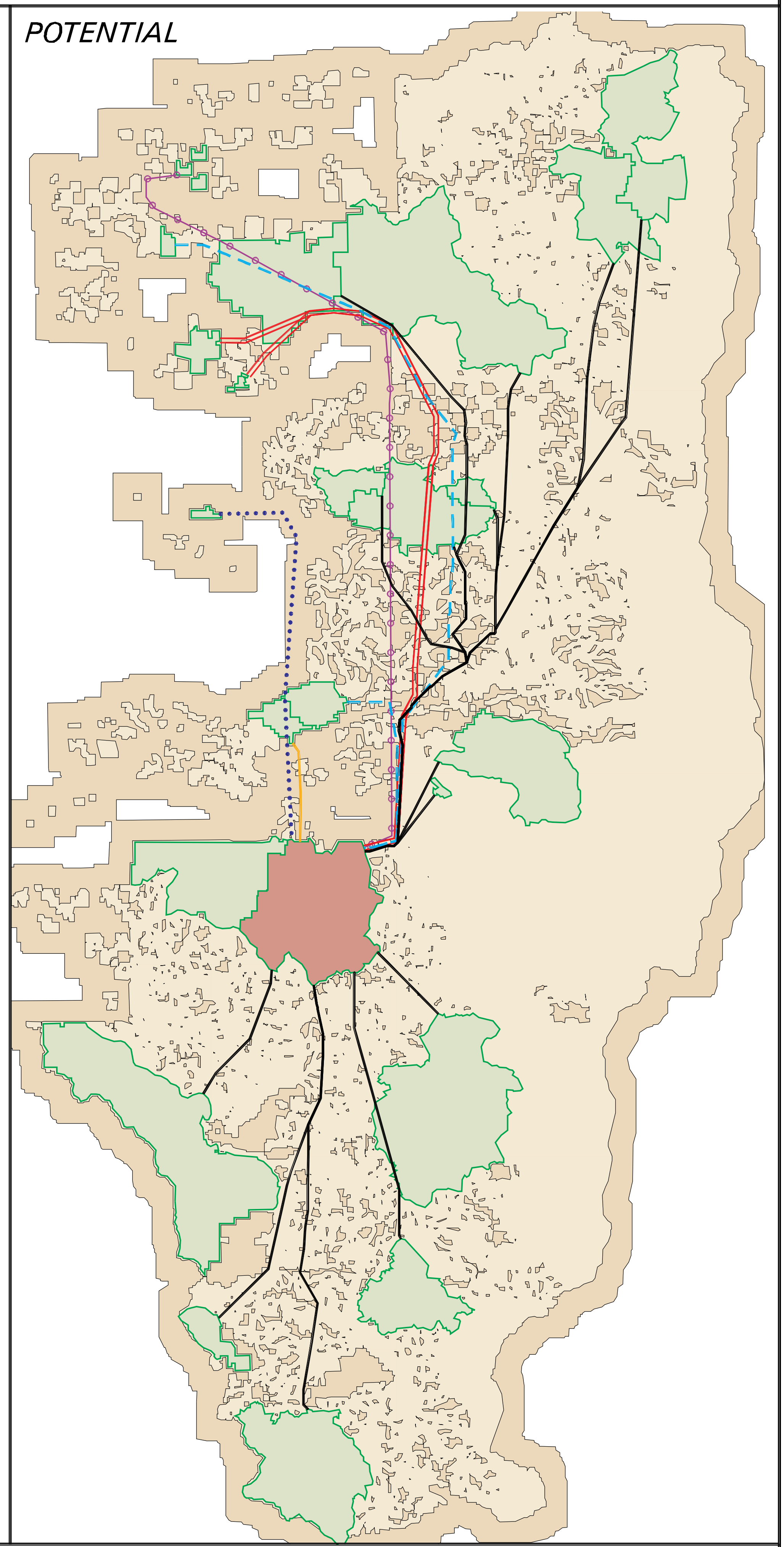
LOCATION MAP
State of Oregon



Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

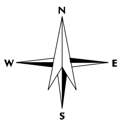
RO 219: FALL CREEK, Eastern Section





Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

Late Successional Habitat connected at 382 meters.
Late Successional Habitat connected at 4.83 kilometers.



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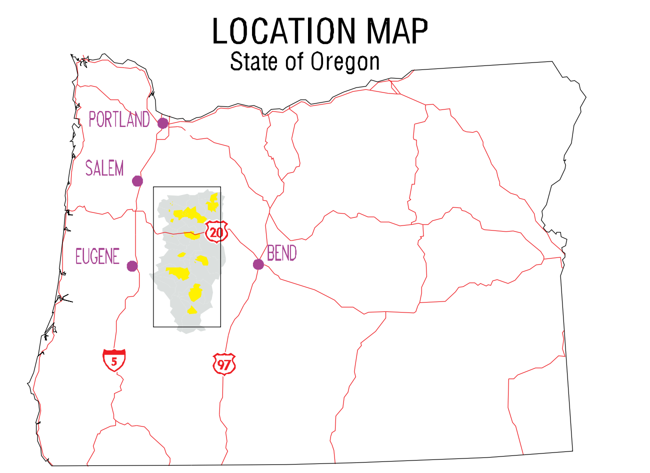
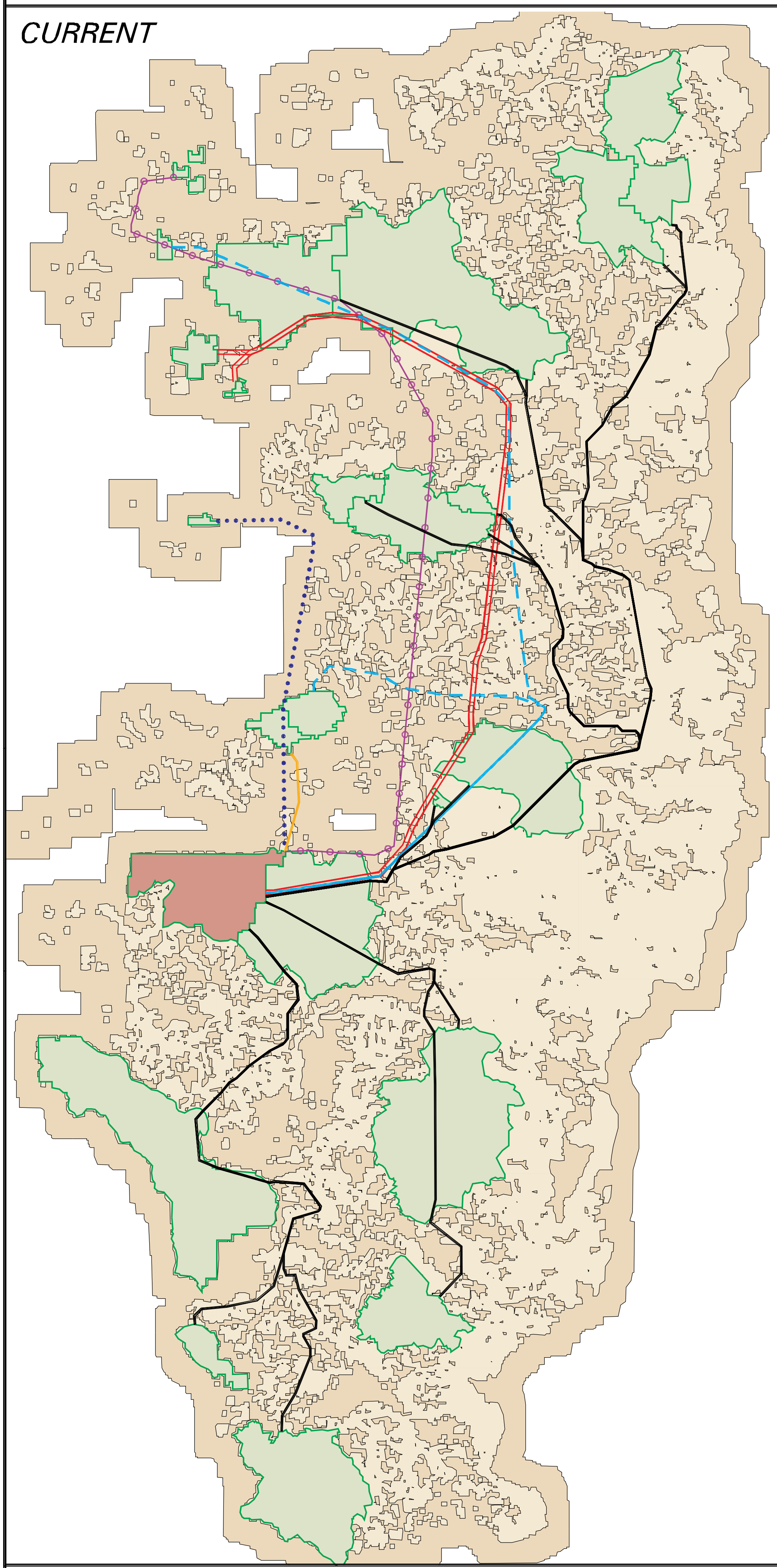
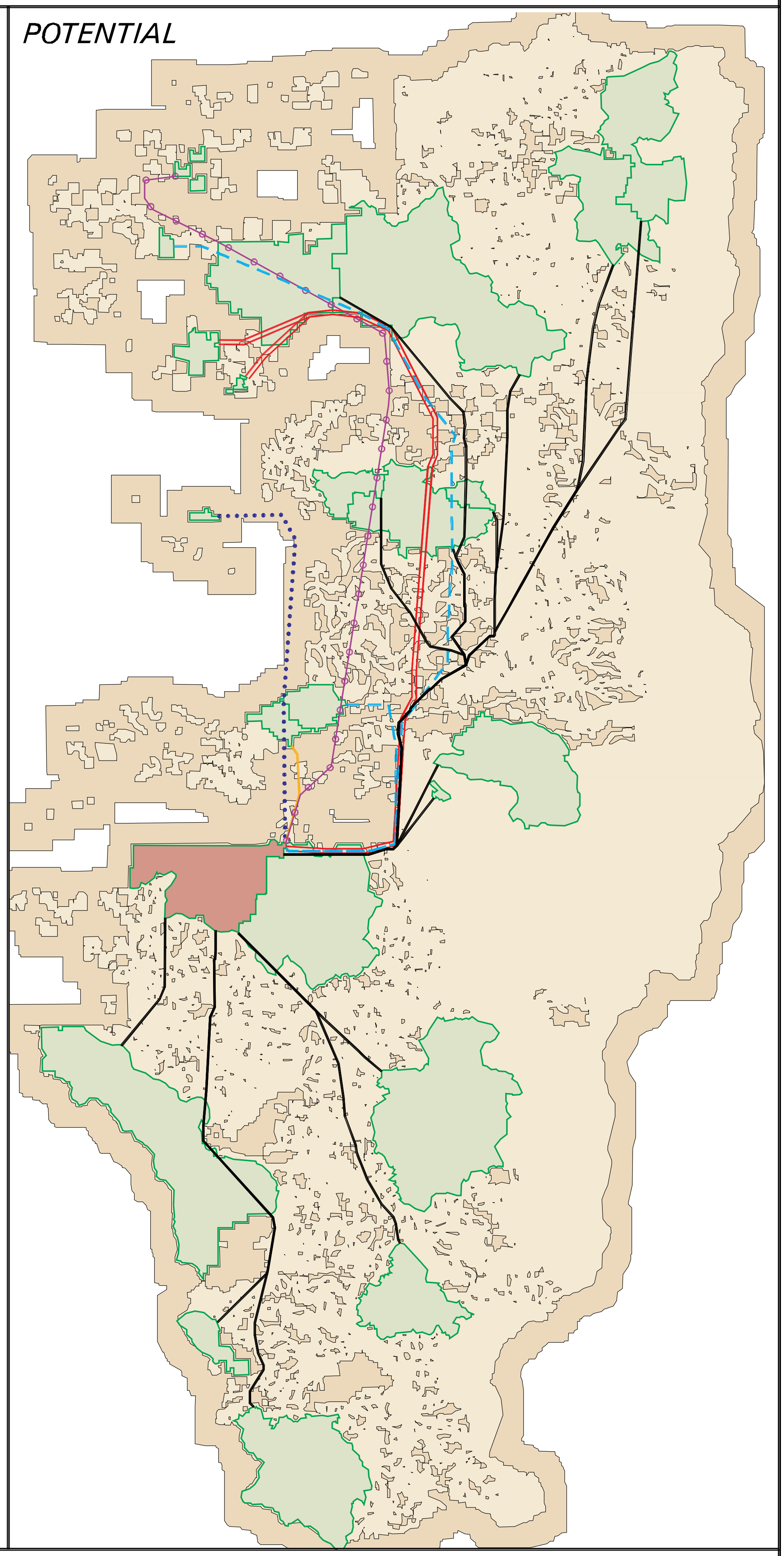


RO 219: FALL CREEK, Western Section

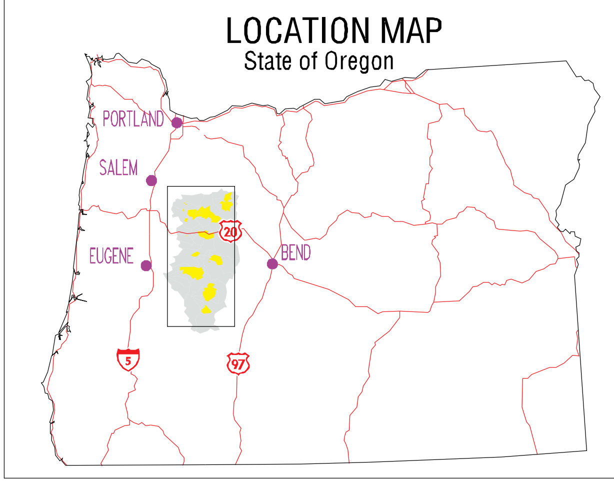




Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

Late Successional Habitat connected at 382 meters.
Late Successional Habitat connected at 4.83 kilometers.

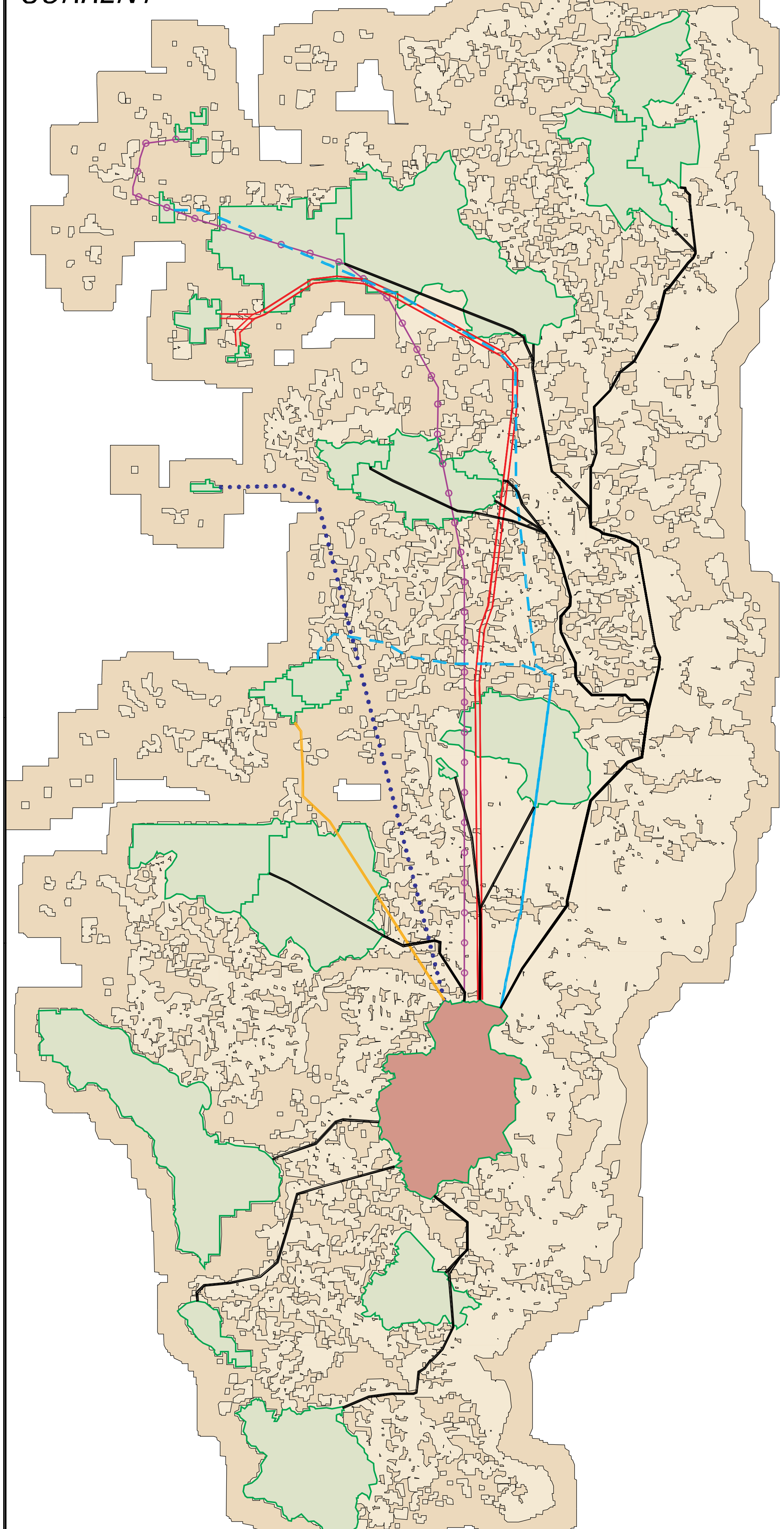
Willamette N.F. GIS Shop. 03/30/98



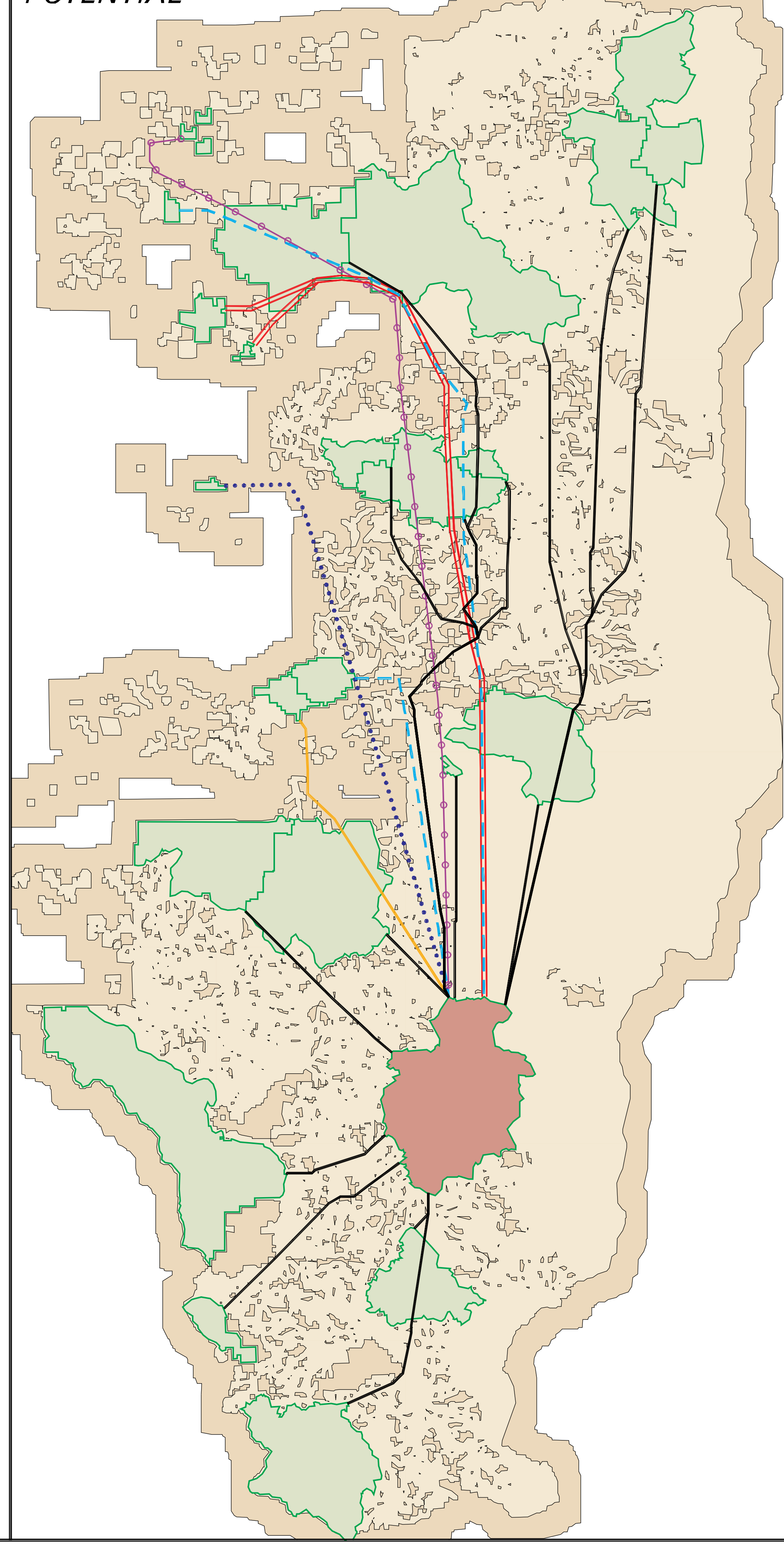
Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 220: WALDO WEST

CURRENT



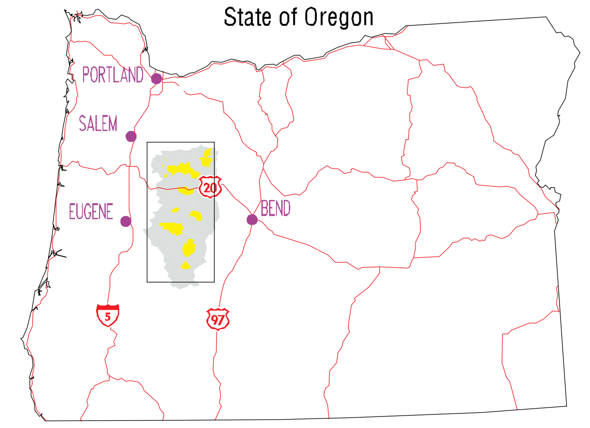
POTENTIAL



Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

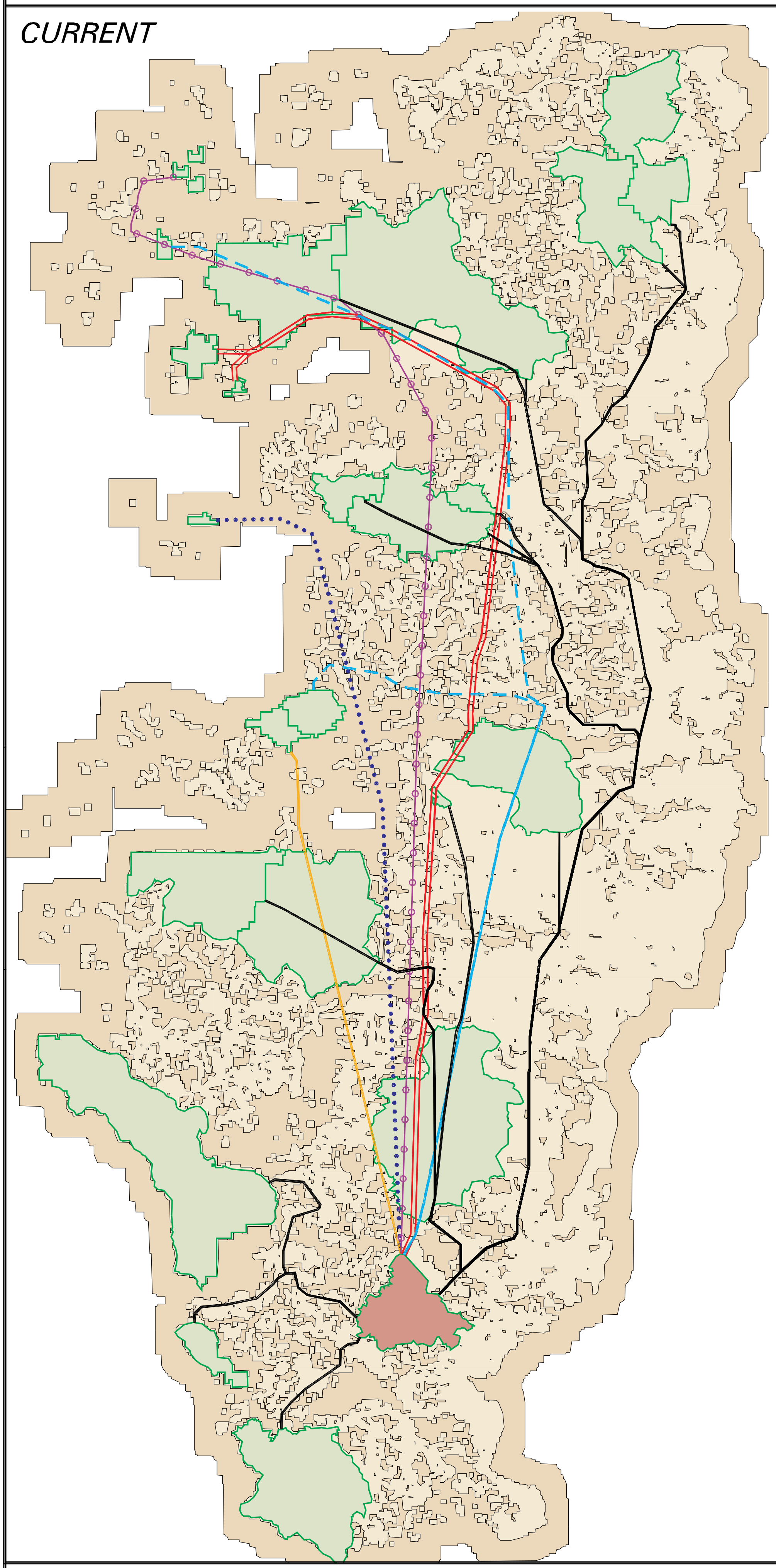
Late Successional Habitat connected at 382 meters.
Late Successional Habitat connected at 4.83 kilometers.

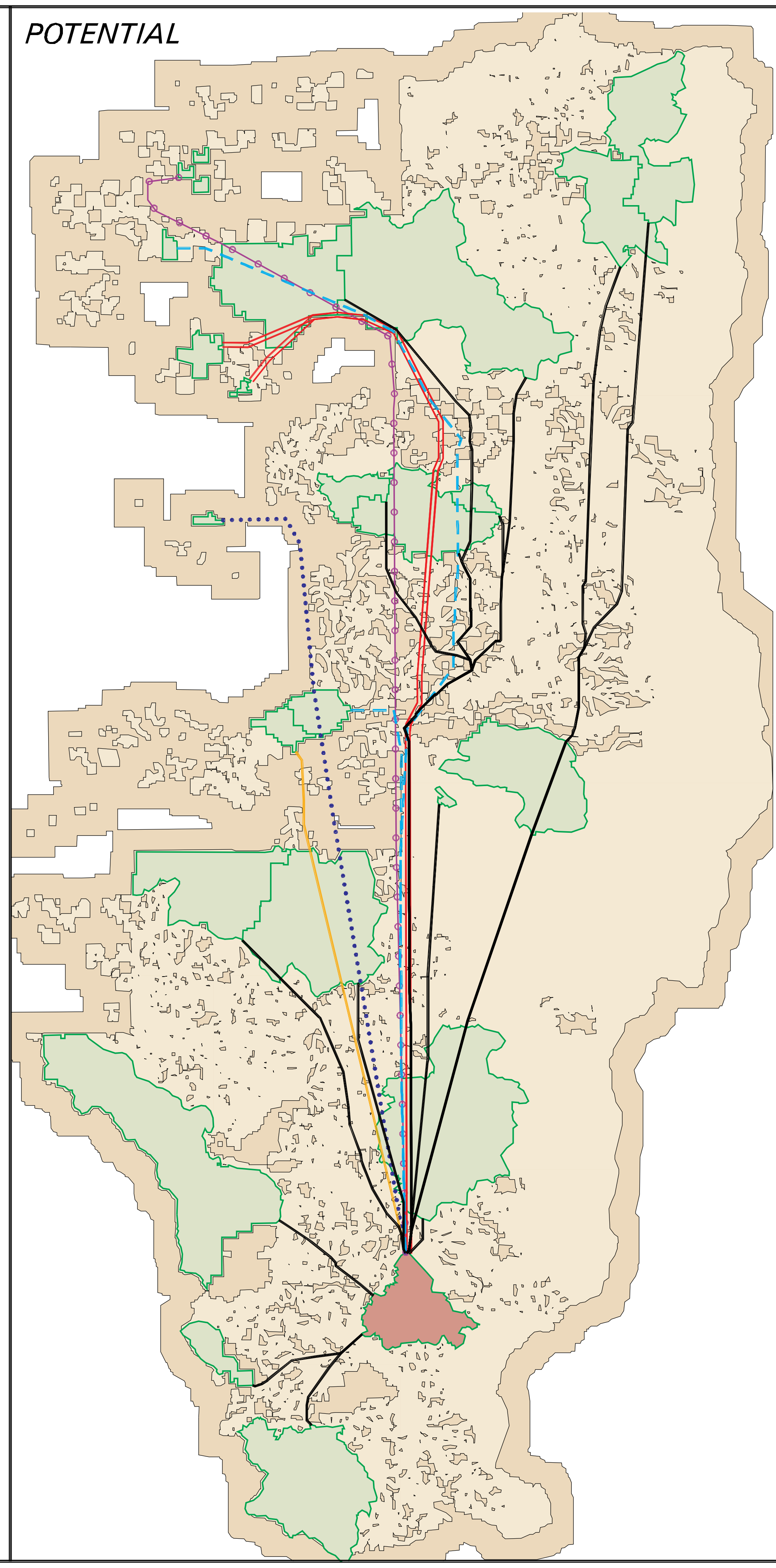
LOCATION MAP
State of Oregon



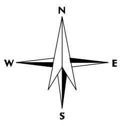
Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 221: HILLS CREEK





- Connectivity at 382 meters.
- Connectivity at 763 meters.
- Connectivity at 891 meters.
- Connectivity at 1.65 kilometers.
- Connectivity at 1.91 kilometers.
- Connectivity at 4.83 kilometers.
- Late Successional Habitat connected at 382 meters.
- Late Successional Habitat connected at 4.83 kilometers.



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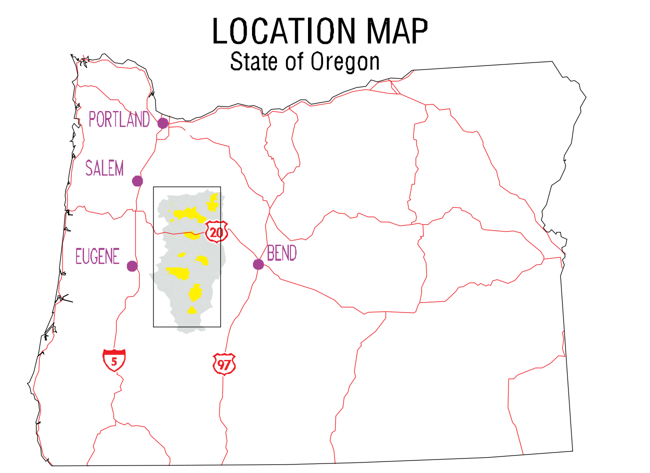
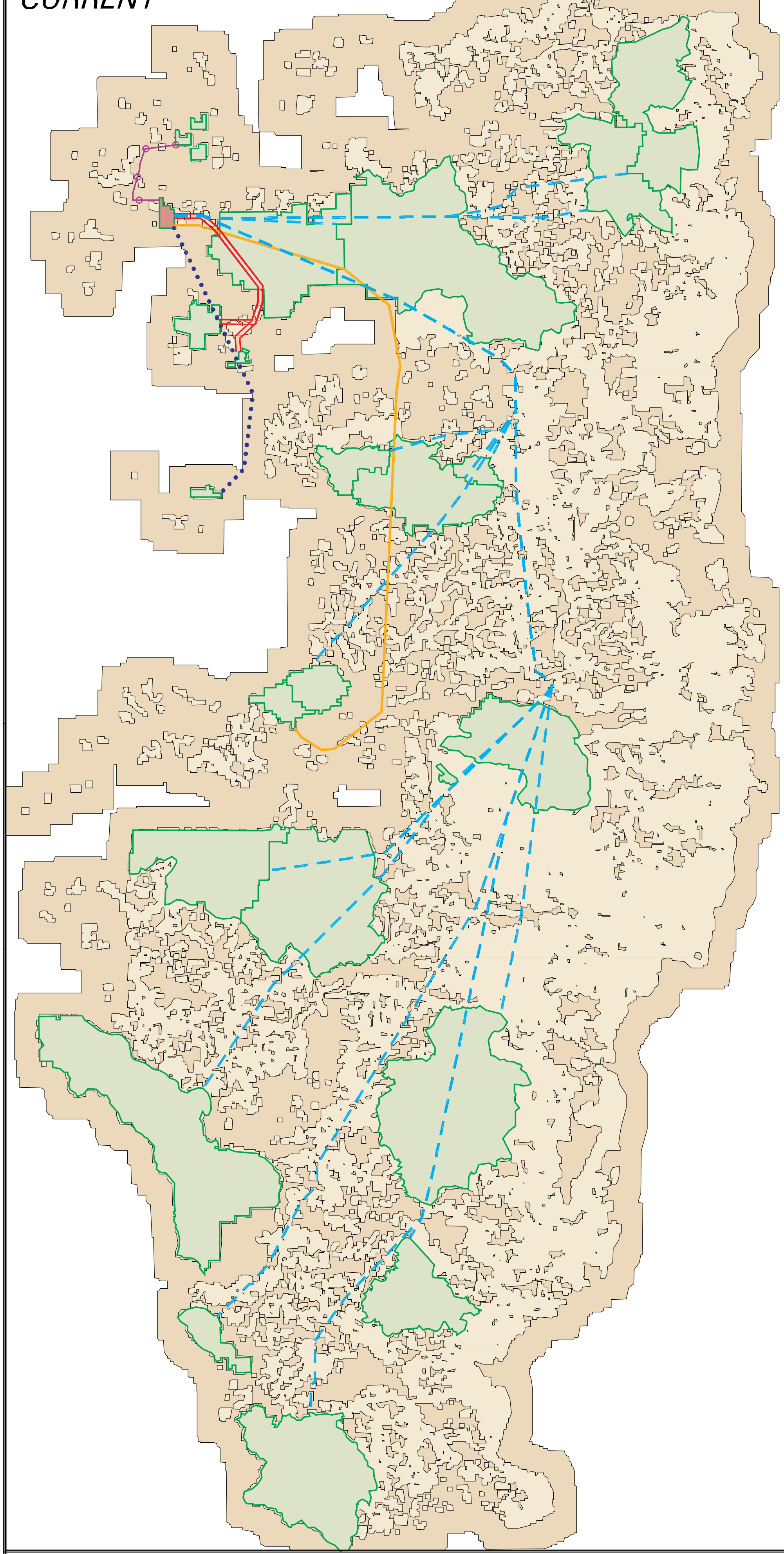


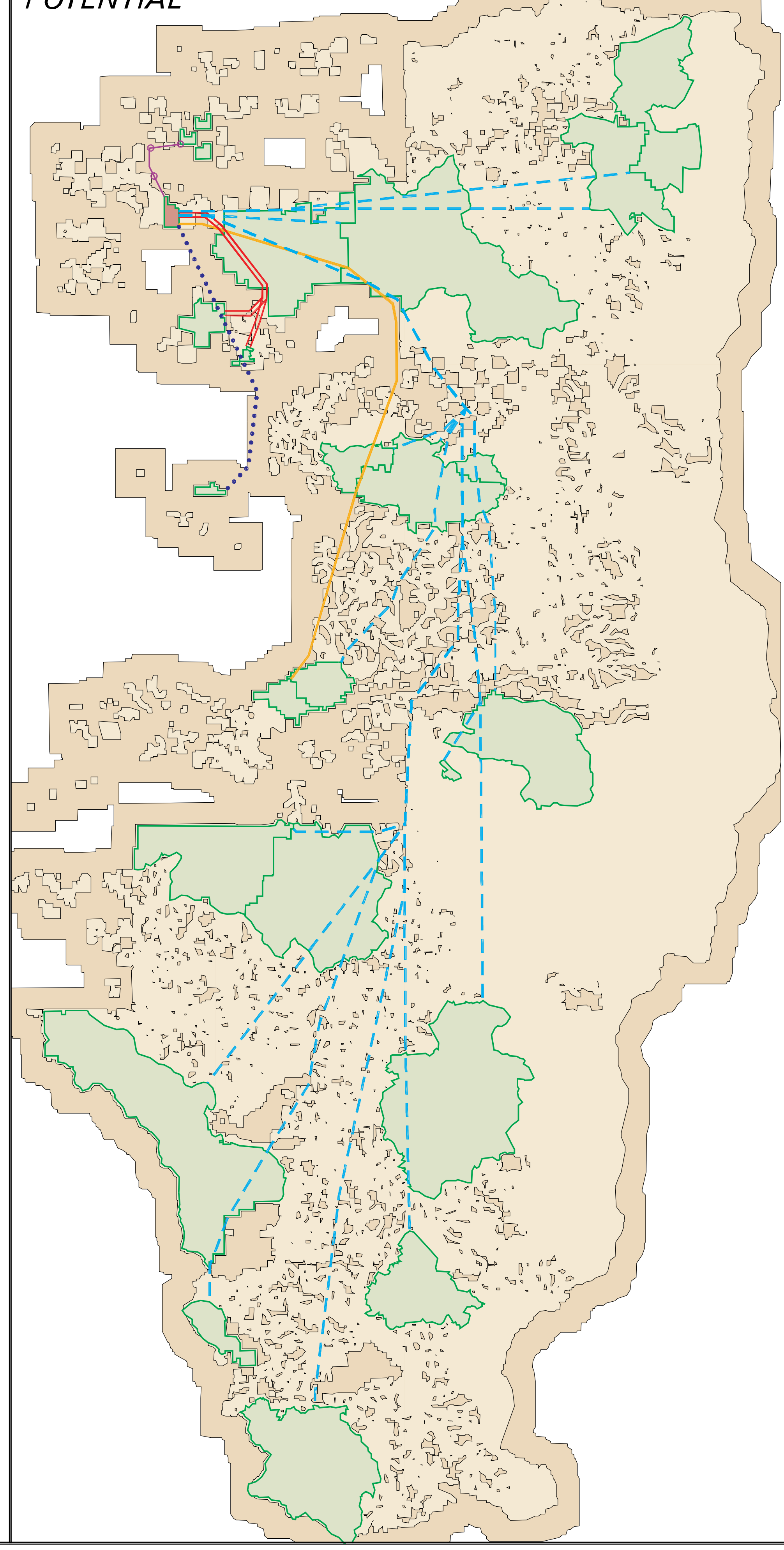
Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 246: THOMAS CREEK, Single Section

CURRENT



POTENTIAL



- Connectivity at 382 meters.
- Connectivity at 763 meters.
- Connectivity at 891 meters.
- Connectivity at 1.65 kilometers.
- Connectivity at 1.91 kilometers.
- Connectivity at 4.83 kilometers.
- Late Successional Habitat connected at 382 meters.
- Late Successional Habitat connected at 4.83 kilometers.

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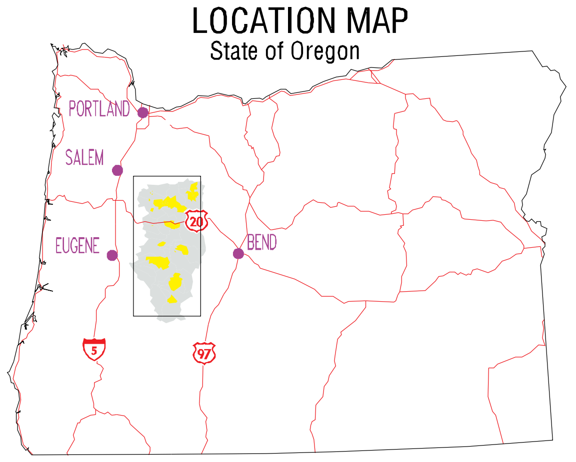
Willamette N.F. GIS Shop. 03/30/98

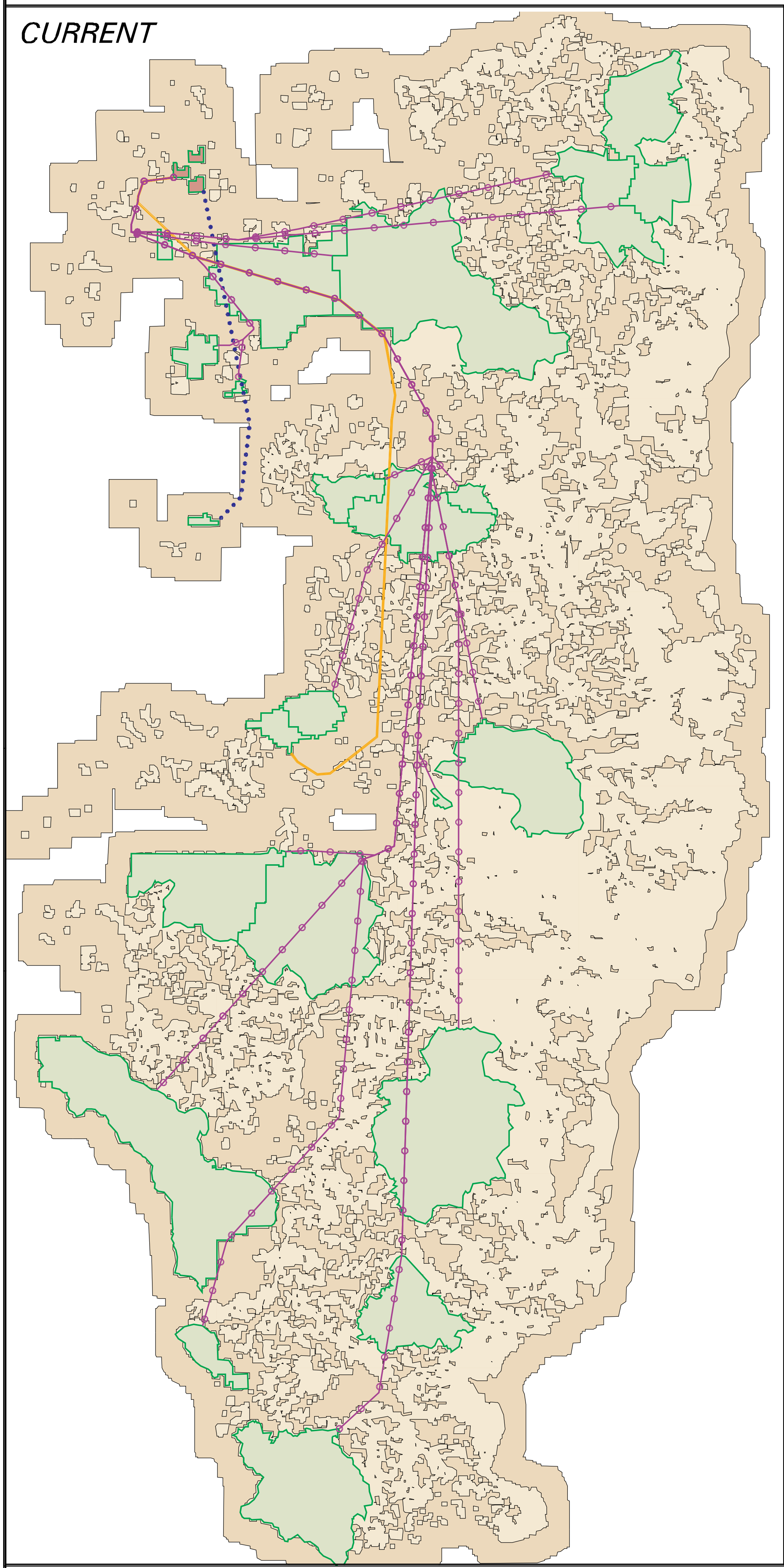
LOCATION MAP
State of Oregon



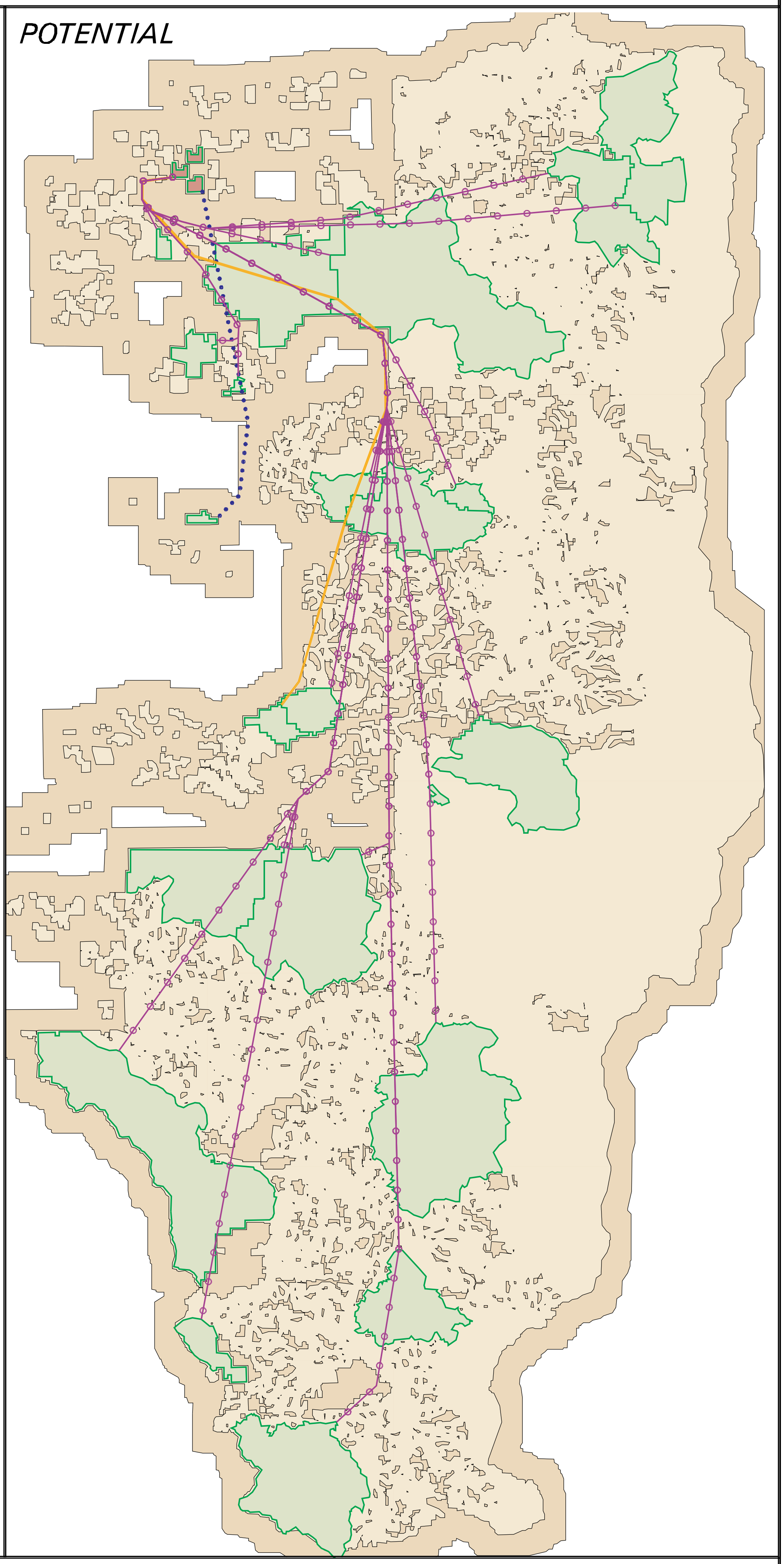
Appendix L: CONNECTIVITY THROUGH CURRENT AND POTENTIAL LATE SUCCESSIONAL HABITAT

RO 246: THOMAS CREEK, Three Sections

CURRENT

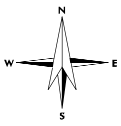


POTENTIAL



Connectivity at 382 meters.
Connectivity at 763 meters.
Connectivity at 891 meters.
Connectivity at 1.65 kilometers.
Connectivity at 1.91 kilometers.
Connectivity at 4.83 kilometers.

Late Successional Habitat connected at 382 meters.
Late Successional Habitat connected at 4.83 kilometers.



ATTENTION
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For more information, contact Willamette National Forest GIS shop (541)465-6923.

Willamette N.F. GIS Shop. 03/30/98

LOCATION MAP
State of Oregon