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Reply To: 1920/2500

Date: May 2, 1995

Subject: South Santiam Watershed Analysis

To: Rolf Anderson, Sweet Home District Ranger

I have reviewed the South Santiam Watershed Analysis documentation. The results meet my expectations for watershed analysis in FY 95 as agreed to at the Forest Watershed Analysis Workshop in January and meet the core principles of watershed analysis listed in the Regional Forester's 1920 memo, Strategy for Implementing Watershed Analysis in the PNW Region, September 29, 1994. The analysis provides an adequate background and understanding of the conditions and ecological processes in the watershed to proceed with project level planning and analysis for a variety of management activities.

The South Santiam WA is the first comprehensive watershed analysis to be completed on the Forest since the pilot efforts. The entire WA Team is to be congratulated for taking the lessons learned from the pilots and quickly applying that knowledge in the South Santiam analysis. The leadership role of the South Santiam team has helped define and focus the key aspects of the WA process on the Forest and has given me a better understanding and appreciation of the WA process.

The Synopsis document is well written and provides a clear, logical flow of information from issues and key questions, through the characterizations and processes to the resulting conclusions and recommendations. Please send one copy of the complete WA documentation as well as the Synopsis to Neal Forrester for the Forest records.

Thank you for your excellent efforts and results.

Darrel L Kenops

DARREL L. KENOPS
Forest Supervisor

cc:
D.Bates
N.Forrester

SYNOPSIS OF THE SOUTH SANTIAM WATERSHED ANALYSIS

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Introduction

Introduction *"Does fuzzy logic tickle?"*

The National Forest portion of this watershed was analyzed in a watershed assessment in February, 1994 for the 1994 Federal Watershed Restoration / Jobs in the Woods program. This analysis uses that work as a starting point and incorporates information about private lands in the rest of the watershed as well as field information collected on National Forest lands in the fall of 1994. As watershed analysis is an evolving process in 1995, this analysis will have gaps that will need to be filled at a later time. Every effort is made to document those gaps and any assumptions that are used for this analysis. The Federal Agency Guide for Pilot Watershed Analysis (version 1.2) provided guidance for the process.

This synopsis includes the information needed to give an overall understanding of the watershed and allow the reader to make sense of the conclusions and recommendations that are included. It incorporates information from the reports required in the Federal Guide. It is somewhat general in nature but is based on a great amount of detail that is found in these reports. They are listed in the Appendix A of this document and can be obtained from the Sweet Home Ranger District office or the Willamette National Forest Supervisor's Office if more indepth information is desired.

The Place

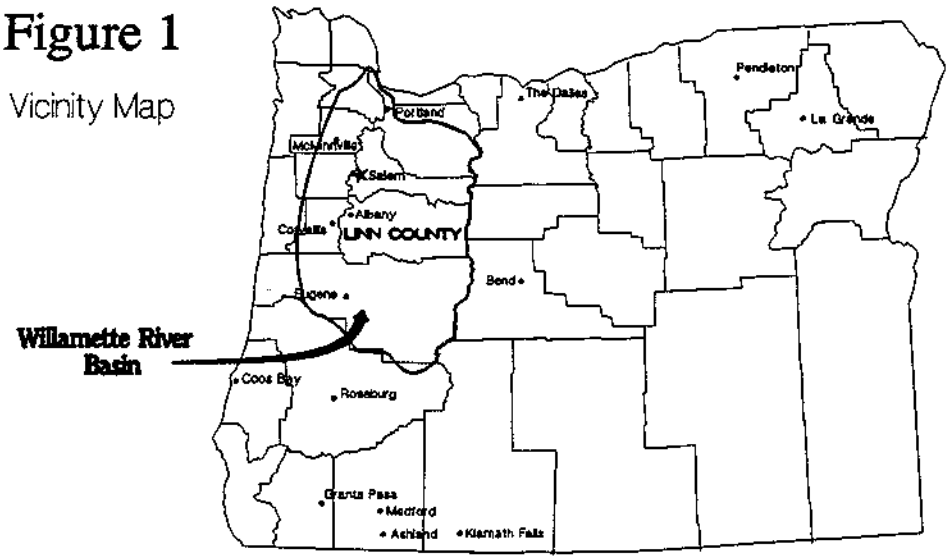
The South Santiam watershed, located in eastern Linn County, Oregon, is the part of the headwaters of the South Santiam River Subbasin in the Willamette Basin, which is part of the Columbia River system (See Figure 1). Approximately 54% of the watershed is on the Willamette National Forest and the majority of the remainder is owned by industrial timber companies. The State of Oregon (Cascadia State Park), Linn County, the Salem District of the Bureau of Land Management and numerous private individuals own small parcels located mainly along the Highway 20 corridor. (See Figure 2)

The watershed is totally within the Western Cascades physiographic province and the range of the Northern Spotted Owl. As such, it has been in the midst of the old growth/spotted owl debate. The town of Sweet Home, which lies just west of the watershed, has received much local and national media attention as a timber dependent community that has been impacted by proposed solutions to this debate. East Linn County governments have been active in rural economic development for much of the 1990's in response to the changes in timber supply from the federal lands. In 1994, Sweet Home Ranger District and Linn District of the Oregon Department of Forestry hosted a Ecosystem Restoration Crew under the Watershed Restoration / Jobs in the Woods program as part of ongoing efforts to improve the employment potential of the area.

On the National Forest, there are several land allocations within the watershed as established by the Willamette National Forest Land and Resource Management Plan as amended by the Standards and Guidelines for Management of the Spotted Owl (hereafter referred to as the Forest Plan). The Menagerie Wilderness lies north of the South Santiam River. A Late-Successional Reserve runs

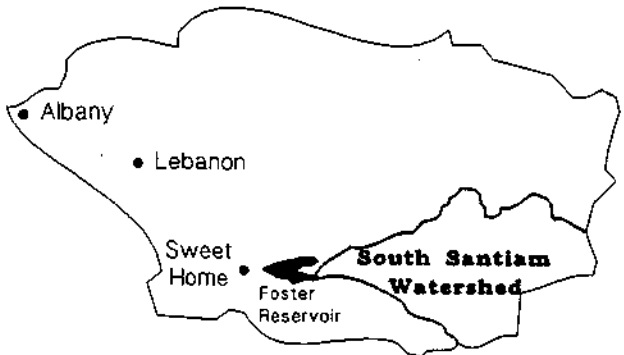
Figure 1

Vicinity Map



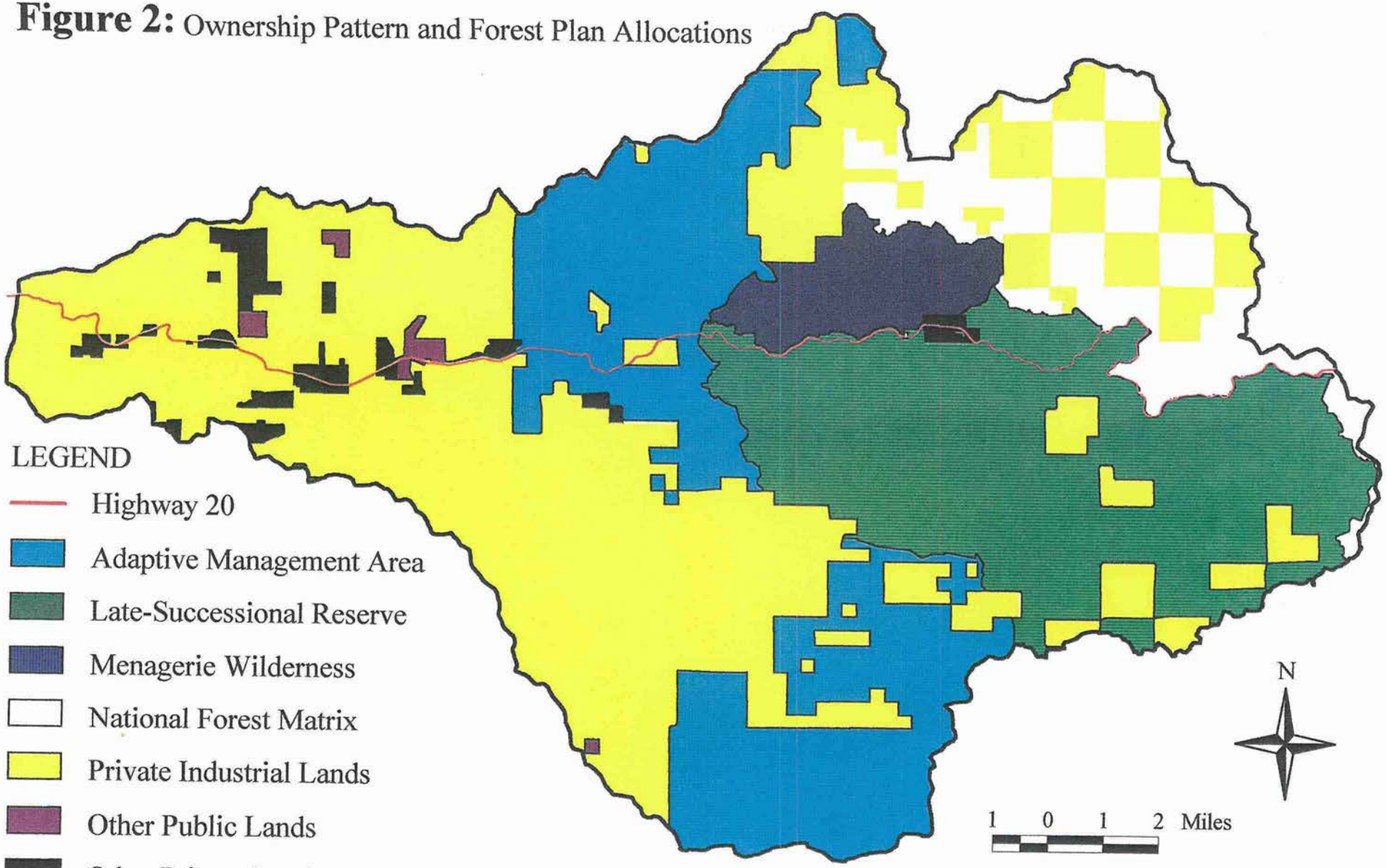
OREGON

LINN COUNTY



SOUTH SANTIAM SUBBASIN

Figure 2: Ownership Pattern and Forest Plan Allocations



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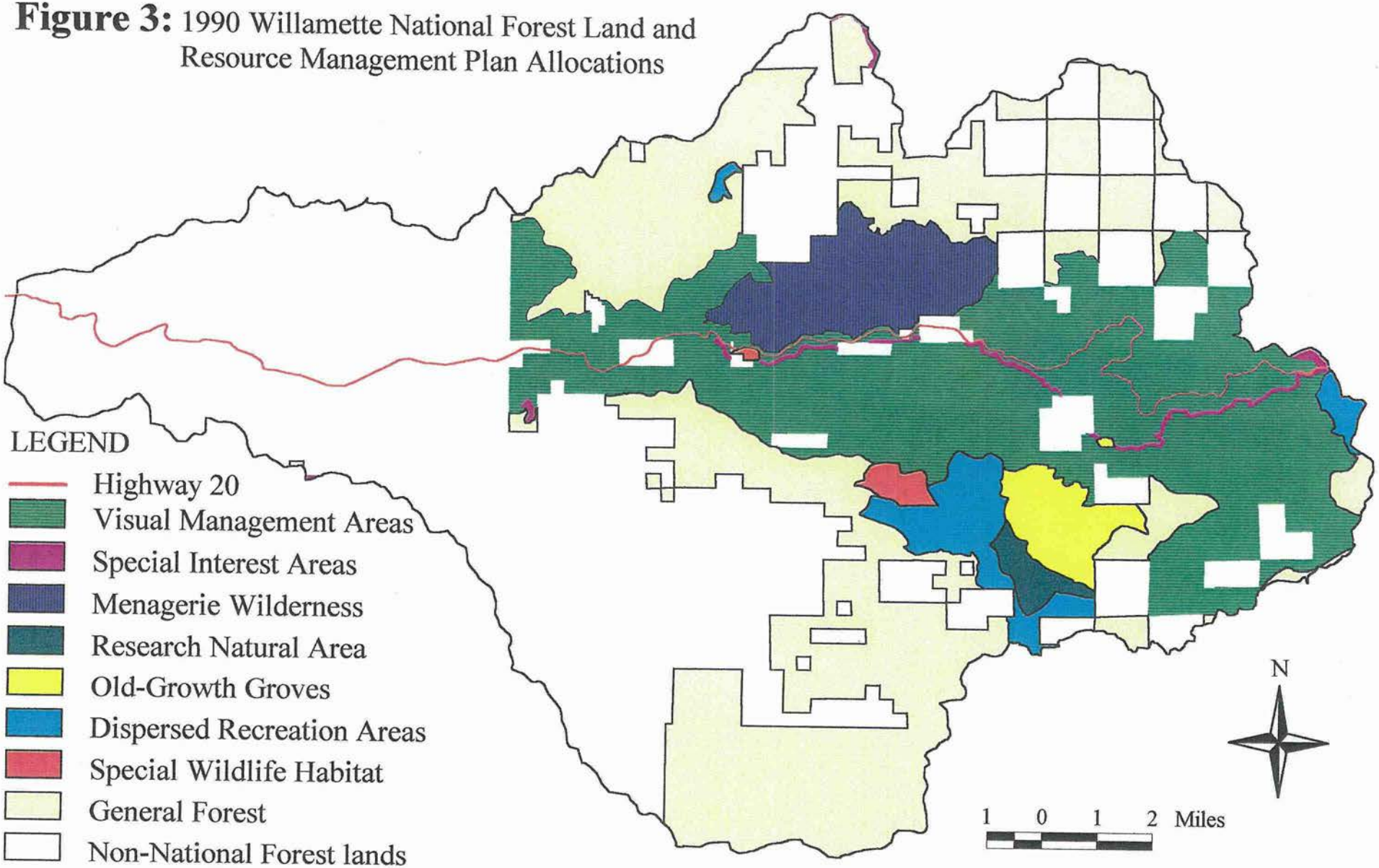
south between Moose Mountain and Harter Mountain is in Matrix (See Figure 2). A summary of acres can be found in Table 1. Riparian Reserves also cover large areas of all these allocations. Underlying these broad allocations are several 1990 Willamette National Forest Land and Resource Management Plan (LRMP) allocations, including the Santiam Wagon Road Special Interest Area, the Three Creeks Research Natural Area, Three Creeks Old Growth Grove, the Cougar Rock Special Interest Area, a semi-primitive dispersed recreation area, and special wildlife habitat area as well as scenic allocations along the Highway 20 corridor. (See Figure 3)

Table 1: Acres by Allocation and Ownership

ROD Allocation	Acres	% of Watershed
Congressionally Withdrawn (Wilderness)	4,949	4
Late Successional Reserve	26,783	21
Central Cascades Adaptive Mgmt. Area	26,013	21
Forest Matrix	10,445	8
Total Federal Land	68,190	54
Non-Federal Land	57,550	46
Total Watershed Acres	125,740	100

Figure 3: 1990 Willamette National Forest Land and Resource Management Plan Allocations



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Physical Characterization

Major physical features of the watershed include the South Santiam River itself, U.S. Highway 20, the communities of Cascadia and Upper Soda, Iron Mountain Lookout, Tombstone Pass, Gordon Lakes and Gordon Meadows, Cougar Rock communications site, Jumpoff Joe Mountain and numerous other buttes and peaks. The primary tributaries to the South Santiam include Sevenmile Creek, Squaw Creek, Soda Fork, Moose Creek, and Canyon Creek. Foster Reservoir, which is on the western boundary of the watershed, controls the flow of the South Santiam below the watershed. The elevation ranges from about 600 feet at Foster Reservoir in the west to 5,455 feet on top of Iron Mountain in the east.

Geology

The geologic foundation of the South Santiam watershed is older Tertiary basalt lava flows, tuffs and tuffaceous sedimentary rocks. This formation (Little Butte Sequence) dates back to 17 to 32 million years ago. Overlying the Little Butte formation, flows and flow breccias form broad caps on the higher elevation main ridges in the Gordon Lakes/Soapgrass area and throughout the Harter Mountain area. These rocks range in age from 10 to 17 million years old. Resting on these broad upland deposits are even younger ridge-capping flows and flow breccias some of which are similar to flows found in the High Cascade volcanic sequence. This layer is 4 to 10 million years old. (Walker and Duncan 1989)

These rock formations have been extensively modified by erosion created by both mountain glaciation and slope instability. Glacial landforms and glacially derived soils are common to parts of the watershed. During the earliest and most extensive glacial periods that occurred about one million years ago, valley glaciers probably travelled down the South Santiam canyon and some of its tributaries. With the more recent glaciations, smaller glaciers carved cirques on the north and east aspects of the higher peaks. Examples of glacial cirques can be found at the headwaters of Sevenmile and Squaw Creeks as well as on Soapgrass and Tidbits Mountains, Twin Buttes and Two Girls Mountain. In addition to cirques, other glacial features such as hanging valleys and assorted morainal deposits can be found in the watershed but most have been extensively altered by stream erosion and slope instability.

Large scale slump/landflow instability has been a significant factor in slope development and channel morphology since the glacial period ended about 10,000 years ago. The materials of the Little Butte Series can weather to form deep colluvial and residual soils that create conditions where both rotational and translational failures are common. In many areas, actively unstable remnants of these larger landflows can still be found. Most still manipulate and control stream channel morphology to a high degree. Stabilized slump/landflow features such as sag ponds, bench and scarp topography, and disrupted drainages are common in Sheep Creek, Sevenmile Creek, Squaw Creek, and Canyon Creek.

This complex geologic history has produced a diverse landscape in the watershed. The landforms include the highly glaciated upland benches and flats with extensive ground moraine as found in the headwaters of Sheep Creek, the steep rocky canyons and crags of Moose

Creek, the large scale stabilized slump/earthflow complexes and associated glacial deposits of Sevenmile and Canyon Creeks, and the flat stable river terraces and outwash plains of the South Santiam River below the confluence of Moose and Canyon Creeks. A more detailed description of the geologic history of the watershed can be found in the Soils and Geology Report.

Mineralization

Associated with plate tectonic movement and subduction zone melting, concentrations of gold, silver, copper, and lead mineralization lay like widely spaced beads on an unclasped necklace that is strung down the western front of the Cascade Range. Historically, each bead has been the center for mineral exploration and mining activity. This necklace extends from at least Mt. Hood to well into the Umpqua National Forest. The line of the necklace crosses the watershed from the upper part of the Moose subwatershed, across the Menagerie and down through the upper end of the Owl subwatershed. The South Santiam watershed appears to lie in the empty area between the beads. To the north is the Quartzville mining district and to the south is the Blue River (Gold Hill) mining district. Little or no base and/or precious metal mineralization has ever been found in the South Santiam.

Hydrology

The South Santiam watershed is typical of many western Cascades watersheds. This watershed has deeply incised stream channels and a high stream density. These streams originate from the glacial terraces found on the northeastern and southeastern boundaries of the watershed. Progressing downslope, these relatively flat stream channels increase in gradient dramatically and become very steep, high energy streams with very incised, steep valley walls. These high energy streams form a river system with a geologically constricted valley bottom. Within the main stem of the larger tributaries and the South Santiam River, small areas of deposition occur as a result of these geologic constrictions (i.e. earthflows and /or exposed bedrock outcrops). Applying a level I Rosgen channel typing methodology, 90 to 95 percent of the smaller streams rate A and Aa+. These channel typings describe the steepness and the high energy nature of the system. A result of this high energy, sediment storage capacity is limited and is tied to the accumulation of large wood in the channels.

A unique feature of the South Santiam watershed is that, due to the fire history, most of the large wood component of the stream system has been removed. Historic records reveal a large stand replacement fire in the 1850's followed by a 100 year storm event in 1861. As result of these two events the channel system was inundated with massive amounts of soil and rocks (sediment) and organic debris. Subsequent fires in 1911 and the 1930's removed the organic component of this debris over a large portion of the watershed. After that, storms were able to mobilize the stored sediments in the river system and flush them downstream. The result is a high energy system that is a very efficient sediment transporter.

In order for the channel to moderate the high energy it works the channel area and removes material on the bottom of the channel. This downcutting of the channel bottom eventually

is restricted when the channel encounters bedrock. Approximately 30% of the channels length surveyed is bedrock with 48% having a boulder, cobble substrate. These areas of boulder cobble and finer particles are very mobile during 10 to 20 year return interval storm events. Due to the mobility of these sediments, benthic organisms are disrupted and nutrient cycling within the stream is very short lived.

Currently the complex history of fire, flood, and management activities have created a very efficient sediment transportation system, one that is highly resistant to increases in peak flows. The upper watershed areas and tributary streams are currently developing a vegetative cover that the area has not experienced naturally since the 1850's. Due to fire suppression and other management activities (putting large wood in streams) these channels are starting to develop the capacity to store sediment again. As these channels accumulate structure and sediment, peak flows become critical in determining the residual time these characteristics can be retained. The residual time in the system will influence the amount and effectiveness of the associated habitats.

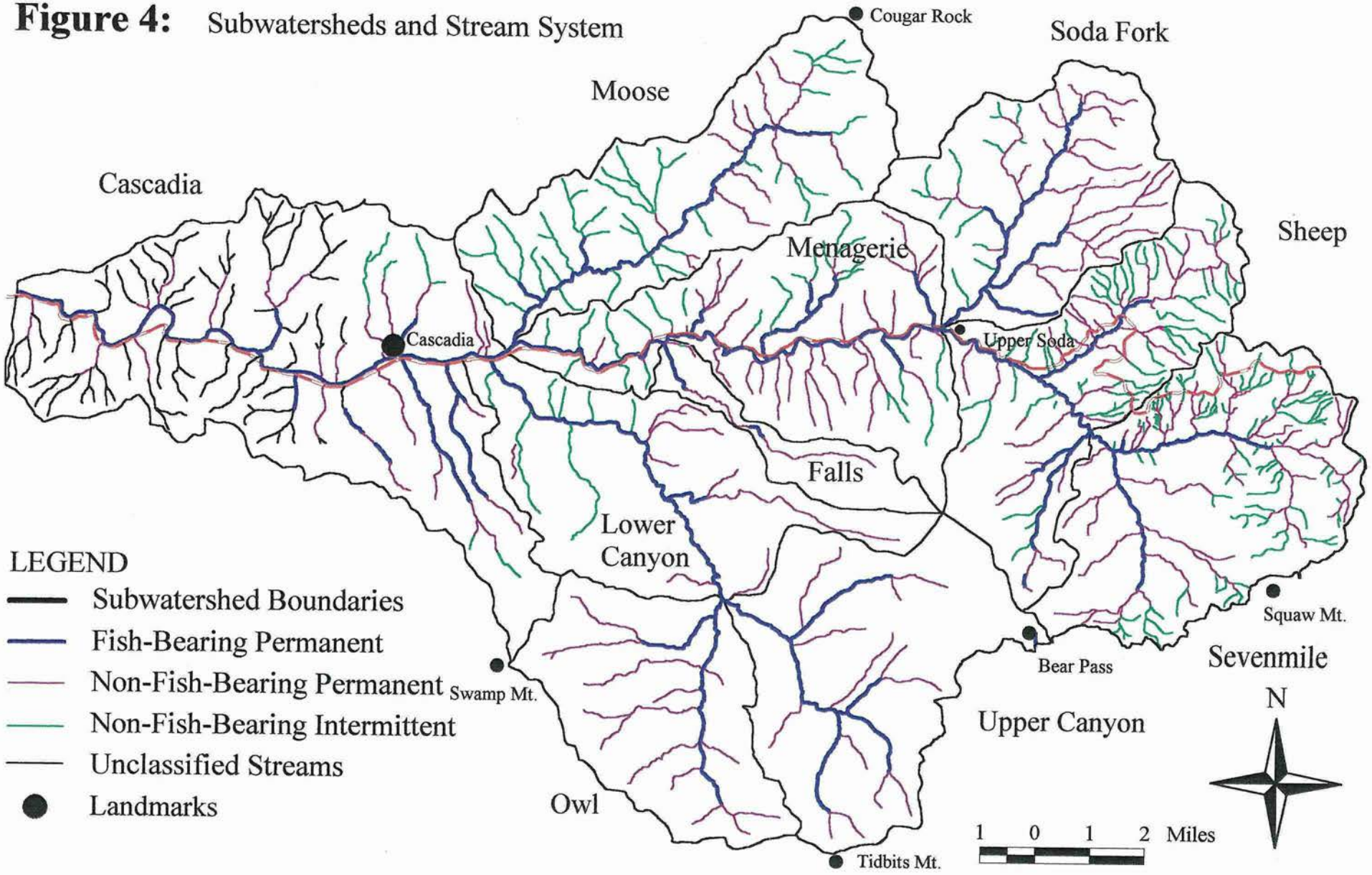
The beneficial uses found within this watershed are domestic, fisheries, recreation, hydroelectric, agricultural, and industrial. Domestic use is associated with the small landowners, located primarily along Highway 20. The fisheries beneficial use covers anadromous and resident fisheries as well as non-game aquatic species. Recreation uses include the campgrounds, Cascadia State Park, and Highway 20 and the Old Santiam Wagon Road where they are within the South Santiam River Riparian Reserve. Hydroelectric use is associated with the Falls Creek Hydroelectric project. Agricultural uses are associated with the small farms and homesteads around Cascadia. Triple T Studs sawmill, located near the confluence of Moose Creek, is the only industrial user. Prioritization of instream flows for western Cascades watersheds by the State of Oregon has not been done and is beyond the scope of this analysis. Potential minimum instream flow requirements will vary over the watershed due to topography, vegetation, and the beneficial uses being supported.

The South Santiam watershed has been spatially aggregated into four geographical areas consisting of the 10 subwatersheds that make up the watershed. These areas and subwatersheds will be referenced throughout the document. Subwatershed size and locations can be found in Table 2 and Figure 4, respectively. Also shown on Figure 4 are the streams in the watershed. Not all intermittent streams have been mapped but stream densities throughout the watershed are expected to be similar to those found in the east half of Sevenmile subwatershed.

Table 2: Acres by Subwatershed

Area	Subwatershed	Acres
Upper South Santiam (53,286 acres = 42%)	Sevenmile	14,035
	Sheep	12,023
	Soda Fork	10,451
	Menagerie	14,066
	Falls	2,711
Canyon (35,095 acres = 28%)	Upper Canyon	13,066
	Owl	9,779
	Lower Canyon	12,250
Moose (11%)	Moose	13,564
Cascadia (19%)	Cascadia	23,795
South Santiam Watershed		125,740

Figure 4: Subwatersheds and Stream System



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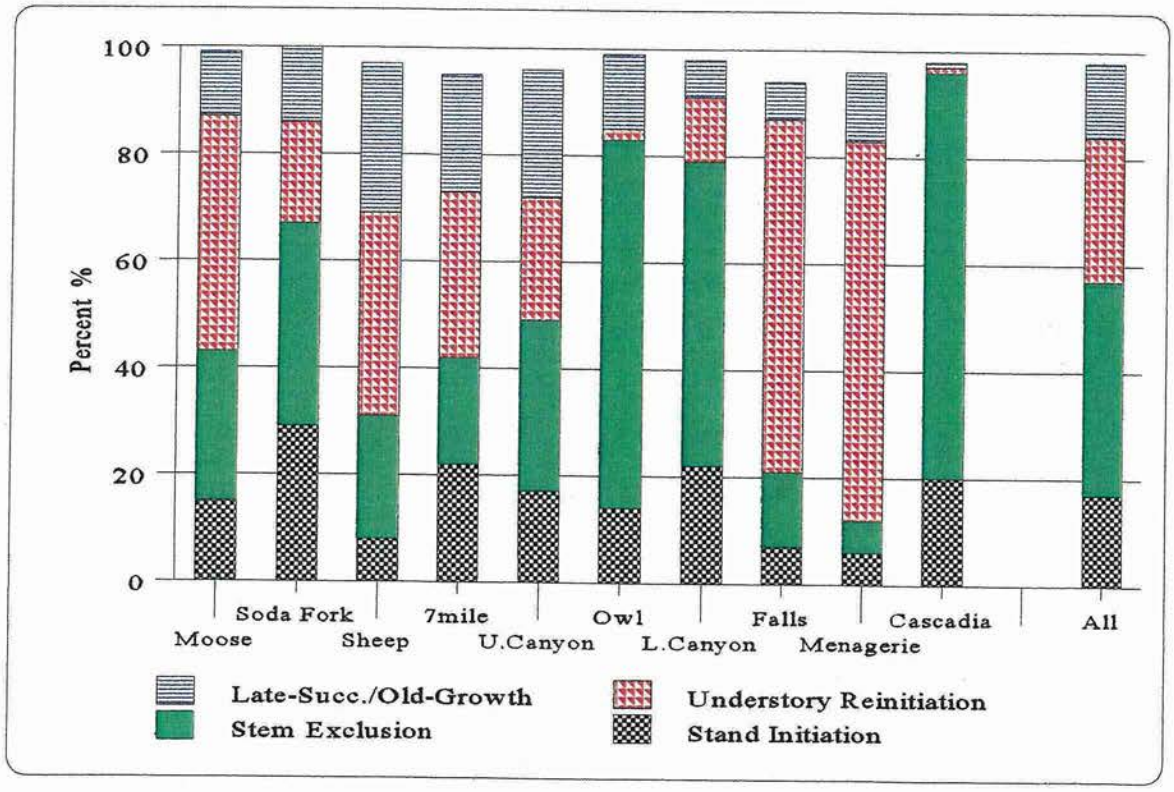
Biological Characterization

Vegetation

The watershed lies within the western hemlock and Pacific silver fir vegetation zones (70% and 30% respectively). Dominant tree species include Douglas-fir, western hemlock, western redcedar, Pacific silver fir, noble fir, red alder, and bigleaf maple. Common understory species include vine maple, rhododendron, sword fern, salal, huckleberries, beargrass, and numerous grasses and forbs.

About 41% of the watershed is covered with the older seral stages (understory reinitiation (27%) and late-successional/old growth (14%)) dominated by conifer tree species with a high degree of canopy closure. The other 57% is in the early seral stages as a result of clearcut patch harvesting that has been scattered throughout the watershed over the last fifty years. Figure 5 illustrates the percentage of each seral stage in the watershed as a whole and in each subwatershed. The amount less than 100% for each bar is accounted for by non-forested lands. See Figure 6 for a description of these seral stages and Figure 7 for a map of the current pattern of seral stages.

Figure 5: Current Distribution of Seral Stages



Riparian vegetation conditions vary due to land ownership patterns and National Forest land management allocations. For example, nearly the entire riparian area adjacent to Keith Creek (Menagerie subwatershed) is composed of understory reinitiation stands indicative of the fire history of the area. On the other hand, Soda Fork Creek (Soda Fork subwatershed) shows a patchwork of understory reinitiation and stand initiation seral stages on National Forest lands, with stand initiation and stem exclusion seral stages being predominate on private lands. See Figure 8 for graphs depicting the distribution of seral stages found in riparian reserves within each subwatershed and each area.

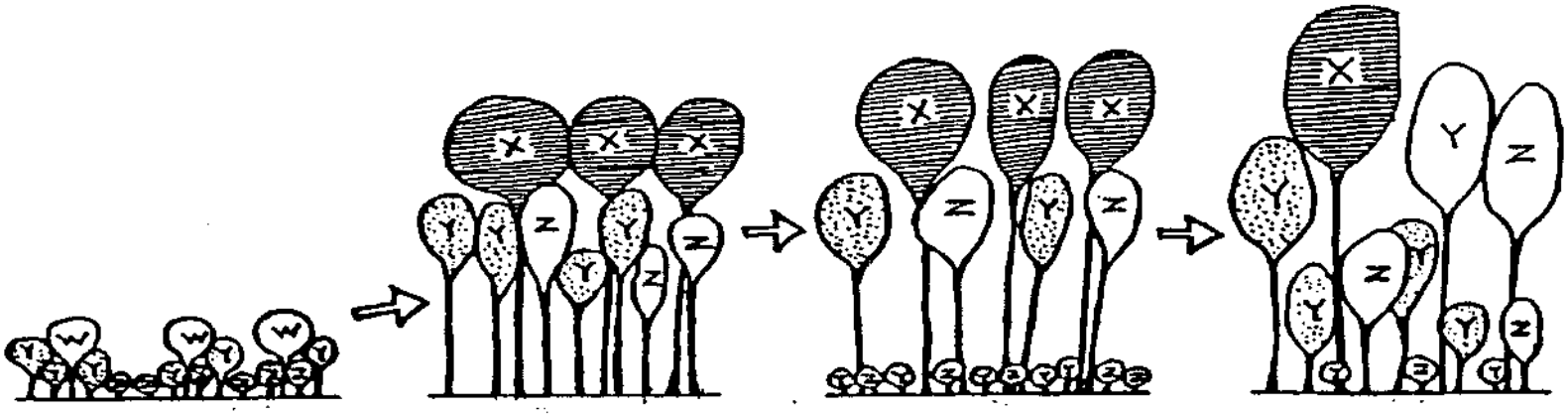
Past forest fires played a key role in shaping the size and distribution of vegetation in the watershed as is characteristic of most Western Cascade forests. Stand replacement fires affecting this watershed occurred around 1200 and 1550, and in 1856 and 1911. The stands created by these last 2 fires now occupy about 27% of the watershed, most of it in one contiguous block. See Figure 9 for a map of the pattern of seral stages that existed in 1914.

Reforestation history: The majority of the 56,000+ acres that have been harvested in the watershed have been artificially reforested by tree planting or aerial seeding. The remaining small percentage seeded in from natural seedfall. Parts of the Sevenmile Burn were planted between 1915 and 1917 and this planting project was part of the first significant recorded artificial reforestation in Oregon.

Regeneration techniques used in the watershed parallel those used in the western Cascades over similar time periods. Prior to the mid 1950's much of the reforestation was accomplished by natural seed-fall from seed trees left for this purpose or from trees in adjacent stands. From the mid 1950's to late 1960's, a mixture of tree planting and aerial seeding were the predominate reforestation methods. Because tree planting established and grew trees faster and used less seed, it became the predominate reforestation method over aerial seeding from the late 1960's to the present.

Seed used for reforestation in the watershed has been evolving toward increased genetic improvement for wood quality and growth while preserving genetic diversity. Since the late 1960's most of the reforestation seed used in the watershed has been from local parent trees selected for their good growth and form characteristics. From the mid 1970's increasing levels of genetically improved seed, from seed orchards and progeny testing, have been used for reforestation. Timber Service Company's Mason Seed Orchard is located in the west end of the watershed near Sweet Home and is one of the oldest Douglas-fir seed orchards in the Pacific Northwest. This seed orchard was started in 1960 and since 1974 all their reforestation seed has come from this orchard. The Forest Service has 3 evaluation plantations within the watershed which are part of the Willamette National Forest genetic tree improvement program.

Figure 6: Seral Stage Descriptions



Seral Stage	Stand Initiation	Stem Exclusion	Understory Reinitiation	Late Succ.\Old Growth
Seral Code	SI	SE	UR	OG
Typical Age Range	0-30	15-70	50-200	150+
Current Average*	10	35	75	
Typical DBH Range	0-6"	4"-10"	8"-36"	24"+
Current Average	1"	7"	20"	30"+
Elk Habitat	Forage	Hiding Cover	Thermal Cover	Optimal Thermal
Riparian Structure	Small	Small	Medium	Large
Owl Habitat	Non-habitat	Non-habitat	Dispersal	Nesting, Rearing, Foraging
Snag Habitat	Some snags	Almost no snags	Some snags	Full complement

Adapted from Oliver and Larson (1990) for South Santiam Watershed Analysis

*Tree ages are typically younger than the age of the disturbance that created the stand.

Figure 7: Current Seral Stage Pattern

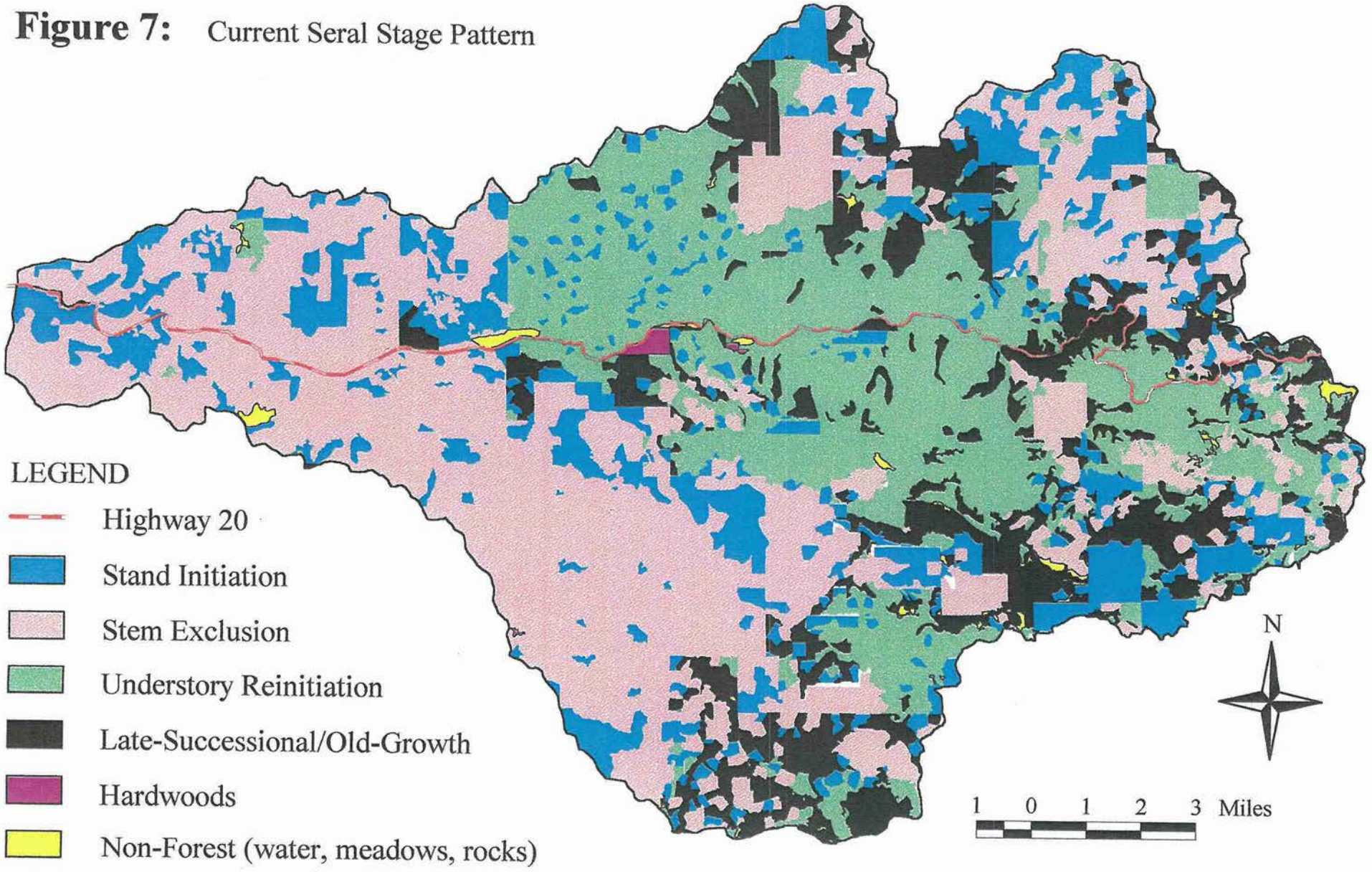


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Figure 8: Riparian Reserve Seral Stages by Subwatershed and Area

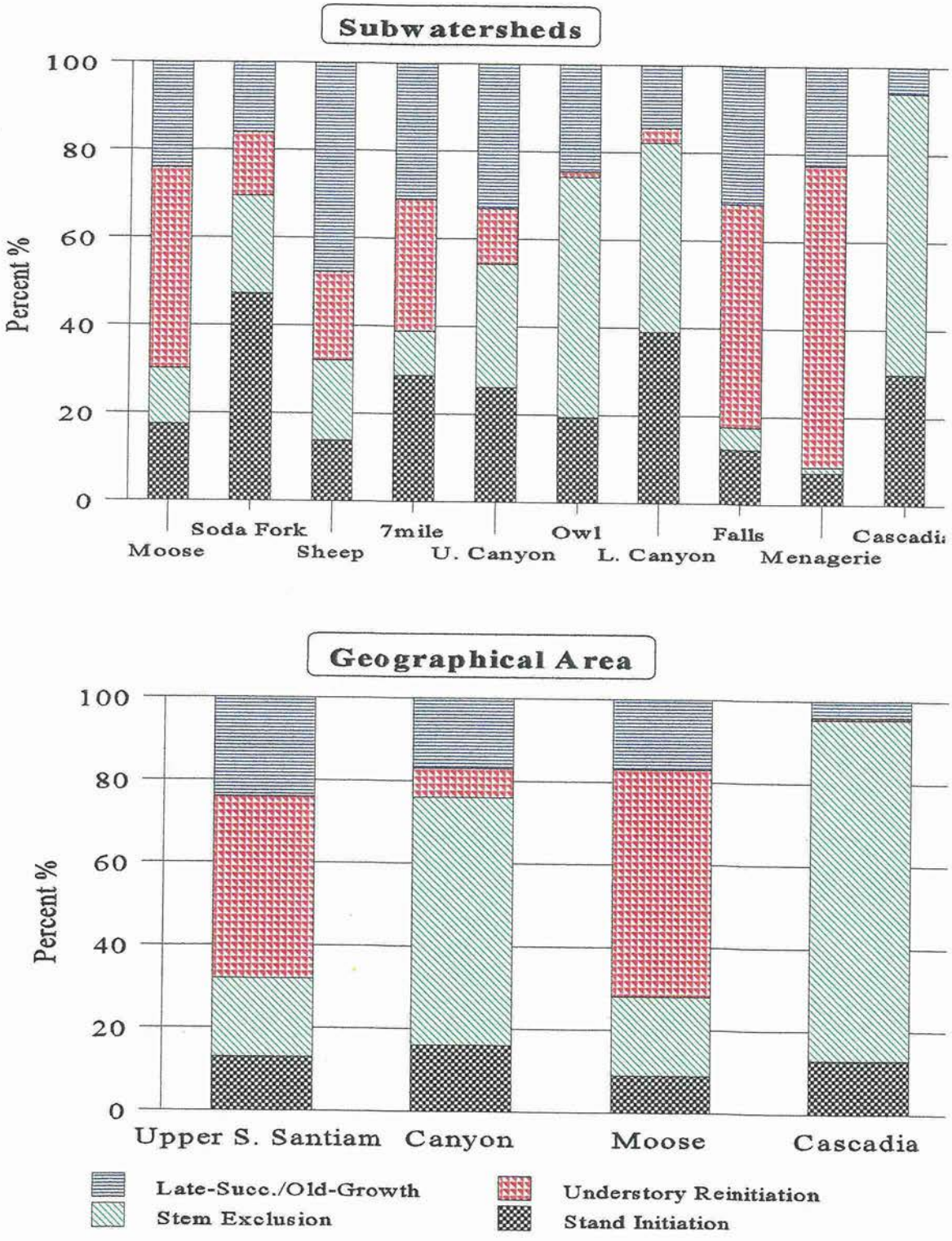
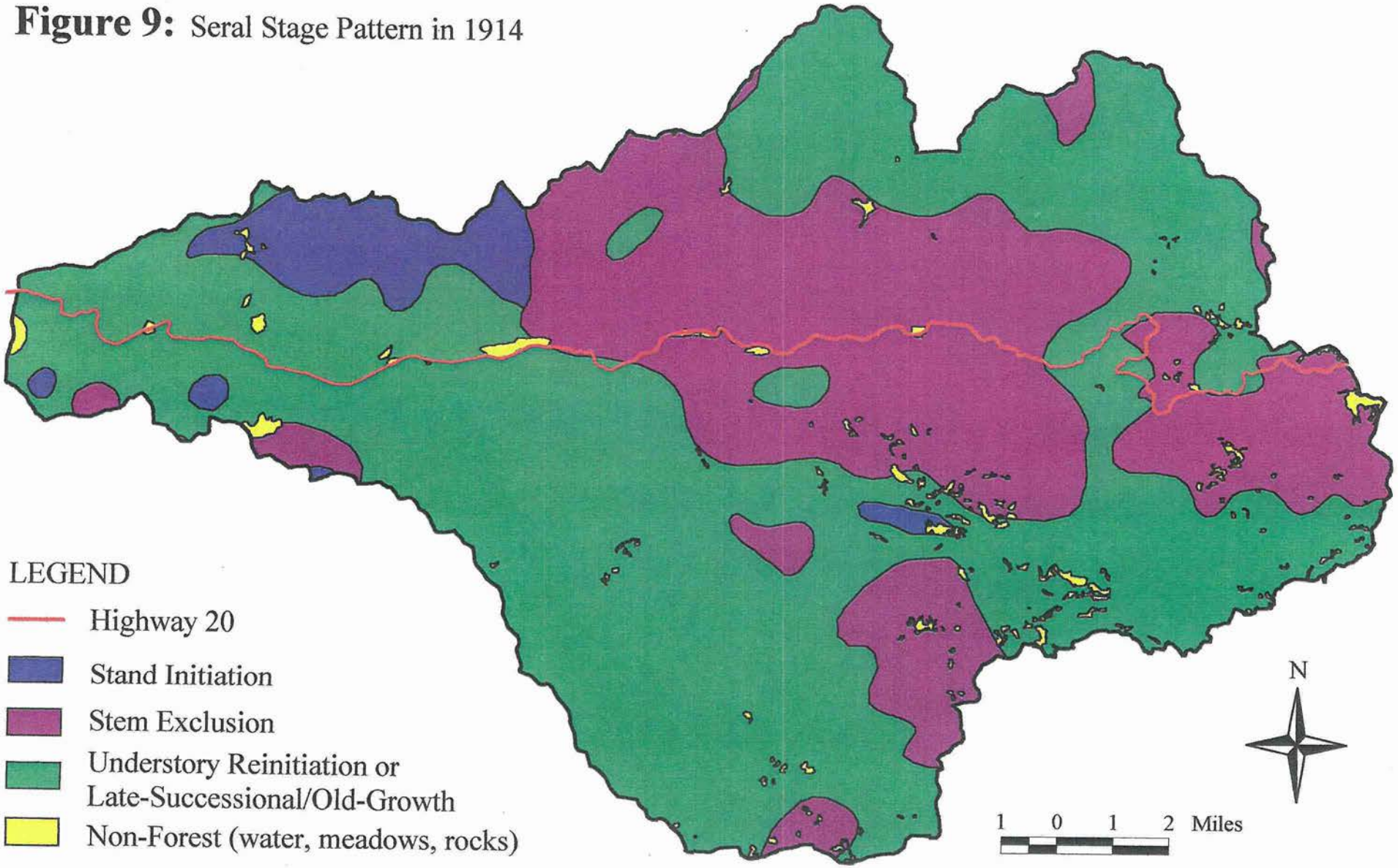


Figure 9: Seral Stage Pattern in 1914



Aquatic Wildlife

This watershed supports many fish species, from warmwater game fish and kokanee within Foster Reservoir to sculpin, dace, and native and anadromous salmonids in mainstem and tributary streams. Aquatic habitats also support a wide diversity of other aquatic dependent species, such as caddis flies, the red-legged frog and the harlequin ducks.

The South Santiam Watershed is home to the remnants of a run of wild winter steelhead which, prior to construction of Green Peter and Foster dams, numbered in excess of 2600 returning adult fish. The sixty percent of the run which spawned in the Middle Santiam no longer exists, as no adults pass over Green Peter. Of the other 40% of the historic run only two to three hundred adults pass over Foster and into the South Santiam watershed to spawn each year.

Spring chinook is the only race of salmon native to the entire Santiam watershed. Of the historic spring chinook production in the entire South Santiam system, 85% occurred above the Foster Dam site (ODFW 1992). This production was lost with the construction of Foster Dam and only partially mitigated by the construction of Foster Dam fish hatchery. Prior to reintroduction of chinook upstream from Foster Reservoir in 1994, adult chinook were not passed over Foster Dam as Oregon Department of Fish and Wildlife had concerns about disease interactions between the downstream hatchery-raised chinook and the wild run above Foster.

Bull trout has been eliminated or seriously reduced in abundance throughout most of its range (Meehan and Bjornn, 1991) due to habitat altered by land management activities, fishing pressure, and interactions with introduced fish species (USDA 1994). The last reported sighting of bull trout in the South Santiam system was in 1953 (Oregon State Game Commission 1953).

Terrestrial Wildlife

Habitat conditions are the prime determinants of wildlife abundance, both in the number of species and the number of individuals, and is directly dependent upon the condition of that habitat. Some species, such as the ubiquitous deer mouse and Roosevelt elk are found living equally well in early as well as late seral stage forest stands within the watershed. Most mammals have one habitat to which they seem better adapted and in which they are found in greater numbers (Ingles 1965). Late-successional/old-growth dependent species such as the northern spotted owl nest, forage and rear young, within the watershed where such habitats occur. Townsend's big-eared bat has been found in two caves, and a pair of peregrine falcons have successfully nested on cliffs within the watershed.

Riparian areas and freshwater wetlands are among the most heavily used wildlife habitats occurring in forest lands of western Oregon and Washington (USDA 1985). Harlequin ducks have successfully nested in the South Santiam River, and have been seen with young in Moose, Soda Fork and Canyon Creeks. Red-legged frogs, western toads, Northwestern and

Pacific giant salamanders, and many mollusk species have been found in or near many of the streams within the watershed.

Dead and down woody materials are important components of wildlife habitats in western forests which furnish cover and serve as sites for feeding, reproduction, and resting for many wildlife species. The fire and timber harvest histories within the watershed have resulted in a landscape generally deficient in large snag habitat necessary for such cavity nesting birds as the Western blue bird and pileated woodpecker. Also missing in many stands is the large down wood in various stages of decay necessary as habitat for such species as the Oregon slender salamander.

There are 35 known northern spotted owl sites within the watershed. Surveys during the past four years indicate that sites may not always be occupied from year to year. However, northern spotted owls have successfully reproduced in younger seral stage stands that have remnant large trees and snags and older seral stage stands within the watershed. Land ownership patterns within the watershed have created a mosaic of mixed aged forest stands which in turn has resulted in impediments to dispersal of this owl. Connectivity between suitable habitats and especially patterns of late successional/old growth is essential for providing biological and ecological flows that sustain animal and plant species dependent on successional/old growth (FEMAT 1993). The connectivity between Late Successional Reserve 215 (within the watershed) and 213 to the north is hampered by the checker board land ownership pattern in the Harter Mountain area. The U.S. Fish and Wildlife Service recognizes the Upper South Santiam Area as an area of concern, and is concerned that populations of northern spotted owls may become geographically isolated

This watershed is located within two Roosevelt elk management units identified by Oregon Department of Fish and Wildlife (ODFW) where elk numbers are managed to provide the optimum recreational and aesthetic benefits while maintaining elk numbers compatible with primary land uses. The area north of Highway 20 is within the South Santiam Wildlife Management Unit and the area south of Highway 20 is in McKenzie Wildlife Management Unit. Elk numbers within the South Santiam unit are estimated to be close to the management objectives of 3900 animals. In the McKenzie unit, the management objective is 5200 animals. The 1994 census estimates that there are currently 2600 animals but ODFW considers this part of the unit to be meeting their population objectives.

Within the watershed, elk utilize Moose Creek Area, Cascadia Area and the lower portions of the Canyon Creek Area during the winter (High Emphasis Winter Range). They utilize the Upper South Santiam Area the heaviest during the summer. The High Emphasis designation for this area may need to be reassessed as Forest Plan objectives for the area are no longer compatible with ODFW management direction since much of the area is now Late-Successional Reserve and will not supply very much elk forage in the future.

Social Characterization

The South Santiam watershed has a long and rich history of human activity. Humans have used this watershed as a place to live, work, and play. Evidence from Cascadia caves shows use from at least last 8,000 years ago. That use has changed over time in ways that are similar to much of the Western Cascades. Nearly 120 recorded prehistoric archaeological sites with a corollary extensive historic trail system have been recorded within the watershed suggesting an active landscape of human resource use and adaptation to changing environmental conditions. Botanical and subsistence analyses have indicated that the watershed evolved from one of moist post-glacial conditions to one of much drier conditions approximately 4500 years ago. The archaeological record suggests that as the climate, environment, and recent geology shifted, human adaptation kept pace on a broad and local scale. A detailed account of the history of the Sweet Home area from about 1850 to the 1960's can be found in "Sweet Home In The Oregon Cascades" (Carey and Hainline 1979)

Native Americans

Three tribes of Native Americans used this watershed; the Mollala; the Kalapooya; and one of the bands of the Warm Springs. Winter camps were used in the Cascadia subwatershed. Summer base camps were found in Owl, Sevenmile, and Upper Canyon subwatersheds. Major travelways for trade and subsistence consisted of the South Santiam River corridor (east/west) and the Mollala trail, a north/ south route that followed Canyon Creek and Moose Ridge between Tidbits Mountain and Cougar Rock. The benches and terraces along these major trail systems provided locations for bases camps from which foraging, hunting, and religious activities occurred. There is some evidence that these tribes used fire as a tool to maintain the productivity of area for food. Native use of fire to increase both hunting and gathering success and resource diversity is documented in early trapper journals in the Willamette Valley and in tribal oral traditions for both the valley and uplands. In the 1840's and 1850's settlers began moving into the area. Tribal populations collapsed as a result of disease. Descendants of these tribes are currently part of the Siletz, Grande Ronde, and Warm Springs reservations.

The Homestead Era

The early settlers tended to occupy the broad river terraces that are found along the South Santiam River as well as other low elevation areas that had gentle slopes. Some of these terraces are now under Foster Reservoir. Their use of the resources found in the watershed was also mainly for subsistence. Soon the need for a better transportation system was recognized and in 1864 the Santiam Wagon Road was completed. It became one of the main east\west travel corridors for the area, taking stock to be grazed in Eastern Oregon. This road allowed people to move farther up into the watershed (Walton Ranch) and settlement in the communities of Cascadia and Upper Soda. Cascadia became a popular mountain resort because of its mineral springs, abundant fish and game, camping and swimming opportunities. The first sawmills were built in the 1850's mainly to supply lumber for homebuilding in the local area.

In the 1880's there was a mining boom in the area. Most of the mining took place in the Quartzville and Calapooia watersheds since mineralization is rare in this watershed. However, hunting to support the mining population increased dramatically. Elk was hunted extensively for its hide and antlers as well as for food. Grazing of domestic livestock in Gordon Meadows probably began around this time. The need for wood from the forests in the watershed also increased but was still minimal. Most logging occurred in the areas closest to the Santiam Wagon Road and in the westernmost part of the Cascadia subwatershed. In the 1890's logs were floated from Sweet Home to mills in Lebanon.

Early Twentieth Century

Around the turn of the century mining activity died out. Homesteads in the upper parts of the watershed were abandoned because they couldn't support the families trying to live there. At this time the current ownership pattern began to take shape. The Hill family (now known as Timber Service Company) purchased the alternate sections along the South Santiam River that had been granted by the Federal government to the company that built the Santiam Wagon Road. The Cascade Forest Reserve was established in the area that is now the Willamette National Forest. Fire suppression efforts started and way trails, lookouts and phone lines were built. In 1905, the first automobile to cross the continent came down the Santiam Wagon Road and through this watershed. Construction of Highway 20 as far as Cascadia was completed in 1930. Not much timber harvest occurred in the watershed because wood was more accessible and more economical to log west of the watershed and many of the stands that were accessible to the Santiam Wagon Road/Highway 20 had burned in the 1856 and 1911 fires and consisted of relatively small trees. Agriculture was the economic mainstay of the community.

The Depression Era

The railroad made it to the area in 1931. The population of Sweet Home at that time was 189. The Civilian Conservation Corps had a camp at Canyon Creek and a work camp at House Rock. They built and improved trails and lookouts and the first roads in the watershed besides the Santiam Wagon Road/Highway 20. These roads were built mainly to access lookouts on Iron Mountain and Jumpoff Joe Mountain but also provided access for some of the first timber harvest that took place in the watershed in the 1940's. Longbow Organizational Camp was built to provide a place for Boy Scouts from the Eugene area to camp in the forest. The Ranger Station was built in Cascadia. The resort business in Cascadia became unprofitable and in 1940 the land was sold to the State of Oregon to eventually become Cascadia State Park. Construction of Highway 20 pushed farther east until it was completed in 1939. Much of this part of the highway followed the same route as the Santiam Wagon Road. A large part of the Sevenmile subwatershed burned in 1936 (?) as a result of highway construction activities . The watershed was no longer just a conduit for east/west commerce and trade but was becoming an important part of the economic base of the community. By 1939 there were 4 major sawmills operating in Sweet Home.

World War II and Post-War Era

The Sweet Home area went through a boom time. Timber harvest in the watershed increased in order to support the war effort and national post-war housing needs. The 1950 census placed the population at 3,603. By 1950, there were 8 large mills and numerous smaller ones depending on this and other nearby watersheds for their timber supply. The timber industry replaced agriculture as the economic base of the local communities. Initially, most of the harvest occurred on private lands. In the late 1940's, timber harvest began on public lands in the watershed as well. Gordon Road, Canyon Creek Road, Soda Fork Road, and Moose Mountain Road, main access roads in the watershed, were built during the 1950's. The 1950's also brought the consolidation of many smaller mills and land-holdings into the large industrial ownerships found in the watershed today.

In the 1960's, timber harvest on public lands increased dramatically in response to the economic development needs of the nation and local communities. The community also began experiencing boom/bust cycles tied to the national housing market. From 1960 to 1990, the miles of roads in the watershed tripled in support of timber harvest. Most of these roads were built under cost share agreements with the intermingled industrial owners. Other uses of the forest increased at the same time. Trout Creek and Fernview campgrounds were built. The first ascents on many of the rocks in the Menagerie roadless area were recorded. Increases in all types of dispersed recreation paralleled the national trends. The 1964 flood took out a lot of the bridges and damaged other facilities in the watershed. Most accessible streams were cleared of large woody debris in the aftermath of the flood. Foster Dam, started in 1961 and completed in 1968, was built to provide flood control, electrical power and water recreation. The U. S. Forest Service began extensive use of broadcast burning to control fuel loadings on harvest units. *"We spent half the time lighting fires so we could spend the other half putting them out."* (firefighter observation 1995). Forest management practices were quite similar on both public and private lands in the watershed. This is particularly evident in the Soda Fork subwatershed which contains the largest area of checkerboard ownership in the watershed.

The 1970's and 1980's

The late 60's and the 1970's brought enactment of many of the environmental and land management laws that influence this landscape today. The first Willamette National Forest Land and Resource Management Plan was completed in 1977. Roadless areas were delineated on public lands. The Oregon Department of Fish and Wildlife started working with the U.S. Forest Service on elk management. There was increased motorized recreational use in the watershed. Heavy timber harvest continued on public and private lands. Unit size restrictions were put in place. By the early 1980's smoke management concerns were starting to influence fuels treatment in the watershed.

In the 1980's, Sweet Home area mills were producing 1% of all the softwood used nationally and this watershed became a microcosm of the conflicts developing over management of the National Forests. What had been local issues became national issues. The Menagerie

roadless area became a Congressionally-designated Wilderness Area in 1984. There were tree sitters in timber sales in the watershed. The growing debate over old-growth and the Northern Spotted Owl was highlighted by events in the Three Creeks area (Menagerie and Sheep subwatersheds) during second round of land management planning. Even individual old trees became an issue. Anadromous fish, and particularly salmon, became an issue. On National Forest lands in the watershed, instead of removing wood from the streams, wood was starting to be put back in the channels. Closing roads for protection of wildlife and other resource concerns also became an issue for those people that used these roads for recreation. The Falls Creek Hydroelectric plant and associated diversion structure was completed in 1985. It generates 4 megawatts of electricity, enough to serve 800 households.

During the 80's, forest management practices on public and private lands became substantially different. Silvicultural practices in the stand reinitiation and stem exclusion seral stages became much more intensive on private lands (thinning, fertilization, pruning, brush control, etc.). Use of herbicides was restricted on National Forest lands and logging prescriptions became more restrictive. Timber supply from public lands was curtailed. In the late 80's eastern Linn County hit economic hard times. Mill closures were a common occurrence and resulted in an unemployment rate that often exceeded 10%. Unlike previous downturns, this one was not tied to a national recession or bad housing market.

The Current Situation

In 1990 the second Willamette National Forest Land and Resource Management Plan went into effect. This plan identified the South Santiam River and Sevenmile as being eligible for designation under the Wild and Scenic Rivers Act. Guistina Land and Timber Co. has joined Timber Service Company and Willamette Industries as a major industrial land owner in the watershed. There has been an increasing awareness of the importance of working with Native American tribes on resource management issues on public lands. In 1994, the President's Forest Plan for Managing Federal Lands in the Range of the Northern Spotted Owl was put in place. The business community is diversifying and retirees are moving into the area. Economic recovery is slowly taking place and unemployment has dropped.

The 1990 Farm Bill gave the U.S. Forest Service a role in economic recovery of the area. The community of Sweet Home established the Sweet Home Economic Development Group and Linn County communities joined to establish the East Linn County Economic Development Alliance to respond to the need to diversify the local economy. The Sweet Home Ranger District is a member of both groups. These groups have identified the following strategic goals and objectives for developing a sustainable economic base for the area:

- Maintain and/or enhance the liveable environment.
- Maintain forest-based employment and diversify the uses of wood fiber.
- Expand the economic base by developing commercial and industrial sites.
- Develop recreation and tourism capacity with a focus around the lakes, rivers, and trail systems in the area.

Issues
and
Key Questions

Issues and Key Questions *"I don't have a solution but I admire the problem."*

The issues and key questions were initially developed by the Sweet Home Ranger District personnel at a meeting on December 1, 1994. Also present at the meeting were Dave Furtwangler (Cascade Timber Consultants), Karen Strohmeyer (Cascade Pacific Resource Conservation and Development Area, Inc.), Diana Bus (Central Cascades AMA Coordinator), and Allison Reger (Willamette SO, Analyst). The Core Team further sorted, developed and refined those issues and key questions.

Sustainable Communities

Local Communities: The economy of east Linn County is intertwined with the forested, mountainous lands that comprise its geography. Changes in management of Federal lands has changed the relationship between those lands and the communities that are their neighbors. The prices now being paid for fiber have changed how and when industrial as well as non-industrial forest landowners harvest their timber resource, a factor especially in the west end of the watershed. Access to wood for home heating has been much more limited, affecting those on the margins of financial well-being the most. There has been increased use of the forest by homeless people noticed mostly along Moose Creek, Squaw Creek and a couple of spur roads in Canyon Creek. The decline of timber-industry-based employment has increased the harvest of special forest products as people are still trying to make a living off the forest resource that surrounds them. There is little information available to make management decisions on levels of sustainable harvest for many of these products. Federal lands also have an important role to play in supporting tourism and other areas of economic diversification.

Native American Communities: This watershed has been part of a major travel route, the Mollala Trail, for Native Americans for at least 8,000 years. Cascadia Cave and other archaeological evidence supports claims by three groups to traditional use of the South Santiam. The Siletz, Grand Ronde, and Warm Springs tribes have identified areas of interest to them for traditional resources and ceremonial use. Resources of particular interest to them are yew, cedar, beargrass, huckleberries, salmon, and lithic sources. The Willamette National Forest and Sweet Home Ranger District are in the initial stages of collaboration with these tribes to address their interests in a government to government relationship.

Central Cascades Adaptive Management Area: The Adaptive Management Areas were established by the President's Plan to facilitate the tie between resource management and research on Federal lands and economically sustainable communities. This watershed provides an opportunity to work in creative ways to integrate the needs of the local communities, tribes, plant and animal communities and the larger social framework of the state and nation.

KEY QUESTIONS

- SC1. What type of commodities can be produced by the watershed on a sustainable basis? Where can they be produced? How many acres of National Forest land can provide wood fiber?

- SC2. What type of watershed restoration investment is appropriate for this watershed?

- SC3. What management activities in the South Santiam watershed in general, and the AMA in particular, respond to, are supportive of and/or help implement local community Strategic Plan Goals and Objectives?

- SC4. What activities/projects/opportunities can be worked on or developed in the AMA to bring together research, resource managers, and the communities?

- SC5. What parts of the watershed have attributes that lend themselves to Native American traditional and/or ceremonial use?

- SC6. Are there conflicts between Native American traditional uses and the application of the Aquatic Conservation Strategy in this watershed?

Anadromous Fish

The South Santiam River supports a remnant of the last wild winter steelhead run in the Santiam system. Historically, this run numbered over 2000 returning adults. Foster Dam was built in the 1960's with a fish ladder and a fish hatchery. Smolt survival in the resulting reservoir has been affected by the presence of squawfish which prey on them during their downstream migration. It is also suspected that smolts are caught as part of the recreational trout fishery which is supported by the planting program and serves to increase fishing pressure in the system. Spawning occurs mainly in Moose Creek, Canyon Creek and Soda Fork. Moose Creek is currently closed to all fishing. In the last 10 years the run has declined to 200-400 returning adults per year.

Spring Chinook Salmon occupied the South Santiam system in the past as well. The Oregon Department of Fish and Wildlife cut off upriver migration of adults due to concerns about disease interactions between wild and hatchery raised salmon after the dam was built. In 1994, due to a recent change in management practices and philosophy, 75,000 smolts were released in the South Santiam River above Foster Reservoir. It is expected that these smolts will seed those areas not currently occupied by winter steelhead: Squaw Creek, Sheep Creek, the upper areas and smaller tributaries of Moose Creek, Canyon Creek and Soda Fork, and the main stem of the South Santiam.

These 2 anadromous species as well as native trout and other aquatic species are being affected by the current condition of the streams in the watershed. In 1856, a large fire in the watershed loaded

the South Santiam stream channels with lots of wood which caused an aggradation of the channels. Most of this large wood component was removed by subsequent fires, flood events, and, more recently, timber salvage harvest. One result was downcutting in the channels and today many channels including the South Santiam River run mostly on bedrock. This creates high energy stream flows that affect the ability of juvenile fish to occupy the habitat. During high winter flows they suffer a greater risk of predation and can be washed out of the streams along with essential nutrients. Lack of large wood also has decreased the amount of hiding cover (holdover habitat) available for the adult fish especially during low flows. Another result of downcutting is that some Highway 20 culverts are no longer on a grade with the river. This situation plus culverts on some other roads in the watershed hamper migration for anadromous fish as well as native resident fish.

KEY QUESTIONS

- AF1. What are the geomorphological processes operating in the watershed? Where does sediment come from and where does it go? How does it move through the system and in what time frames do these processes operate?

- AF2. What processes have affected stream channel structure, water quality, water temperatures and stream habitat conditions? What effect are these processes having on the maintenance and enhancement of aquatic functions? How have these stream attributes changed through time?

- AF3. What are the processes which have, and are now effecting the population dynamics of anadromous and resident fish and other aquatic species?

- AF4. Which streams are deficient in instream and/or riparian large wood? Why are they deficient? How much large wood recruitment can be expected from riparian areas over time?

- AF5. What, where, and in what priority do we need to do restoration or enhancement of habitat for spring chinook and/or wild winter steelhead (spawning, rearing, cover/hiding for adults)? Are there subwatersheds which can function as refugia while these habitat projects occur elsewhere in the watershed?

- AF6. Where in the watershed would it be appropriate to reestablish the link between a stream channel and its floodplain?

- AF7. For beneficial uses other than fish, what modifications of watershed processes would have a positive effect?

Forest and Native Plant Diversity

Two major conifer tree series, Western hemlock and Pacific silver fir, exist in the watershed. There are 34 forested plant associations within these 2 series (Plant Association and Management Guide, Willamette National Forest 1987). One minor conifer tree series, Douglas-fir along with several related plant associations, has also been identified in the watershed. These Douglas-fir plant associations are uncommon this far north on the Willamette National Forest and have been designated as rare forested plant associations in the Special Habitats Management Guide (WNF 1992)

Changes in the disturbance processes (fire suppression and timber harvest) in this century have affected the diversity and distribution of plant species as well as the age class distribution of forested plant communities. Timber harvest and associated road building have decreased and fragmented habitat for old-growth related plants and fungi, while simultaneously increasing habitat for invasive non-native plants. Species composition in riparian areas has been altered by the early seral conditions that follow timber harvest. Special habitats (non-forested communities) have been impacted in areas of intensive timber harvest, but not where they occur within large blocks of younger fire-regenerated stands.

Special Habitats: The occurrence of special habitats (non-forested communities) and their distribution across the landscape is central to plant diversity. Special habitats support many plant and animal species which are dependant on a particular habitat during part or all of their life history. For instance, peregrine falcons are only found associated with rocky peaks in the watershed and Townsend's big-eared bats only inhabit dry caves. Eighty-five percent of the flowering plants in the central western Cascades are found in non-forested areas such as rock outcrops and meadows which comprise only about five percent of the landscape (Hickman 1976). Timber harvest impacts to special habitats have been concentrated in the Cascadia, Soda Fork, Owl, Upper and Lower Canyon subwatersheds, where timber harvest has been the most extensive. Most of the rare plants in the watershed, including those that are on the Region 6 Sensitive Plant List, are associated with these special habitats. Six Region 6 sensitive plant species have been found in the watershed, plus one additional rare plant species that has not yet been added to the Region 6 list. There are eight species in the watershed on the Oregon Natural Heritage Program review or watch lists and 11 species in the watershed on the Willamette National Forest concern List.

Tall bugbane: One sensitive species that is not associated with special habitats is tall bugbane (*Cimicifuga elata*). This species is a perennial herb that inhabits moist, forested north slopes at lower elevations on the west side of the Cascades. Much of its habitat is under private ownership and has been altered by development or timber harvest. This species appears to respond positively to forest canopy gaps that result from features, such as rock outcrops, or small-scale disturbance processes, for instance, laminated root rot pockets. There are 11 populations of tall bugbane known to occur in the watershed. Five of these populations are within the Central Cascades AMA. There is an opportunity to learn how habitat suitability for tall bugbane can be enhanced by harvest methods that mimic natural openings and small-scale disturbances.

Survey and Manage Species: The fire history and resultant pattern of timber harvest in the watershed has led to a limited amount of habitat suitable for species associated with old-growth forest conditions, including some lichens, fungi, mosses, liverworts and vascular plants. The remaining old-growth forest in the watershed is unevenly distributed on Forest Service lands and almost non-existent on private lands. Dispersal capabilities are limited for a number of these species, thus, in a fragmented landscape, geneflow may be restricted between populations. Riparian areas, which are quicker to attain characteristics of old-growth forests, may serve an important role as corridors for dispersal and geneflow.

Non-native plants: The extensive road system in the watershed allows for continued dispersal and colonization of noxious weeds and other invasive non-native plant species. Most of these plants are colonizers of disturbed sites and are thus found on roadsides, landings, clearcuts, trails and other disturbed places. Noxious weeds and other non-native plants are a threat to native plant diversity. These species also reduce the quality and quantity of forage available to animals because many of these weeds are toxic or otherwise unpalatable. Forty species of non-native plants have been documented in the watershed. Two species of particular concern in the watershed are Himalaya blackberry (*Rubus discolor*) and evergreen blackberry (*R. laciniatus*). These two species have been documented at over 100 sites on Forest Service land within the watershed and are well established on private land. They are well suited for riparian habitats and quickly out compete and overtop the native vegetation. The ability of non-native blackberries to spread beneath a forest canopy, rather than remaining in open, disturbed sites, makes them a greater threat to native plant diversity than many of the other weeds found in the watershed.

KEY QUESTIONS

- FD1. What are the natural and human-caused disturbance processes that created the current pattern of seral stages?
- FD2. What environmental conditions are likely to have contributed to the presence of the rare forested plant associations in this watershed?
- FD3. Where are the special habitats (as defined in FW-211) in this watershed?
- FD4. What amount and pattern of seral stages is needed to maintain the function of these seral stages in relationship to native plant and wildlife habitat diversity?
- FD5. What processes created the current conditions in the Riparian Reserves? What conditions in Riparian Reserves could be enhanced by management activities?
- FD6. How will the potential harvest pattern created by the interim Riparian Reserves effect the overall functioning of the watershed? What hypotheses about these effects could be tested in the AMA portion of the watershed?
- FD7. What widths of Riparian Reserves will accomplish the Aquatic Conservation Strategy objectives in this watershed?

- FD8. What is the effect of the current condition of the interim Riparian Reserve network on the status of the former MA9b and MA9c areas (pileated and pine marten)? Do any of them need to be added back into the late successional reserve system to maintain the dispersal function meant to be provided by the Riparian Reserve network?

- FD9. What do we know about the sensitive plant species in the watershed?

- FD10. What was the historic occurrence of tall bugbane in the watershed? What effect has fire history had on tall bugbane habitat? What other types of disturbance are active in bugbane habitat and what is their effect on habitat suitability? What hypotheses about tall bugbane habitat suitability could be tested in the AMA?

- FD11. What are the appropriate management options for dealing with non-native species of concern?

- FD12. How is road use contributing to non-native plant abundance? What effect does closing or decommissioning roads have on non-native plant abundance?

Development in South Santiam River Riparian Reserve

Most of the existing development in the watershed occurs within the Riparian Reserve for the South Santiam River. This includes many sections of Highway 20, many homes and several summer cabins, the Falls Creek Hydroelectric plant, 5 campgrounds, a phone line, a power line, barrier-free fishing platforms and portions of the Old Santiam Wagon Road. Most of the recreational development proposed by the Forest Service would be located within the Riparian Reserve. It is quite naturally the place that most people find desirable for living and playing. The mixed ownership pattern in the watershed is especially evident along the South Santiam River. In the past, analyzing an individual project's effect on the river has been difficult because there has been no comprehensive analysis of the condition of the entire system. There is a need to provide context for several proposed projects along the river. These include the Federal Highways Administration's Highway 20 improvement project, new fishing platforms and associated parking areas, capital improvements and vegetation management in existing campgrounds and stream restoration projects. It would be very helpful to know how to evaluate these projects in relationship to the Aquatic Conservation Strategy given the important social component that exists along this particular waterway. Other streams in the watershed do not have capital improvements in their riparian reserve areas other than roads which have some dispersed recreational use. This recreational use is not seen as an issue at the watershed scale but may be of concern in site specific cases.

KEY QUESTIONS

- SS1. What are the effects of the current uses and facilities on the functioning of the South Santiam Riparian Reserve?

- SS2. How can proposed developments or uses be designed to be compatible with the habitat requirements in the Aquatic Conservation Strategy? What criteria should be used to evaluate project proposals?

Wildlife Population Health

Temperate coniferous forests of the Pacific Northwest provide habitats for a diverse array of plant and animal species. Urban growth, fire and fire suppression, timber harvest and road construction have caused a significant reduction and fragmentation in late seral stage forests and special habitat areas throughout the Northwest. A corresponding change in species composition and habitat complexity has occurred. Some species populations, such as many amphibians, have declined due in part to shrinking amounts of quality habitat and the inability of the species to successfully disperse across the landscape. Others, such as the barred owl, have taken advantage of the fragmented landscape to invade once inhospitable areas.

The geographic isolation of populations due to habitat fragmentation, and the decline of species populations, stresses the need to "maintain and or restore habitat conditions to support viable populations, well distributed across their current range, of species known (or reasonably expected) to be associated with old-growth forest conditions" (FEMAT 1993).

Snag dependent species: The fire history and harvest patterns in the watershed have brought snag habitat to the minimal level especially in Sevenmile, Moose, Upper Canyon, Cascadia and Menagerie subwatersheds.

Elk and other big game: The area is currently at the population objectives for Roosevelt elk set by the Oregon Department of Fish and Wildlife. However, forage quality is low in winter range on National Forest lands in the watershed and the amount of forage available is expected to decrease because of changes in National Forest management practices. The changes in harvest patterns between public and private lands may cause the elk to move to private lands in the western part of the watershed with the potential for conflicts with private land uses and values.

Northern Spotted Owl: Land ownership patterns have created a mosaic of seral stages within the Willamette Province which has resulted in impediments to dispersal of many species. The most publicized species affected by this mosaic is the Northern spotted owl. The U.S. Fish and Wildlife Service (USFWS) recognizes that past timber harvest activities on both Federal and private lands has created an Area of Concern in the Harter Mountain area and Middle Santiam River areas. The forest landscape in these areas is so heavily fragmented that the USFWS is concerned that populations of northern spotted owls may become geographically isolated. Part of the watershed is in a Critical Habitat Unit as designated by the USFWS. To more effectively evaluate projects, especially those where manipulation of riparian reserves may occur, there is a need to analyze the amount and distribution of nesting and foraging habitat in the watershed. There are currently 35 known owl sites in the watershed.

Peregrine Falcon: A pair of falcons has been known to be nesting in the watershed since 1991. Falcons are highly susceptible to disturbances within 3 miles of their nest site. The most likely disturbance factors for this pair are rock climbers, helicopters and blasting during road construction or rock pit development. These concerns effect scheduling and methods of project implementation and are best dealt with during project planning. Therefore, they will not be dealt with as an issue for this watershed analysis.

KEY QUESTIONS

- WH1. What processes have led to the current condition of the wildlife species habitats? How have these processes affected the connectivity of late-successional/old-growth habitats in the Western Oregon Cascades Province?

- WH2. What is the effect of the current conditions on function of the Riparian Reserves network as habitat for riparian wildlife species and dispersal habitat for terrestrial wildlife species?

- WH3. What areas are appropriate for management as high emphasis areas for elk? What is the current and expected future quantity and quality of Elk habitat in the watershed by area (winter and summer ranges)?

- WH4. What are the effects of roads on wildlife use in the watershed?

- WH5. What, where and in what priority do we need to do restoration or enhancement of habitat for wildlife (particularly Threatened, Endangered and Sensitive species)?

- WH6. What habitat conditions in the Late-Successional Reserve could be enhanced by habitat manipulation such as prescribed fire or thinning, etc.?

Access and Travel Management

Highway 20 is a major travel corridor between I-5 and the crest of the Cascades. It attracts people to and is the primary access for the watershed and has been for at least a century. The highway is the starting point for many backcountry roads. Because of reduced road maintenance budgets associated with reduced harvest levels on Federal lands there is a need to eliminate or close some National Forest roads and reduce the maintenance levels on others. These management actions will change where people can go and what they can do in the area and many of them don't like it. At the same time, there is a need to maintain access to private land and for fire suppression purposes on National Forest and private lands. Dispersed recreation use occurs throughout the watershed. Some of this dispersed use is occurring on closed and decommissioned roads. There appears to be some increased use of lower elevation areas of the watershed by homeless people.

KEY QUESTIONS

- AT1. What are the human use and development patterns in the South Santiam watershed?

- AT2. What is the current condition of the transportation system? What changes are expected to be made in the transportation system? What are the likely effects of these changes?

Livestock Grazing

The Hyatt/Gordon Grazing Allotment currently uses 2 areas in the watershed, Walton Ranch and Gordon Meadows. Grazing has been a disturbance mechanism at Gordon Meadows for 140 years and may have helped minimize tree encroachment into the meadow. However, several conflicts have developed over time between grazing use by cows and other resource values. The pattern of use by cows is causing a loss of archaeological information in the meadows, is adversely affecting the structure of recreational trails in the area, and is impacting the breeding habitat for amphibians, sensitive plant habitat and the overall plant composition of the meadow. In addition, as recreational use has increased, conflicts between cattle use and recreational use of the meadows have also increased. The Aquatic Conservation Strategy also presents some dilemmas for continued use of the meadows for grazing. At Walton Ranch, cows are exacerbating the existing noxious weed problem and are a source for introduction of new non-native plants. There is also a beneficial relationship between cattle grazing and elk management at Walton Ranch in maintenance of quality big game forage.

Most of the questions arising from this issue are best dealt with during the allotment planning process. The questions generated by the watershed analysis scoping session have been given to the team with responsibility for the allotment planning process, except for the one remaining question listed below.

KEY QUESTION

- LG1. Where and under what circumstances is grazing not an appropriate activity in the watershed? What parameters should be used when considering livestock grazing on National Forest lands outside of Walton Ranch?

Recreation Management

Highway 20 Viewshed: There is a perceived need for a comprehensive viewshed analysis that documents the current conditions of each visual quality objective zone so that regeneration harvest activities and other projects can be evaluated. In the east end of the watershed, there is potential for future harvest activities to occur in the scenic allocations. Partial harvest does not trigger the limits set in the 1990 Willamette National Forest LRMP standards and guidelines. Probability of this type

of viewshed analysis being needed in the near future is low. Most other visual quality concerns are best dealt with during the project planning process. Therefore, Highway 20 viewshed analysis will not be considered an issue for this iteration of watershed analysis.

The Forest Highway Project on U.S. Highway 20 (Garland Bridge to Trout Creek) has sites scattered along the length of the highway as it runs through the watershed. Concerns about the highway project will be dealt with during the project planning process.

Menagerie Wilderness: This analysis provides an opportunity to synthesize information for input into the Wilderness Implementation Schedule. The Highway 20 improvement project is directly adjacent to the wilderness boundary in a couple of locations. The effects of that proximity on the boundary are unknown at this time. It is suspected that the collection of moss as a special forest product in the wilderness is occurring. This is an inappropriate activity for wilderness.

Information collected for addressing other issues will be available for the development of the Wilderness Implementation Schedule but collection of information solely for that purpose is a low priority at this time for this watershed analysis process. The key questions that deal with special forest products and the peregrine falcon should provide the line officer the information necessary to make management decisions in this wilderness. Therefore, the management of the Menagerie Wilderness will not be addressed as an issue in this watershed analysis.

Wild and Scenic Rivers: The South Santiam (Recreational) and Sevenmile Creek (Wild) were determined eligible for Wild and Scenic Rivers designation during the land management planning process that took place in the 1980's. There is a need to verify the eligibility or ineligibility of other streams in the watershed for designation under the act. There is also a need to validate the Outstandingly Remarkable Values for the South Santiam and Sevenmile. This analysis provides an opportunity to document current information about the streams for use in whatever Forest-wide process determines additional eligible Wild and Scenic Rivers.

KEY QUESTIONS

- RM1. Which major tributaries in the watershed were not analyzed in the eligibility assessment developed for the 1990 Willamette National Forest LRMP? What attributes (Outstandingly Remarkable Values) do they have that may warrant their further consideration under the Wild and Scenic Rivers Act?

- RM2. Are the Outstandingly Remarkable Values currently listed for the South Santiam River and Sevenmile Creek valid?

Processes and Trends

Processes and Trends

"Ever stop to think and forget to start again?"

There are many processes at work in this watershed. Flood, insects, disease, and wind storms are normal processes found throughout the Western Cascades. They operate here as well and in ways that are typical. However, in this watershed, their influence tends to be localized and is overshadowed by the following key processes. More detailed discussions of these processes can be found in pertinent individual reports. In this and following chapters answers to key questions will be noted by referencing the number of that key question after the pertinent statement (e.g. SC1).

Fire

Fire is the dominant disturbance process that has affected the current conditions of the South Santiam watershed. It is more helpful to discuss human-caused and lightening-caused fire than natural and historic fire because this watershed has been occupied by humans for at least 8,000 years. Humans have used fire intentionally and accidently throughout that time.

Lightening-caused fires in the eastern headwaters and higher elevations of the watershed were often associated with precipitation, tended to stay small and leave behind elements of the pre-fire forest structure. Stand replacement fires were less frequent than underburns. In the western and lower elevation areas of the watershed, large blocks experienced catastrophic stand-replacement fire events, particularly the Moose, Menagerie and Sevenmile subwatersheds. These fires seem to have occurred during drought conditions that led to large, high intensity fires because of timing and available fuels and were lightening and/or human-caused. The geographic characteristics of the main canyon consist of an strong East-West orientation and a steep 'V' shape. This geography creates a chimney effect that intensifies normal fire season winds and has probably contributed to higher intensities and rapid spread over larger areas once fires ignited. The lack of residual large wood in the stream channels and channelbanks, where it would have been predicted to survive the known fire events of the last 100 years, suggests that repeated large fires affected these areas even before European humans settled the area.

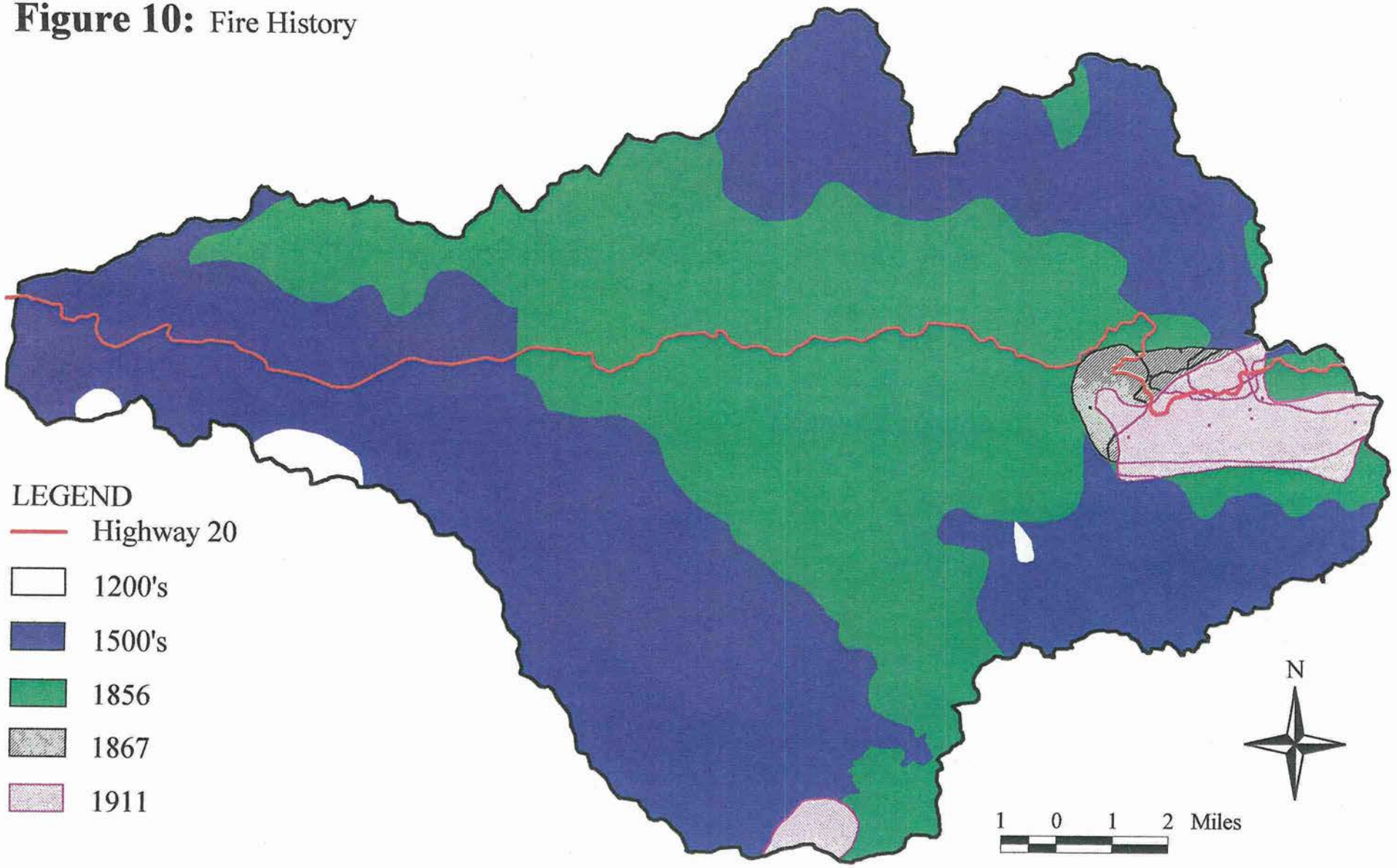
The lack of a well-developed duff layer on some north-facing slopes in these 3 subwatersheds also suggests that fire intensities were high and/or frequent for a period of time. In a more typical Western Cascades situation, the moister climate of north-facing slopes results in more duff accumulation as compared to south-facing slopes in an particular area. A probable scenario is that a stand replacement type fire burned through an area creating lots of snags and, over time, a large amount of fuels on the forest floor. Several years or decades later, a second fire came through that was carried by these heavy fuel loads and burned up snags and down wood and the duff layer even more thoroughly than the first fire.

The Regional Ecosystem Assessment Project (REAP) assessed three fire history studies done on the adjacent Blue River Ranger District of the Willamette National Forest (Morrison and Swanson 1990, Teensma 1987, and Connelly and Kertis 1992). REAP constructed a range of natural variability for the two major tree series present in this watershed. This coarse filter assessment indicated a wide range of natural variability for these tree series. Evidence indicates that portions of the watershed

experienced a more severe fire history (larger patch size, with hotter burns) than the areas sampled by the Blue River fire studies. About 25% of the watershed along the main river canyon is characterized by these conditions. Fire patterns in the remainder of the watershed seem similar to those in the Blue River fire studies.

There is one area, the Three Creeks Research Natural Area, that has not experienced a stand replacement fire in the last 800 years. This seems to be a consequence of geographic location, landform, weather patterns, and random chance. The evidence a large landscape scale fire occurring in the watershed 400-500 years ago comes from a preponderance of old growth trees in this age range. Major fires also occurred in 1856 and 1911. See Figure 10 for a map of the fire history.

Figure 10: Fire History



The Major Consequences

A. There is a general lack of snags and large down wood in the uplands, in riparian areas and in the stream channels.

B. The resulting seral stage pattern heavily influenced the harvest patterns and associated road building pattern throughout the watershed. (FD1)

C. There are soils in several areas that are younger, colluvial soils with a minimal duff layer. The distribution of duff development does not correlate well with the seral stage pattern.

The Effects of these Major Consequences

The following discussion includes observations that are generally true for this watershed. As in most things, exceptions can be found to any of these consequences somewhere in the watershed.

A. There is a general lack of snags and large down wood in the uplands, in riparian areas and in the stream channels.

- All seral stages are lacking snags and down wood structural components.
  - There is less habitat for those wildlife species that depend on these 2 structural components to support their life cycle than the distribution of seral stages would indicate.
  - The stands in many areas are just starting to develop new snags.
  - The suppression of wet-lightening-storm-caused fires has impeded the development of small snag patches that would have normally resulted from these small, low intensity fires.
- The effects of natural soil instability was not moderated by trapping of slope failure sediments by large down wood.
  - This put more sediment in the stream channels but because of lack of sediment storing structure in the stream channels, this sediment left the watershed, destined to eventually become part of the beaches on the Oregon Coast.
- Lack of down wood slowed the redevelopment of the duff layers which decreased the water and nutrient storage capacity of the soils.
  - There is potential that this has slowed the redevelopment of the mycorrhizal component of these soils.

- There is less habitat for the ground dwelling, duff-dependent wildlife, plant, and fungal species.

- This has lowered productivity in some younger fire regenerated stands by slowing tree growth. This is a very localized effect.

■ The major stream channels (South Santiam River, Moose Creek, Canyon Creek and Soda Fork) are downcut to bedrock along a greater percentage of their length than would occur if there were large wood in those channels. Geologically, the watershed is in a downcutting phase and these channel types would naturally have some reaches that are dominated by bedrock.

- These stream have lost their ability to moderate flood flows.

- The streams became disassociated from their floodplains.

- The gradient of side channels coming into the main channels steepened to the point where these confluences are a barrier to the migration of some aquatic organisms.

  - Less of the watershed is available to anadromous fish now than has been in the past.

- There is a lack of fish habitat (spawning gravels, hiding cover, and winter refugia) in the main channels as well as in some tributaries.

- The water table in the floodplains was lowered which decreased the number and size of wet special habitats that would be expected to be found on the floodplains.

  - This affects the abundance of riparian area species, including those in the survey and manage list (Table C-3, ROD).

B. The resulting seral stage pattern heavily influenced the harvest patterns and associated road building pattern throughout the watershed.

■ When timber harvest and road building began in the 1940's, they were concentrated in those parts of the watershed that were private land or supported large areas of Late-Successional/Old-Growth stands on National Forest lands. (Cascadia, Lower Canyon, Owl and Soda Fork subwatersheds)

- Areas were harvested that hadn't experienced a catastrophic fire or other disturbance event for a long time.

- The salvage of dead trees along the road system has eliminated a source for recruitment of large down wood.

- Many of these first roads are now the main transportation routes in the watershed.

  - Road construction standards from the 1940's to the 1970's included sidecasting of waste material, less compaction of the subgrade, undersized culverts, and culverts that were not placed with fish passage in mind.

    - Undersized culverts increase the velocity of the water passing through which can make them a barrier to the migration of aquatic organisms.

    - Culvert outlets are too high for aquatic species to jump or crawl upstream.

    - There are more road failures and maintenance problems on these roads than those built with more recent construction standards.

    - Roads in the Canyon Creek area created a pulse of sediment in a way that seems to mimic the geologic pattern for this area when viewed over a 500 year period.

  - Most are closely associated with the major stream channels which means they may have interrupted the functioning of the riparian area in those locations.

  - Traffic-generated sediment can be a site-specific problem on some of these roads.

- A combination of the seral stage pattern and ownership pattern along with the associated harvest pattern has had an effect on the connectivity of habitats in the watershed.

  - An estimated 53% of the watershed was in the 2 late seral stages in 1900, with a majority of that in Late-Successional/Old-Growth. Presently, 41% of the watershed is in these 2 stages with a majority in the Understory Reinitiation stage.

  - Cascadia, Soda Fork, Sheep, and Lower Canyon subwatershed harvest patterns seems to mimic historic catastrophic fire patterns that tended to create a boom/bust cycle on a large area for specific seral stages.

  - The pattern of harvest in Owl, and parts of Sevenmile and Moose subwatersheds has created a pattern that consists of smaller scattered patches of seral stages which is not as typical in the Western Cascades as the large fire-generated patch size.

  - Because of the interaction between the seral stage pattern and the harvest history, there is a lower percentage of the habitats that are associated with the Understory

Reinitiation and Late-Successional/Old Growth seral stages than was typical for this part of the Cascades over the last 400 years.

- Soda Fork subwatershed is marginal for the north/south dispersal necessary to preclude genetic isolation for the Northern spotted owl and other species associated with the Late Successional/Old Growth seral stage. North and west of this watershed in the Middle Santiam watershed, the private land ownership pattern, along with its harvest history and expected timber harvest rotation length, makes the Soda Fork subwatershed a critical north/south link between populations of the Northern spotted owl in this province.

- Cascadia is marginal for the east/west dispersal of the Northern Spotted Owl but the current conditions in the Willamette Valley west of Cascadia are the biggest impediment to dispersal. This subwatershed is adequate habitat for many other species.

- The harvest pattern concentrated the effects of different management practices. These sets of management practices tend to mimic particular fire regimes as summarized in Table 3.

C. There are soils in several areas that are younger, colluvial soils with a minimal duff layer. The distribution of duff development does not correlate well with the seral stage pattern.

- Some of these areas are less productive and still subject to surface erosion.

- These soils have a low potential for producing turbidity because they have a very low clay content.

- The minimal duff layer is one factor contributing to a higher frequency of debris chutes on these areas. Lack of large down wood and lower root strengths are other factors that contribute to this effect.

Table 3: Summary of Historic Management Practices

Time Period	Management Practices	Fire Regime	Subwatersheds
1940's to 1950's	Left wood in the stream channels Left lots of large woody debris Left some snags and cull and/or green trees No riparian area buffer Minimal fuels treatment (private and public lands)	Low frequency of high intensity fires, low intensity fires present	Cascadia Falls Lower Canyon Owl Sheep Soda Fork
1960's to mid 80's	Cleaned wood out of stream channels Left very little large woody debris Left very few snags and cull and/or green trees Left some riparian area buffer Fall-type burning conditions with low duff retention on public lands Minimal fuels treatment on private	High frequency of high intensity fires, effects of low intensity fires is masked	Cascadia Owl Lower Canyon Sevenmile Sheep Soda Fork
Mid 1980's to Mid 1990's	Putting wood back in the channels Left some large woody debris Left some snags and cull and/or green trees Left riparian area buffers Spring-type burning conditions with some duff retention requirements	Low frequency of high intensity fires, low intensity fires are present	Moose Sevenmile Upper Canyon

Trends

The following trends are also contributed to by the social processes at work in the watershed.

- Because of the accumulation of fuels probable under the current set of management practices (Table 4), there is a high probability of very high intensity fires occurring some time in the future particularly on the public lands.

- Because of the light flashy fuels being created on private lands, there is a short term high risk of catastrophic fire in the Cascadia subwatershed.

Table 4: Summary of Current Management Practices

Time Period	Management Practices	Fire Regime	Subwatersheds
Mid 1990's into the foreseeable future	Public Lands More wood in the streams Lots of large woody debris, snags, and cull/green trees left Wider riparian area buffers Fuels treatment will consist of more pile burning than broadcast burning	High frequency of low intensity fires	Moose Upper Canyon
	Private Lands Less residual large woody debris, snags, and cull/green trees Some riparian area buffers Minimal fuels treatment because of a lack of large fuels needing treatment 70 year rotation length	High frequency of high intensity fires	Lower Canyon Cascadia

- Fire suppression is allowing the accumulation of some large down wood because fire size has been minimized and there are less underburn type fires.

- It is estimated that natural stands will need to grow to 110 years old to have significant numbers of trees greater that 24" DBH. This means existing Stem Exclusion and Understory Reinitiation stands will need an average of 75 years and 30 years, respectively, to grow into this larger DBH range. Thinning can shorten these times to an average of 45 years and 20 years respectively. (AF4)

- In general, thinning in the Stem Exclusion stage can speed development of large wood on uplands and in Riparian Reserves by 30 or more years as compared to unthinned stands. Fertilization can further shorten timeframes needed to grow large diameter trees. (AF4)

Sediment Production and Transport

There is a continuous high level of production of sediment in this watershed. Large scale upland earthflows and debris chutes are the most visible methods of production. Creep and slough are less obvious but important contributors which have been increased by the effects of the fire history. Stream channels and their upper banks also contribute to the level of sediment produced by the watershed.

Not much turbidity is generally produced because the younger soils in the eastern 2/3 of the watershed are lacking in the finest sediments (clays and colloidals). In the western 1/3 (Cascadia subwatershed) there are more silty clay loams that are much more weathered and create more natural turbidity. This turbidity is evident during storm events.

Geology and the lack of down wood to trap sediments has created high energy stream channels that are highly efficient sediment transport systems. These high energy channels maintain their energy during storm events long enough to carry the finest sediments out of the watershed.

The Major Consequences

A. Sediment does not stay in the system very long because of the stream channel characteristics, one of which is the lack of structure (large down wood) discussed under Fire. It moves out storm event by storm event instead of staying in the watershed for several seasons.

B. Overall water quality is high and the nutrient levels are low because of high stream energies.

C. The mosses and other small aquatic plants have been and are being scoured from the channels because of the amount of sediments being moved downstream and the high stream energies.

D. The current stream system is very resistant to the effects of changes in the amount and timing of water produced by the watershed.

E. The addition of in-stream structures can have an immediate, dramatic influence on the retention of sediment in the system.

F. Rapid movement of the finer particles out of the watershed has created the mud flats at the upper end of Foster Reservoir.

The Effects of These Major Consequences

A. Sediment does not stay in the system very long because of the stream channel characteristics, one of which is the lack of structure (large down wood) discussed under Fire. It moves out storm event by storm event instead of staying in the watershed for several seasons.

- There are riffle and bedrock dominated stream reaches that have a lack of spawning substrates.
    - This has limited the areas suitable for reproduction of anadromous and resident fish in the Moose and Upper South Santiam Areas.

B. Overall water quality is high and the nutrient levels are low because of high stream energies.

- Clarity recovers quickly after storm events.

- Contributes to a lower level of fish production.

C. The mosses and other small aquatic plants have been and are being scoured from the channels because of the amount of sediments being moved downstream and the high stream energies.

- The nutrients normally contributed by these plants are at lower levels in these streams than streams that have a similar geomorphology but are lower energy or carry a lower sediment load.

  - Also contributes to lower fish production levels.

- There is more wetted bank instability than would exist if these plants were established.

D. The current stream system is very resistant to the effects of changes in the amount and timing of water produced by the watershed.

- The stream system's sensitivity to changes in the amount and timing of peak flows will increase as a result of stream restoration projects. These changes in peak flows may be induced by management actions and/or natural processes.

E. The addition of in-stream structures can have an immediate, dramatic influence on the retention of sediment in the system.

- There can be positive effects because the stored sediments create better fish habitat and there may be negative effects on water quality and existing facilities depending on location. These negative effects may include increased instability along the highway and adjacent to the campgrounds and increase in the length of time that turbidity affects water clarity.

- This improves the ability of streams to retain aquatic organisms and utilize organic materials.

F. Rapid movement of the finer particles out of the watershed has created the mud flats at the upper end of Foster Reservoir.

- These mud flats provide the site for the annual Sweet Home Mud Flat Races.

  - Mud-caked vehicles and $1000's spent on vehicle cleaning and repair result from this 2 day event as well as fun and frustration. Some local merchants benefit.

Trends

- This level of sediment production is expected to continue far into the future.

- The transport of sediment out of the watershed will continue if structure is not added to the channels.

Human Interactions with the Watershed

Prior to the 1940's the watershed was used mostly for the subsistence of area residents much like it had been used by the Native Americans that came before them. Major changes in the economy of the local and national economies heavily influenced the harvest history in the watershed for the next 50 years. Today resource management is political. Private land rights is an issue. Tribes are more interested in traditional and ceremonial uses of the watershed. Decline in timber harvest on public lands has decreased the availability of the financial resources needed to maintain the road system. Anadromous fish habitat management is a national issue. There is also expected to be a stable or increasing demand for wood fiber. Diverse recreational use is also expected to increase due to the growing population of the Willamette Valley.

The Major Consequences

A. Foster Dam has had a major impact on fish populations in the watershed.

B. Management of public lands road system is changing due to multiple resource objective needs and current and projected federal road maintenance budget declines.

C. Santiam Wagon Road has influenced the current conditions found in the watershed.

D. Highway 20 is effecting the South Santiam River and other streams in the watershed. It occupies about 5% of the riparian area along the South Santiam River.

E. The ownership pattern is a major influence on the pattern of activities in the watershed.

F. Harvest of timber and other forest products was a major element in the economic development of the local communities.

G. The Falls Creek Hydroelectric project was well designed and is providing electricity in cost effective way with minimal environmental effects on the Falls subwatershed. (this is it, nothing else is added in following section)

H. Humans have been a major factor in the fire history in the watershed. The consequences of this fire history were discussed at the beginning of the chapter. (this is it, nothing else is added in following section)

I. The Highway 20 corridor is an attraction for tourists and local recreationists. The proximity of the river and highway is an important element of the scenic quality of the drive between Sweet Home and Sisters. (this is it, nothing else is added in following section)

The Effects of these Major Consequences

A. Foster Dam has had a major impact on fish populations in the watershed.

- The reservoir created conditions suitable for a recreational warm water fishery (bass, blue gill and crappie) and a kokanee fishery.

- As a result of hatchery management practices, chinook salmon were eliminated from the watershed.

  - Reintroduction of these fall-spawning salmon creates a conflict with the timing of future in-channel restoration projects and other management activities.

- The presence of predators (bass and squawfish) in the reservoir is limiting the survival of juvenile anadromous salmonids during downstream migration.

  - This decreases the ability of the salmonids to reseed the available habitat because there are so few adults returning to spawn.

B. Management of public lands road system is changing due to multiple resource objective needs and current and projected federal road maintenance budget declines.

- The road system represents a large capital investment that needs to be protected by maintenance or storage.

- Roads on public lands will be less accessible due to lack of surface and roadside maintenance and less miles will be available because some roads will be decommissioned. See Figure 11 for a map of the current and predicted transportation system.

  - Traffic on roads with low maintenance standards is likely to create more turbidity than a closed road would create.

  - Less open roads on public lands will further increase the recreational pressure on private industrial lands in the watershed. The owners are putting more restrictions on public use of their lands because of increasing vandalism, fire prevention, and liability concerns.

  - Reductions in open road densities is beneficial to wildlife that are sensitive to disturbance from motorized vehicles.

- The 700+ miles of the road system has substantially increased the drainage network. This is especially evident in Upper Canyon and Owl subwatersheds.

- Habitat for some riparian species has been created in ditchlines that intercept subsurface water and behind partially plugged culverts in a watershed where small wetlands are relatively rare except for on the glacial flats in the headwaters.

- The road drainage system has influenced the timing and magnitude of peak flows but it is difficult to know whether peak flows are increased or decreased.

■ Except for Soda Fork subwatershed, open roads are not disrupting elk use of an area because of low open road densities, increasing hiding cover along existing roads and strategic wildlife road closures (for example, the road into Walton Ranch). See Table 5 for the current road densities of each subwatershed.

■ Construction, maintenance, and use of roads continues to exacerbate the spread of weeds and it is costing ever-increasing amounts of time and money in attempts to control these species.

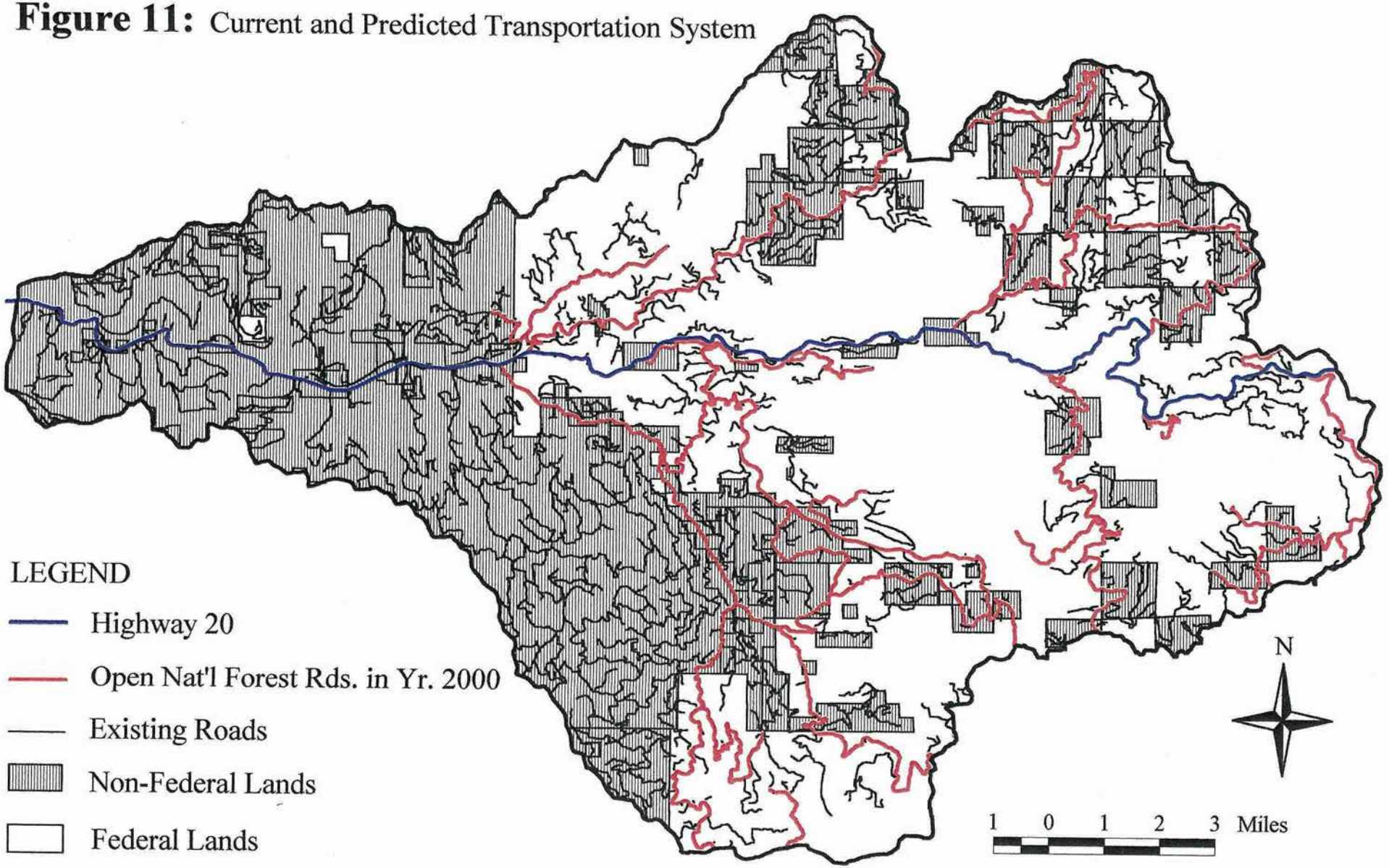
■ There will be a lower density of available four-wheel drive habitat but it will be of higher quality.

- There will be a higher density of aluminum recovery sites along the remaining habitat, providing a source of supplemental income for enterprising individuals.

Table 5: Road Densities

Subwatershed	Road Density
Cascadia	4.06
Lower Canyon	4.90
Menagerie	2.50
Moose	3.57
Owl	5.17
Sevenmile	3.32
Sheep	2.82
Soda Fork	4.50
Upper Canyon	3.04
Watershed	3.71

Figure 11: Current and Predicted Transportation System



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C. Santiam Wagon Road has influenced the current conditions found in the watershed.

- It is highly probable that there is a major highway instead of a forest road in this watershed because of the travel pattern established by the Wagon Road.

- The road has been a conduit for invasion of non-native plant species into the watershed since the 1860's because of its use as a stock driveway.

- The designation of the Santiam Wagon Road as a recreation trail complements east Linn County's Strategic Action Plan's recreation and tourism objectives.

  - This use may increase the probability of human-caused fires.

  - Reconstruction has increased the amount of sediment being produced by the Wagon Road in the Sevenmile and Sheep subwatersheds at least in the short term.

- It supported development of Walton Ranch as a homestead which has been grazed for 130 years.

  - This long term use as a pasture and elk refuge has narrowed the area of riparian vegetation on that side of the South Santiam River.

  - The ranch is an example of the old homesteads along the Santiam Wagon Road that provides opportunity for interpretation and education.

  - This river terrace would have a stand of conifers or alders on it by now except for its grazing history.

D. Highway 20 is effecting the South Santiam River and other streams in the watershed. Facilities within the watershed have added to the high energy nature of the South Santiam. The main facilities that have an effect on the system are Highway 20, forest roads, and campgrounds. Approximately 7% of the riparian area has been influenced by these facilities and the highway accounts for 5% of that 7%.

- The location of the highway has channelized the South Santiam River in the low gradient reaches such as those found by the Trout Creek, Longbow and Fernview campgrounds (where the highway and the river are within spitting distance of each other) because riprap was placed on the riverbank and the highway cut off the meanders that would naturally have occurred in these spots.

  - This creates a stream channel which cannot utilize its flood plain to moderate its energy and hence carries that energy downstream, downcutting the channel as it goes.

- This disassociation with its flood plain has other riparian-dependent species consequences; loss of wetland habitat due to dewatering of site from channel downcutting; loss of tributary connectiveness due to downcutting of main channels; and loss of refugia areas.

- West of Upper Soda, protecting the highway will affect where and how channel restoration projects in the South Santiam River are implemented .

  - Poor placement of structures could cause undercutting of the highway and/or flooding of the roadbed during 10 to 20 year interval storm events.

- The highway interrupts the functioning of the travelway between the river and the uplands for small creatures.

- There is potential for a hazardous material spill that can have grave consequences if the material ends up in the river.

  - Fluids from normal use of vehicles and equipment do not seem to be affecting water quality.

- The cinders used to provide traction on the highway in the winter months is becoming a component of the sediments in some Class II and Class III tributaries in the section between Upper Soda and Tombstone Pass.

  - These non-typical gravels are highly porous and accumulation of them can move flow to subsurface.

    - This may decrease the availability of surface-water aquatic habitat by dewatering sections of the smaller streams.

- Roadside brushing to maintain sight distance and hazard tree removal for safety of highway travelers keeps some riparian vegetation from fully developing.

E. The ownership pattern is a major influence on the pattern of activities in the watershed.

- Because private industrial lands are currently operating on a 70-80 year rotation, Cascadia, Lower Canyon and Owl subwatersheds contain a large contiguous block of the stem exclusion seral stage.

- Cost-share roads reduces the options available to manage the public road system to meet other objectives.

F. Harvest of timber and other forest products was a major element in the economic development of the local communities.

- The communities became dependent on the timber industry for primary and secondary employment.
  - Salvage practices supported a cadre of small family-owned logging businesses.
    - The requirements to retain snags and down wood on National Forest lands has contributed to a decline in the small sales these operators depended on for their business.
- The standard of living was improved because of the financial resources available to develop social, educational and civic structures.
- Most roads in the watershed were built to support timber harvest.
  - These roads made more of the watershed accessible to the general public for recreation use and firewood gathering.
    - Landings have attracted dumping of garden waste, contributing to the spread of non-native plants, especially blackberries.
- Because this harvest happened during a relatively short period of time, it has tended to create large areas that now look like stands created by stand replacement fires of the past. *("50 isn't old if you are a tree.")*
  - Cascadia subwatershed has more tree cover now than it had in 1946. It is a sea of green but is missing the snag component.

Trends

A. The Forest Plan will be a major influence on management of National Forests in the watershed in the future. It sets a broad pattern on the landscape by placement of the Late-Successional Reserve and Matrix. It has established a desired future condition that has both short-term and long-term consequences.

- There is currently a tendency in the Region to interpret the ROD very conservatively and the potential for gridlock is still high. *"We have to know everything before we can do anything."*
- The 1990 Willamette Land and Resource Management Plan created a desired future condition for elk habitat that is in conflict with the desired future conditions set forth in the 1994 Amendment because Late Successional Reserve 215 is in the same place as an high emphasis elk management area.

- Harvest prescriptions will tend away from clearcutting to thinning in natural and managed stands in the short term.

  - Maintenance of the road system to support this type of harvest will be challenging from a financial standpoint.

- The desired future condition is for riparian areas to consist of only the late-successional/old-growth seral stage. The management of Riparian Reserves, especially on Class IV streams, will not mimic fire history in this watershed.

- The pattern of regeneration harvest that will result from the Riparian Reserve pattern in the AMA and Matrix will be on ridgetops only and will not mimic fire-generated patterns which tended to burn across intermittent and small non-fish-bearing permanent streams.

  - For those wildlife guilds that are associated only with the uplands this vegetation pattern may adversely affect travelways for those species. This affect will be concentrated in the AMA and Matrix and could affect the healthy functioning of this watershed for wildlife species diversity.

- Implementation of watershed restoration as stated in the 1994 Record of Decision creates some conflicts with the processes at work in this watershed.

  - Road decommissioning may preclude access to other more critical restoration projects because decommissioning will tend to occur at a faster rate than other type of projects can be planned and funded.

  - The "Roads are bad" bias can lead to a poor investment strategy. For instance spending dollars to design and install a culvert capable of handling a 100 year flood event versus accepting the risks of culvert failure and putting those dollars towards adding structure to the channels

B. Sediment from road failures will not generally be a significant problem for streams in the watershed because of the sediment production and transport processes described previously. Most road failure sediment is expected to be storm-related and minor compared to the background sediment load coming out of the watershed.

C. On the National Forest, we will be facing year 2000 management needs with the equivalent of the 1950's road system in terms of miles of open roads. It is estimated that 139 miles of National Forest system roads will be managed as open roads by the year 2000 (See Figure 11).

- This has implications for young stand management, fire suppression efforts and the cost and ability to accomplish restoration projects.

- As closed roads revegetate, noxious weed abundance will decrease except for non-native blackberries because they can tolerate shade.

D. Most private industrial lands have a 70-80 year rotation and most have been converted to managed stands. This will generate spikes in the seral stage distribution.

- In the next 10-30 years there will be a sharp decline of the Stand Initiation seral stage in the watershed, possibly to as low as 2-3 percent of the watershed. This is due to existing age distributions and the relatively short time span in the stand initiation stage (30 years) compared to the longer time frames of the other seral stages. As the existing early seral stages move through time there will also be corresponding spikes, well above 25%, for the stem exclusion and understory reinitiation seral stages in the next 20-60 years.

- It is anticipated that this rotation length may limit options for timing and scale of timber harvest activities on the public lands.

- The large down wood left behind during logging in the 1940's and 1950's will decrease because of decay and lack of replacement potential from the stands managed with a 70-80 year rotation.

- Soda Fork subwatershed will always have low connectivity of seral stages because of the checkerboard ownership pattern.

  - Because of the pattern of forage and cover and the potential for meeting Forest Plan requirements, this could be a great place for elk.

  - Soda Fork Creek will continue to be a high energy system with low potential for changing this characteristic if restoration projects are limited to public lands.

  - The Riparian Reserves in this subwatershed will lack the continuity needed to meet the terrestrial wildlife objectives (objectives 3,4,5) of the Aquatic Conservation Strategy.

- Cascadia and Lower Canyon subwatersheds will continue to be dominated by stand initiation and stem exclusion seral stages.

  - There are likely to be more open roads in the cost-share areas (Soda Fork, Upper and Lower Canyon, and Owl) which will have a tendency to concentrate motorized recreation use in these areas.

Summary of the Relevant Trends

Fire

- Because of the accumulation of fuels probable under the current set of management practices, there is a high probability of very high intensity fires occurring some time in the future particularly on the public lands.

- Because of the light flashy fuels being created on private lands, there is a short term high risk of catastrophic fire in the Cascadia subwatershed.

- Fire suppression is allowing the accumulation of some large down wood because fire size has been minimized and there are less underburn type fires.

Table 6: Summary of Current Management Practices

Time Period	Management Practices	Fire Regime	Subwatersheds
Mid 1990's into the foreseeable future	Public Lands More wood in the streams Lots of large woody debris, snags, and cull/green trees left Wider riparian area buffers Fuels treatment will consist of more pile burning than broadcast burning	High frequency of low intensity fires	Moose Upper Canyon
	Private Lands Less residual large woody debris, snags, and cull/green trees Some riparian area buffers Minimal fuels treatment because of a lack of large fuels needing treatment 70 year rotation length	High frequency of high intensity fires	Lower Canyon Cascadia

Sediment Production and Transport

- This level of sediment production is expected to continue far into the future.

- The transport of sediment out of the watershed will continue if structure is not added to the channels.

Human Interactions with the Watersheds

- The Forest Plan will be a major influence on management of National Forests in the watershed in the future. It sets a broad pattern on the landscape by placement of the Late-Successional Reserve and Matrix. It has established a desired future condition that has both short-term and long-term consequences.

- Sediment from road failures will not generally be a significant problem for streams in the watershed because of the sediment production and transport processes described previously. Most road failure sediment is expected to be storm-related and minor compared to the background sediment load coming out of the watershed.

- On the National Forest, we will be facing year 2000 management needs with the equivalent of the 1950's road system in terms of miles of open roads.

- Most private industrial lands have a 70-80 year rotation and most have been converted to managed stands. This will generate spikes in the seral stage distribution.

Conclusions

Conclusions *"I could explain it to you but your brain would explode."*

A. The warm water fishery in Foster Reservoir is in conflict with the anadromous fish goals of Pacfish.

B. Moose Creek is an important refugia for anadromous fish above Foster Reservoir.

C. In Owl, Upper Canyon, and Lower Canyon subwatersheds, the structure is not in place yet to take advantage of sediment. Failures that produce large amounts of sediment will take out the limited structure that exists. This structure is very important because of the depressed numbers in the wild winter steelhead run in Canyon Creek.

D. Stream energies will continue to be relatively high even with adequate structure in the channels. Large woody material will only be effective in some parts of the stream system.

E. Historic sediment production levels and future sediment production levels are expected to be similar.

F. Assuming that current standards for road design and location will be used in the future, additional road construction or reconstruction will not affect the sediment transport and delivery processes in this watershed.

G. As more structure is added to the channels, the effect of road failures in the Owl, Upper Canyon and Lower Canyon subwatersheds will decrease.

H. This watershed may be more suitable for focusing on habitat needs of early seral stage species than adjacent watersheds.

I. Because of the relatively low number of acres of stands with late-successional and/or old-growth structure in the watershed, there are several large blocks of old/growth that will be important refugia, for those species needing this quality of habitat, for at least the next 30 years.

J. Because there is likely to be relatively little clearcut harvest on private and public lands in the next 20 years, the stand initiation stage is going to occupy a smaller part of the watershed as these 2 decades unfold.

K. Silvicultural treatments can speed the development of late-successional structure in the stem exclusion and understory reinitiation seral stage stands in this watershed.

L. National Forest lands in this watershed can provide a minimum of 6MMBF of wood fiber per year over the next 20 years and maintain the functioning of the current stands of late-succession/old-growth and the Riparian Reserves. This assumes thinning or other partial harvest prescriptions would be the only harvest prescriptions for the next 20 years. (SC1)

M. Past stand replacement fires burned over the Riparian Reserves on many small permanent and intermittent streams and those kinds of fire are likely to behave the same way in the future.

N. The collection of items for traditional use by Native Americans will generally not conflict with the Aquatic Conservation Strategy. Conflicts may arise if a resource can only be obtained from a particular site or at a particular time. (SC6)

O. Current and most foreseeable recreation projects will not detract from the healthy functioning of this watershed because of their scale.

P. Human inhabitance has been and will be a major influence on this landscape and there will continue to be conflicts over land and resource use and management for the foreseeable future.

Q. The land ownership pattern will continue to be a major influence in this watershed well into the future.

Stuff Grows, Gravity Happens, and It's Complex!

Recommendations

Recommendations

"I can see clearly, now the brain is gone."

The following recommendations assume that site-specific project analysis will proceed most projects and there will be times when these watershed-scale recommendations will not make sense for a specific location. These recommendations only apply to National Forest lands unless specifically stated otherwise.

Sustainable Communities

Local Communities:

Forest Commodities: (SC1)

- A1. Harvest of **Special Forest Products** in accordance with the Willamette National Forest Plan standards and guidelines is generally OK in Forest Matrix and the Adaptive Management Area and in the stand initiation and stem exclusion stands in the Late-Successional Reserve. This will require a site-specific amendment to the Forest Plan. Current regulations prohibit commercial harvest in the Menagerie Wilderness.

- A2. **Firewood** gathering is an appropriate activity in the Forest Matrix and the Adaptive Management Area. In the Soda Fork subwatershed, it needs to be sensitive to poor connectivity of late-successional/old-growth habitat and lack of down wood.

- A3. **Timber Harvest**: In the Forest Matrix the best opportunities for timber harvest in the next decade are in Sheep and Sevenmile subwatersheds. In the Adaptive Management Area thinning projects should be used to test Riparian Reserve hypotheses early in the planning cycle. In the Late-Successional Reserve concentrate on accelerating Stem Exclusion and Understory Reinitiation stands to late-successional structure in high priority stands.

Strategic Plan Goals and Objectives: (SC3)

- A.4 Promote recreational opportunities in the forest setting, such as the Santiam Wagon Road. In this way, visitors know about a wider range of activities available to enhance their enjoyment of the area thereby encouraging longer stays and return visits to the East Linn County area. The Forest Service should stay involved with community organizations so that coordination of efforts is enhanced.

- A5. Pursue the development of projects listed in the Sweet Home Ranger District Recreation Management Plan, Highway 20 Corridor Plan and Dispersed Recreation Strategy.

- A6. Use methods of accomplishing watershed restoration and other management activities that provide stable, year-round employment opportunities for the local community.

Native American Communities: (SC5, SC6)

- A7. Utilize the Adaptive Management Area concepts to enhance communications and collaborative relationships with the Grande Ronde, Siletz, and Warm Springs tribes.

- A8. Cascadia Cave should be managed to protect the scientific resource and tribal interests. This may include being placed in public and/or non-profit ownership.

- A9. Utilize Walton Ranch as a traditional encampment area for the purpose of educating Native American youth in traditional and ceremonial practices. This setting is similar to those historically used in the watershed.

- A10. Maintain and enhance the traditional huckleberry fields in the Cougar Rock Special Interest Area.

- A11. Restore the camas prairie on Wausau tract (in north part of Section 34, T.13S., R3E.).

- A12. Involve Native American youth in native plant transplanting and seed collection .

AMA Opportunities: (SC4)

Test the assumptions made in the Forest Plan Record of Decision and in this watershed analysis. These are stated as hypotheses.

- A13. Firewood can be supplied in a way that meets community needs, is cost-effective to manage and does not impair ecological processes

- A14. Harvesting of special forest products can be done in an ecologically sustainable way.

- A15. Thinning and some special forest harvest in Riparian Reserves can meet Aquatic Conservation Strategy objectives.

    - Currently 75% of the Riparian Reserves in Moose subwatershed are in the Understory Reinitiation and Late-Successional/Old-Growth seral stages and those areas along all fish-bearing streams should function only as controls when doing any timber harvest activities.

    - Use Rosgen level 3 channel typing for testing channel morphology portion of Riparian Reserve objectives 1 and 2.

- A16. Riparian Reserves meet the Aquatic Conservation Strategy objectives for terrestrial species.

- A17. In-channel restoration structures are accomplishing their objectives. Moose Creek could be included in the Oregon State University/PNW Research Station pool complexity study.

- A18. An adequate quality and quantity of elk forage under partial canopy conditions. Validate and/or adjust the Wisdom model for big game habitat.

- A19. Silvicultural treatments in stand initiation, stem exclusion, and understory reinitiation stands do accelerate the development of late-successional structure. Tie in with the Young Stand Study and the Very Young Stand Study efforts.

- A20. Economically viable livestock grazing can be compatible with the Aquatic Conservation Strategy.

- A21. Tall bugbane population viability is related to various small-scale disturbance processes. (FD10)

(End of hypotheses)

Anadromous Fish

Restoration needs: (listed in priority order) (AF5)

- B1. Establish cooperative agreements with industrial landowners for management of Canyon Creek to provide anadromous fish habitat. (SC2)

- B2.Modify stream energies in selected areas mainly to improve anadromous fish habitat.

    - Add structure to Canyon Creek, Moose Creek, some areas in the South Santiam River, and Soda Fork (listed in priority order).

- B3. Eliminate fish passage barrier created by culvert on Suttle Camp Creek on Rd. 2041.

- B4. Focus on cooperative management of Soda Fork Creek for anadromous fish habitat in Section 18 and 19 (T13S, R5E) and/or acquire Section 19 to improve management efficiency.

Forest and Native Plant Diversity

Seral Stage Distribution: (FD4)

Each of the four seral stages have plant and wildlife constituencies. We do not yet know all the species associated with each seral stage or their degree of dependence on a particular stage. Keeping approximately equal proportions of the early and late seral stages in the watershed will minimize risk of adversely impacting any one species that may depend on a particular seral stage. The Forest Plan requires that at least 15% of Federal lands in a watershed be in stands where the average diameter of the overstory trees is greater than 21" (Forest Plan, C-44). Currently 36% of Federal lands meet this criteria. The 1990 LRMP Standard and Guideline FW-205 recommends minimizing the effects on significant old-growth stands and connective corridors.

- C1. Given the allocation and ownership pattern and the fire history in the watershed, support the trend towards a 50%-50% distribution between the early and late seral stages over the long term to maintain habitat diversity. The available land base and harvest scheduling on National Forest lands will only allow minimal opportunities to affect the sharp decline in the stand initiation stage over the next 10-30 years.

    - One way to help level out projected large seral stage fluctuations is to thin to very wide spacings in stem exclusion stands (50-100 trees per acre) and some understory reinitiation stands (20-25 trees per acre). This would allow enough light to the ground to create forage and at the same time keep the option open to allow that stand to develop toward an late-successional/old-growth stage. In many ways, this type of disturbance is consistent with medium mortality natural fire disturbances.

    - Provide some stand initiation seral stage in Moose, Owl, and Upper Canyon subwatersheds over the next 30 years

    - Alternatives that keep some level of stand initiation seral stage in the landscape should be considered during project planning.

- C2. Continue the establishment and growth enhancement silvicultural activities in the Stand Initiation and Stem Exclusion seral stages in ways that meet objectives of the different land allocations.

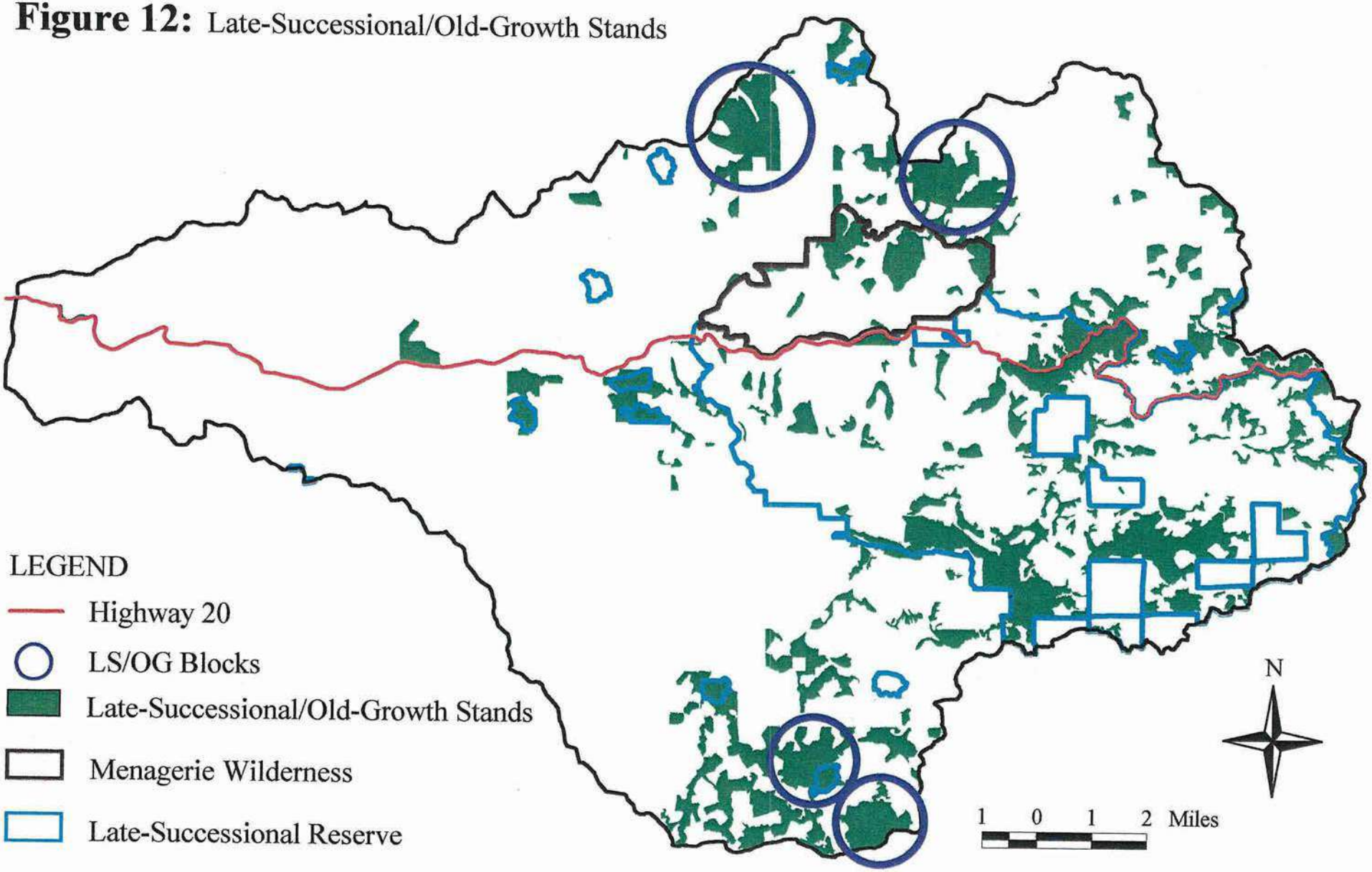
The following recommendations prioritize management of current late-successional/old-growth stands in the watershed so that at least 15% of Federal lands will be in stands meeting the 21" average diameter criteria.

- C3. Delay any harvest for at least the next decade (1995-2005) in large blocks of late-successional/old-growth found in upper Moose Creek, headwaters of Canyon Creek and east of Moose Mountain. These stands are the most significant old-growth stands outside the Menagerie Wilderness and Late Successional Reserve 215 (See Figure 12). (1990 LRMP FW-203 and FW-205)

- C4. Maintain and/or enhance **most** existing late-successional/old-growth stands in Moose, Sheep, Soda Fork, and Sevenmile subwatersheds so that they can provide mitigation for the current poor connectivity between Late-Successional Reserve 215 and Late Successional Reserve 213 to the north.

- C5. Recommendations C3 and C4 will result in at least 17% of Federal lands in the oldest seral stage. Late-successional/old-growth stands in the other subwatersheds are a lower priority for retention. Refer to the Ecologically Significant Old-Growth ratings for these stands to determine priorities. In general, those stands providing the best interior habitat will be a higher priority for retention in the next decade when doing project level planning. Consider leaving late-successional/old-growth fragments to meet the 15% green tree retention standard for regeneration harvest units. (Forest Plan C-41 and C-44)

Figure 12: Late-Successional/Old-Growth Stands



April 1995

Riparian Reserves: (FD7)
There are 5 objectives defined in the Aquatic Conservation Strategy of the Forest Plan for the Riparian Reserve network. They are as follows:

Objective 1: Maintain and restore riparian structures and functions of perennial and intermittent streams.

Objective 2: Confer benefits to riparian dependent and associated species other than fish.

Objective 3: Enhance habitat conservation for terrestrial organisms that are dependent on the transition zone between upslope and riparian.

Objective 4: Improve travel and dispersal corridors.

Objective 5: Provide for greater connectivity. Serve as connectivity corridors among the Late-Successional Reserves.

Riparian Reserve Widths:

- C6. 1990 LRMP widths are adequate for achieving Objectives 1 and 2 in Menagerie subwatershed.

- C7. Interim Riparian Reserve widths are adequate for achieving Objectives 1 and 2 in Soda Fork, Sevenmile, Owl, and Upper Canyon subwatersheds.

- C8. A combination of 1990 LRMP and interim Riparian Reserve widths are adequate for achieving Objectives 1 and 2 in Falls, Moose, Lower Canyon and Sheep subwatersheds.

- C9. No recommendations for Riparian Reserve widths are made for Cascadia subwatershed because it is does not include any Federal land.

- C10. There is not enough information available at this time on wildlife needs to make recommendations for the Riparian Reserve widths necessary to accomplish Objectives 3, 4, and 5. Until that information is available, interim widths will be established in all subwatersheds.

Riparian Reserve Management: The Record of Decision recognizes that some management actions may be helpful within the Riparian Reserves if they are to attain the desireable late-successional vegetative structure. It is assumed that working towards this structure will also benefit the terrestrial species that depend on that type of structure.

- C11. Re-establishing links with the floodplain are best pursued in Canyon Creek because there are lots of opportunities there and it has the best potential for improving fish habitat. It is appropriate in other streams where opportunities exist and there is low risk of damaging existing facilities. The South Santiam River is the 2nd priority in highly selective areas because of the need to improve chinook salmon habitat. Soda Fork Creek is the 3rd priority and success depends on modifying stream energies first. Moose Creek has few floodplains and is 4th priority for this reason. (AF6)

- C12. 35-85% of the Riparian Reserves in Owl, Upper and Lower Canyon, Soda Fork, Sheep (the part that is Forest Matrix), and Sevenmile subwatersheds and along non-fish bearing streams in Moose subwatershed are in the stand initiation and stem exclusion seral stages. Management activities to enhance species diversity, diameter growth for future large wood recruitment to streams, and/or development of late-successional structure is appropriate in areas that currently lack complex structure and/or plant species diversity. (FD5)

- C13. Harvest of special forest products in Riparian Reserves is appropriate if it will help maintain and/or enhance Aquatic Conservation Strategy objectives and is a low risk project such as bough harvest.

- C14. The Riparian Reserve network in this watershed is adequate for replacing the dispersal function of Management Areas 9b and 9c as delineated for the 1990 LRMP. (FD8)

- C15. Small scale projects such as fishing platforms and trails should be designed to avoid small wetlands, river terraces that contain special habitats or an accumulation of large down wood. They should also be designed in ways that doesn't add to the high energy of the streams.

Sensitive Plants:

- C16. *Botrychium minganense* and *B. montanum*: Identify, inventory and retain stands with significant cover (>50%) of western red-cedar or incense cedar. Plant pockets of western red-cedar on moist, flat sites adjacent to wetlands and riparian areas between 3-4000' elevations to reestablish habitat for these species; many of these sites have been harvested and replanted with Douglas-fir.

- C17. *Cimicifuga elata* (tall bugbane): Promote studies in the AMA to determine how harvest methods can mimic natural openings and small-scale disturbances that may enhance habitat. Allow *Phellinus weirii* (laminated root-rot) pockets in areas that are suitable habitat for tall bugbane to convert to hardwoods in the canopy.

- C18. *Montia howellii* (Howell's montia): Control the Himalaya blackberry that is encroaching on the only population of this species in the watershed.

- C19. *Romanzoffia thompsonii* (Thompson's mistmaiden): Eradicate St.John's-wort (*Hypericum perforatum*) from mistmaiden population at Tombstone Pass.

Special Habitats/Rare Forested PA's/Special Areas:

- C20. Verify the rare plant associations in Sevenmile stands 268, 269 and 271; delete these areas from project if they are in the Douglas-fir series.

- C21. Establish Two Girls and Canyon Creek Botanical Special Interest Areas to protect sensitive species, rare plant associations and special habitats.

- C22. Write a management plan for the Three Creek Old Growth Grove that addresses the recommendations made by the Three Creek Old Growth Task Force.

- C23. Eradicate noxious weeds, particularly St. John's-wort, from the Iron Mt./Echo Mt. Botanical Special Interest Area.

- C24. Analyze the possibility of restoring the wetland on the east side of the Moose Creek parcel to promote *Camas* so. for Native American use while maintaining winter forage for elk. This will entail removal of non-native blackberries and seeding with native species.

Noxious Weeds and Invasive Non-native Plants: (FD11)

- C25. Continue collecting and propagating native species for use on decommissioned roads and other ground-disturbing projects that create habitat for non-native species.

- C26. Use of herbicides on new invaders as outlined in the Willamette National Forest Integrated Weed Management Environmental Assessment is an appropriate strategy for use in this watershed. The amount of herbicides applied will be insignificant as compared to the amounts used on adjacent private lands.

- C27. Amend the Integrated Weed Management Environmental Assessment to include control strategies for non-native blackberries.

    - Complete a survey for non-native blackberries in the watershed and repeat the roadside weed survey done in 1989 to document changes in populations of the five species recorded in that survey. Aggressively control non-native blackberries in areas of the watershed where they are not well-established using manual removal methods.

    - Control blackberries, possibly with use of prescribed fire, at old house site in Wausau Tract to promote forage for possible use as a livestock grazing site.

Survey and Manage Species - specific mitigation measures for survey and manage species can be found in Appendix J2 of the FSEIS (1994). The following are some of the more general recommendations that can benefit many of these species simultaneously.

- C28. The 15% green tree retention managed Matrix stands can be scattered and/or left in clumps. These trees should be large, with large lateral branches and emergent crowns. The same retention trees need to be left over successive harvest rotations. Clumps greater than four acres will aid in windfirming and moderate the microclimate.

- C29. Analyze the possibility of establishing Tombstone, Sheep Creek, and Longbow Mycological Special Interest Areas to protect rare fungi as recommended in Appendix J2 of FSEIS.

Development in the South Santiam River Riparian Reserve (SS2)

- D1. Projects that parallel the river that would remove large trees along a major portion of the river would exacerbate the effects of the highway on the Riparian Reserve and should be avoided.

- D2. Small scale projects are OK but should be designed to avoid small wetlands, river terraces that contain special habitats or an accumulation of large down wood. Any project should be designed in a way that doesn't add to the high energy of the river.

- D3. Design projects to avoid increasing the risk of hazardous materials spill reaching the river. Continue to coordinate with the Oregon Department of Transportation.

Wildlife Population Health

Snag dependent species:

- E1. Improving snag habitat is the highest priority for wildlife habitat restoration in this watershed. Efforts should be concentrated in Late-Successional Reserve 215 first. (WH5)

Elk and other big game:

- E2. Provide some stand initiation seral stage in Moose, Owl, and Upper Canyon subwatersheds for the next 10-30 years to provide quality elk forage until private industrial lands begin harvesting their second rotation.

    - In lower elevation areas, areas managed to provide forage should generally be in managed stands rather than on closed road prisms to avoid conflicts with the noxious weed control recommendations.

- E3. Moose and Soda Fork subwatersheds are best suited for management as high emphasis elk management areas in the long term. (WH3)

Northern Spotted Owl:

- E4. Consolidate the checkerboard pattern in Soda Fork and Sheep subwatersheds with Soda Fork being predominately private land and Sheep being predominately Federal land

- E5. **Late-Successional Reserve 215:** See Appendix E for a draft of the Late-Successional Reserve assessment. (WH6)

- E6. **Timber Service Company Land Exchange:** In support of the continuity of habitat within the Late-Successional Reserve, acquire Sections 5 and 9, T.14S., R.5 E.

Other wildlife habitat restoration: (WH5)

- E7. Restoration and/or enhancement of wetlands is the 2nd priority for wildlife habitat restoration.

- E8. Improve bat habitat where possible. For instance, install bat boxes under bridges.

- E9. Restore and/or enhance other special habitats.

- E10. Improve purple marten (a neo-tropical bird) habitat by installing nest boxes next to wetlands.

Access and Travel Management (SC2)

- F1. Since sediment is not generally a problem in this watershed, road decommissioning and storm-proofing are adequate and preferable methods of decreasing annual road maintenance costs as compared to road obliteration. This will protect the capital investment in these roads since many of them will be needed for future projects.

    - Dispersed recreation is an appropriate use in the watershed that needs to be considered along with other resource needs as part of site-specific decisions dealing with road closures. (SC3)

    - Coordinate with the other watershed restoration priorities listed in this chapter as much as practical.

    - Survey for noxious weeds and pursue appropriate eradication strategies before closing roads. Allow red alder to invade roadbeds to shade out weedy species. Higher elevation roads that are not likely to revegetate quickly after closing should be seeded with native herbaceous species.

    - Closely monitor commercial moss and lichen harvest and discourage illegal harvest of these species through law enforcement and road closures below 3000' elevations in Moose, Menagerie, Lower Canyon and the lower part of Falls subwatersheds. Instituting year-round closures on roads that are now closed only in the winter would benefit these species because illegal harvest occurs in the summer and fall when these species are dry.

- F2. Fix unstable culvert fills and do sidecast pullback in the Canyon Area to minimize turbidity and regulate the timing of sediment input until increased levels of in-channel structure are available for sediment storage. Coordinate with the recommendations for anadromous fish habitat restoration.

- F3. Installing 100 year flood culverts is a very low priority for watershed restoration investment in this watershed.

Livestock Grazing (LG1)

- G1. Grazing is not appropriate in the Menagerie Wilderness.

- G2. The existing use at Walton Ranch is not affecting the functioning of the South Santiam River Riparian Reserve. Potential use on the Wausau Tract will not affect these functions either.

- G3. Between the South Santiam River and 3500' elevation grazing will not affect the functioning of Riparian Reserves in general.

    - Small wet special habitats will need monitoring and may require protection that can be accomplished by placement of physical barriers or by timing.

- G4. Above 3500', the existing natural meadows are relatively rare in this watershed and are a low priority for grazing.

    - Timing, scale of operations, and other management practices are more critical to meeting Aquatic Conservation Strategy objectives.

- G5. Maintain noxious weed-free areas of the watershed by quarantine of livestock at Walton Ranch until their digestive system has passed the feed they eat before arrival and/or timing in relationship to weed flowering cycles.

Recreation Management

Highway 20:

- H1. Maintain the slow, windy, scenic nature of this travel route. (SC3)

- H2. Maintain the district's hazardous materials spill plan.

- H3. Support the addition of turn lanes for safety reasons.

Streams for further study under Wild and Scenic Rivers Act: Potential Outstandingly Remarkable Values are listed for each (RM1).

- H4. Squaw Creek - Scenery (waterfalls, vegetation and geology)

- H5. Falls Creek upstream from Rd. 2032-349- Geology/Hydrology (ridgeline stream, meadow)

- H6. Moose Creek - Anadromous Fish (wild winter steelhead)

Geology/Hydrology (landflow blockage)
Scenery (engorged stream, clear water, lake)

Outstandingly Remarkable Values: The following Outstandingly Remarkable Values were validated by information generated by this watershed analysis. (RM2)

- H7. South Santiam River - Recreation, Fisheries, Prehistoric and Historic.

- H8. Sevenmile Creek - Scenery
  Prehistoric and Historic may be ORV's but require further analysis.

Miscellaneous

- I1. We don't have a crystal ball to predict all the possible kinds of small scale projects that may be proposed in the future. What we do know for now is that they generally will not alter the processes operating in this watershed.

Data needs *"It would sure be helpful to know this stuff for the next iteration!"*

- Fish presence surveys in the Class II/III transition area of streams.

- Stand exam data in the Stem Exclusion and Understory Reinitiation stands on National Forest lands (except Menagerie Wilderness).

- Channel typing and stream classification, especially on Class IV streams.

- Update the information on transportation system to reflect recent and expected changes.

- Distribution and abundance of sensitive wildlife species.

- Special habitats need to be inventoried and put into GIS. (FD3)

- Distribution and abundance of sensitive plant species. (FD9)

- Extent and location of Doug-fir rare forested plant association. Locate during future stand exams. They mostly occur on scattered sites associated with dry, unsuited soils. (FD2)

Monitoring *"You are in an endless loop...endless loop...endless loop..."*

- Monitor the effect of recreational use of decommissioned roads on accomplishing the treatment objectives for those roads.

- Monitor vegetation in Gordon Meadows for possible species composition changes resulting from the removal of livestock.

- Monitor the affect of opening a decommissioned road on noxious weeds. (FD12)

- Continue the long-term water quality monitoring on Moose Creek. (Ed Hasted's good work)

- Utilizing state water quality standards, monitor the effect of watershed restoration projects on water quality. (AF7)

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Appendices

"Now where did I put that.....?

Appendix A. References

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Appendix B. List of Reports

Access and Travel Management, Marilyn Hubbard, 15 pages

Botany, Alice Smith, 29 pages

Fire History, Tim Bisby, 5 pages

Fisheries, Todd Buchholz, 28 pages

Heritage Resources, Tony Farque, 13 pages

Hydrology, Dave Halemeier, 61 pages

Recreation and Special Uses, Marilyn Hubbard, 9 pages

Soils and Geology, Doug Shank, 70 pages

Vegetation and Silviculture, Bill Porter, 31 pages

Wildlife, Todd Buchholz and Virgil Morris, 32 pages

Appendix C. Watershed Analysis Team

Core Team

Todd Buchholz - Fish Biologist
Dave Halemeier - Hydrologist
Marilyn Hubbard - Civil Engineer
Bill Porter - Silviculturist
Doug Shank - Geologist
Donna Short - Team Leader

Extended Team

Nancy Ashlock - Fire
Tim Bisby - Fire
Ed Dalton - Engineering Technician
Dean Devlin - Geographic Information Systems manager
Hope Ellington - Cartographer
Tony Farque - Archeologist
Katy Haberkorn - Recreation, Mining and Special Uses
Bob Korepta - Fire
Ken Loree - Silviculture
Brian McGinley - Recreation, Wild and Scenic Rivers
Dean Mills - GIS Digitizing
Virgil Morris - Wildlife Biologist
Wayne Shilts - Project Engineer
Alice Smith - Botanist
Gene Stalnaker - Information Manuscripting
Daren Utley - Forestry Technician and all-around great Helper
Joanne West - Public Affairs and Community Development

Other Forest Service Contributors

Karen Austin - Willamette NF/Siuslaw NF Wildlife Ecologist
Deigh Bates - Willamette NF Forest Hydrologist
Diana Bus - Central Cascades AMA Coordinator
Neal Forrester - Willamette NF Strategic Planning Coordinator
Sarah Greene - PNW Researcher
Cindy McCain - Willamette NF/Siuslaw NF Ecologist
Allison Reger - Willamette NF Analyst
Fred Swanson - PNW Researcher

The Watershed Analysis Team met with the Forest Supervisor on the following dates:

Issues and Key Questions - December 8, 1994
Resource Stories - March 3, 1995
Recommendations - April 7, 1995

Appendix D. Public Contacts

Adjacent Landowners

Campbell Group - Russ Anderson
Cascade Timber Consultants - Dave Furtwangler and Howard Dew
Guistina Resources - Pete Sikora
Guistina Land & Timber Co. - Steven Horvath
Rosboro Lumber Company - Steven Akehurst
Willamette Industries - John VanCleave

Other Agencies

U.S. Army Corps of Engineers - Bob Magne (District Biologist), Kim Larson, and Mike Posovich
U.S. Fish and Wildlife Service - Ray Bosch
Linn Soil and Water Conservation District - Jane Keppinger and Lorriane Stahr
Oregon Department of Fish and Wildlife - John Haxton
Oregon Department of Forestry - Lee Vaughn and Scott Proctor
Oregon State University Cooperative Extension Service - Fielding Cooley
Oregon State University College of Forestry - John Tappenier

Tribes

Confederated Tribes of Siletz - Delores Pigsley
Confederated Tribes of Grand Ronde - Mark Mercier
Confederated Tribes of Warm Springs - Charles Calica

Others

Jack Barringer - retired Timber Services Company manager
Tom Bauman - local rock climber
David Bayles - Pacific Rivers Council
Terry Deacon - Lebanon Union High School science teacher
Dan Dean - Sweet Home City Manager
Shirley Hilts - Friends of Iron Mt.
George Ice - NCASI
Ken Kawazoe - Northwest Steelheaders
Pat Loveland - Santiam Wilderness Committee
Gary Marcus - Frontier Technologies
Bob Mealy - Long time Sweet Home resident
Ross Mickey - Northwest Forestry Association
Bob Ross - Friends of Iron Mt.
Woody Starr - Corvallis Environmental Center
Karen Strohmeyer - Cascades Pacific Resource Conservation & Development Area, Inc.
Mark Stull - Central Oregon Paddlers Club

Methods of Public Contact

The South Santiam Watershed Analysis was listed as a project in the Sweet Home Ranger District's quarterly Schedule of Proposed Actions starting in July, 1994.

Draft copies of the Issues and Key Questions were mailed to the individuals listed above on February 7, 1995. The draft synopsis that contained the Characterizations, Issues and Key Questions, and Processes and Trends was mailed to these same individuals on March 17, 1995.

Ray Bosch (USFWS) met with the Core Team on March 14, 1995.

Bob Mealy met with the Core Team on March 29, 1995 to share his memories as a long-time resident of the area and retired Forest Service employee. His grandfather homesteaded here in 1873.

Tony Farque discussed the watershed analysis process at a meeting with tribal representatives of the Grande Ronde and Siletz in November, 1994. Ann Rogers made a presentation to repesentatives of the Warm Springs tribes on March 25, 1995. Tony Farque discussed this watershed analysis by phone with tribal representatives of the Siletz (February 27, 1995), Grande Ronde (March 9, 1995), and Warm Springs (March 27, 1995).

Rolf Anderson (District Ranger) made a presentation to the Santiam Wilderness Committee on March 15, 1995.

Bill Porter made a presentation to the Sweet Home Kiwanis Club at their March 29, 1995 meeting.

Todd Buchholz gave updates on the process at meetings with the U.S. Army Corps of Engineers on January 17 and January 31, 1995.

Todd Buchholz gave monthly updates on the process at meetings with the Linn Soil and Water Conservation District on December 13, 1994; January 12, 1995; and February 11, 1995.

The Issues and Key Questions were used by Fielding Cooley (OSU Extension) as an exercise during a Linn Watershed Council formation workshop on March 4, 1995.

Appendix E. Draft Late-Successional Reserve 215 Assessment

Introduction

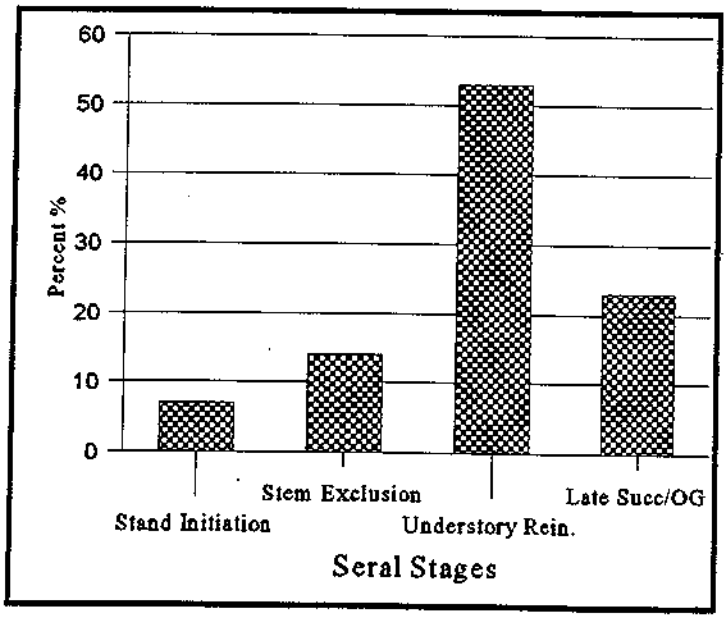
This draft Assessment has been developed in conjunction with the South Santiam Watershed Analysis. This Late-Successional Reserve (LSR) lies entirely within the South Santiam Analysis area. This Assessment reflects a distillation of the biological characterizations, issues, processes, trends and management recommendations, particular to this LSR, which were developed during that Analysis.

History and Inventory of Vegetative Conditions

This LSR lies within the western hemlock and Pacific silver fir vegetation zones (55% and 45% respectively). There are 34 forested plant association within these two series (Plant Association and Management Guide, Willamette Nation Forest 1987). One minor conifer tree series, Douglas-fir, and several related plant associations, are uncommon this far north on the Forest and has been designated as rare forested plant associations in the Special Habitats Management Guide (WNF 1992).

Dominant tree species include Douglas-fir, western hemlock, western redcedar, Pacific silver fir, noble fir, red alder, and bigleaf maple. Figure 1 describes the amount of each seral stage within the LSR. Most of the stand initiation and some stem exclusion stages are a result of clear-cut patch harvesting around the outer edges of the LSR (See Figure 2).

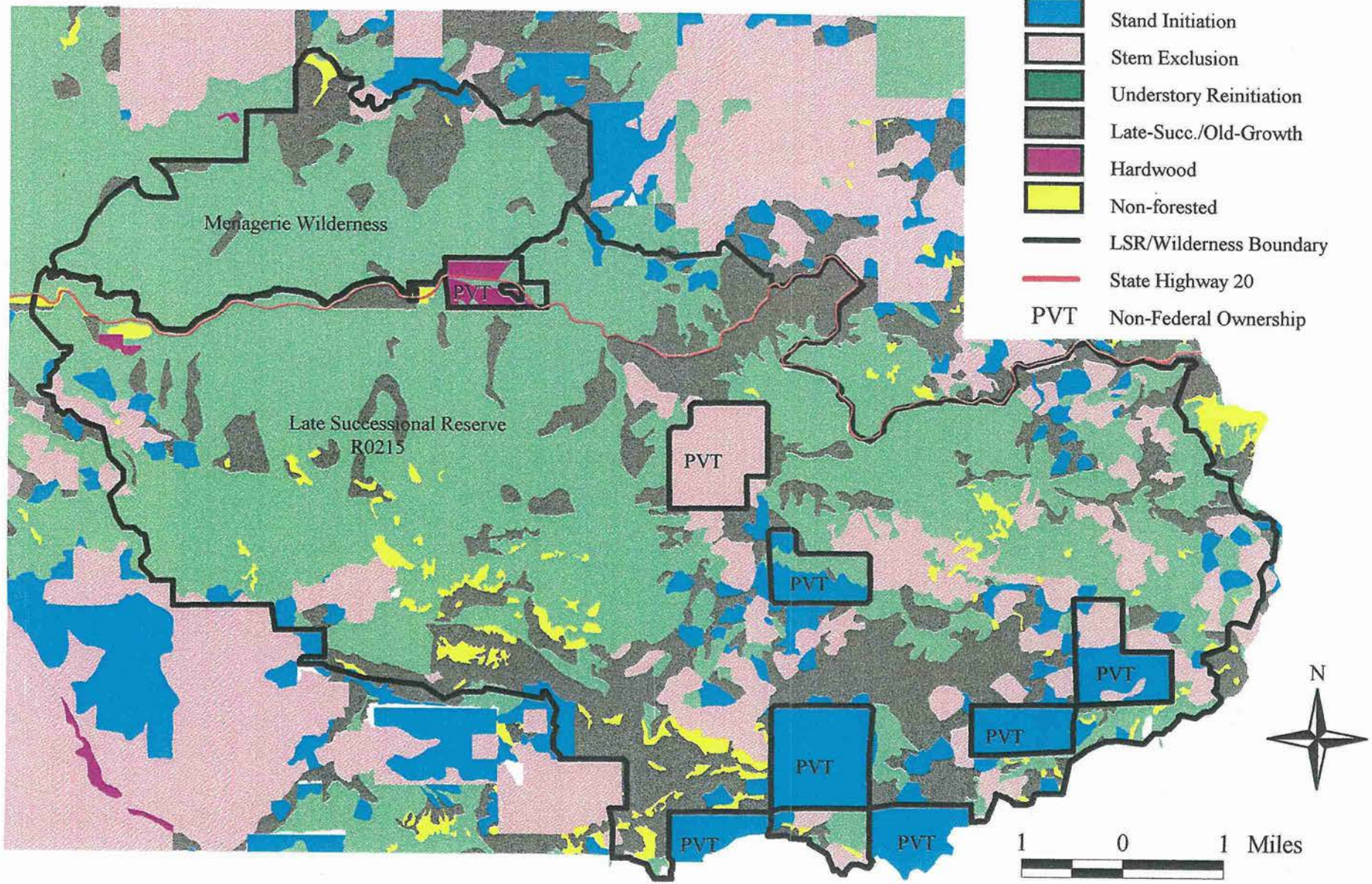
Figure 1: Seral Stage Distribution in LSR0215



Common understory species include vine maple, rhododendron, sword fern, salal, huckleberries, Oregon grape, beargrass, and numerous grasses and forbs.

The 1911 fire burned about 3000 acres in the northeast portion of the LSR. This resulted in a large contiguous patch of forest which is just transitioning into the understory reinitiation stage with tree ages between 35 to 80 years old and average stand ages around 65 years old. Stand densities in many of these stands are high enough that competition mortality is taking place. "Doghair" type densities occur in a few of the stem exclusion stage stands. These stands are slow in achieving the vertical stratification which many stands reach by this stage in their development.

Figure 2: Seral Stages in LSR 0215



Parts of the Sevenmile Burn of 1911 were planted between 1915 and 1917. This is one of the first recorded large scale reforestation projects in Oregon. It is possible that the seed used for these early plantings was obtained from off-site stocks. Many of the planted trees did not survive to form the existing stands we see today. There are some patches of slow growing anemic looking trees which could be progeny of off-site seed. It is also possible that nutrient deficiencies due to frequent hot fires caused these patches of anemic trees .

Special Habitats

The occurrence of special habitats (non-forested communities) and their distribution across the landscape is important for biodiversity of plant and animal species. Standard and guideline FW-211 directs us to protect these habitats and their ecotones. Limited special habitat inventory and mapping in the LSR has been accomplished to date. Some sites were inventoried in the course of surveying the Sevenmile thinning project. Mapping special habitats on to base maps for GIS is underway but far from completion. The following is a qualitative assessment of the occurrence and distribution of special habitats in the watershed.

The distribution of special habitats other than rock outcrops is skewed toward higher elevations. Most of the larger special habitats are associated with old Cascade peaks such as the Jump Off Joe area in Sevenmile subwatershed. Some of these peaks host a wide array of community types and thus provide habitat for a great diversity of plants and animals. Special habitats are rarer at low elevations on the west end of the watershed. .

Dry rock gardens are associated with some of the more prominate rocky areas such as Two Girls. Moist rock gardens are less common but are found on Two Girls, and scattered other locations. Sitka alder communities are common on the north slopes of old Cascade peaks in the watershed. Vine maple/rocky soil associations sometimes occur with Sitka alder but are also found alone; two locations of this community are on the south-facing slopes of Two Girls and Soapgrass Mountain. The only site of the dry beargrass/red fescue community known to occur in the watershed is on Soapgrass Mountain.

Many of the wetter communities are rare or uncommon in the South Santiam watershed. Bogs, with their characteristic *Sphagnum* and sundew (*Drosera* sp.) communities, are found only in and around Gordon Meadows where western toads, Northwestern salamanders and tree frogs are abundant. A sphagnum bog is found in upper Gordon Lake but it has not developed the diverse community found in the Gordon Meadows bogs. Lakes, ponds, sedge meadows and wet meadows are also relatively uncommon. Most occur in flatter portions of the LSR, such as the Gordon Meadows/Lakes area.

Scattered mesic meadows are found in the LSR but are not common. Fire may have played an important part in maintaining such meadows.

Late-Successional/Old-Growth Associated Species Known to Exist in this LSR

LSR0215 is much like any other temperate forest ecosystem in that its mix of plant and animal species is determined by the interaction of a broad matrix of factors which are constantly changing over time and space. Table 1 lists the old-growth dependant species known to be in the LSR. Late-Successional associated species listed in FEMAT, such as elk, flying squirrels, etc are know to inhabit the LSR. Specific location information for these species is on file at the Sweet Home Ranger District.

Table 1: Late-Successional/Old-Growth dependent species known to be in LSR0215.

Category	Species
Wildlife	Northern spotted owl
	Red-backed vole
Moonwort	*Botrychium minganense*
False Truffles	*Leucogaster microsporus*
	Rhizopogon inquinatus
Vascular Plants	*Allotropa virgata*

Northern spotted owl
There are fourteen known owl sites in the LSR. Owl site locations are on file at the Sweet Home Ranger District office.

Red-backed vole
Vole skulls have been found in northern spotted owl pellets in the southern portions of the LSR by researchers from the HJ Andrews experimental forest.

Moonworts
B. minganense is associated with western red-cedar in small seeps or adjacent to streams. One small population is located in the southeast portion of the LSR.

Truffles
*R. inquinatus*is found just west of Tombstone Pass and near the Longbow Organizational Camp along the South Santiam River. *L. microsporus* has been identified in the Sheep Creek area.

Vascular Plants

A. virgata is documented at three locations in the watershed, two are in this LSR.

History and Description of Current Land Uses

Humans have utilized the LSR for thousands of years. Two major Native American trails run through the LSR with many known and suspected pre-historic sites scattered throughout the area (see Heritage Resource Report, South Santiam Watershed Analysis). The Santiam Wagon Road facilitated movement of first livestock (1860') Meadows,, then homesteaders (1860-80's), fire suppression (early 1900's-present) and eventually incursions into National Forest lands for timber harvest and recreation (late 1950's-present).

The predominate land use in the LSR since the 1940's has been timber harvest in the mature forested areas. This is followed by developed and dispersed recreation along the South Santiam River and the State Highway travelway. Upland areas accessed by the existing forest road system provide considerable dispersed recreation. The timber harvest activity began in the late forty's and early fifty's with about twelve hundred acres harvested per decade. Harvest blocks have not been evenly distributed across the LSR, but are associated with the forest road system. The reforestation history of the approximately 4500 acres which have been harvested in the LSR is similar to other reforested areas in the South Santiam Watershed.

What started as the South Santiam Wagon Road became State Highway 20. Four campgrounds, (Trout Creek, Yukwah, Fernview, and House Rock) and the Longbow Organization Camp are accessed by the highway and adjacent to the South Santiam River and within the LSR. Several barrier free fishing platforms, and the Walton Ranch wildlife refuge are also adjacent to the River.

Three major forest road systems access the west end (Rd.2032), middle (Rd.2044), and East end (Rd.1500) of the LSR. Large portions of land between these roads are unroaded. These road systems provide dispersed recreation opportunities and access trail heads for the Gordon Meadows, Jumpoff Joe and other National Forest trail systems (see Recreation Report, in the Analysis). Remnant portions of the South Santiam Wagon Road skirt the north side of the LSR south of the River. This Historic Road provides opportunities for hiking, horse and historic automobile use.

Some special uses occur within the LSR and include; Falls Creek Hydroelectric project, Pacific Power and Light power lines, Fernview summer home tract, and Oregon Department of Transportation maintenance and storage yards or the most obvious.

Fire Management Plan

Fire has been an integral component of Western Cascades ecology in the South Santiam for many centuries. The Fire History and Silviculture Reports with the South Santiam Watershed Analysis provide considerable information on fire frequency, recurrence, and associated stand conditions. Coupled with the "natural fire", Native American habitation/use has been documented in this

watershed for over 8000 years. Native Americans likely used fire as a tool to manipulate vegetation for a variety of purposes (see Heritage Resource Report in the watershed analysis). With that as a background, the following principles will control the fire management objectives for this Late Successional Reserve.

The following recommendations will be developed in accordance Forest Plan and National Environmental Policy Act procedures. All fuels prescriptions will be written to meet the various interdisciplinary objectives.

1. Fire is a natural component of Western Cascades ecology and has played a major role in shaping the forested landscape we see in the LSR today. However, continued suppression of unplanned starts will stay in effect.

2. Late successional and old growth forest stand characteristics are low in abundance due to the fire history. Understory reinitiation stands predominate the LSR. Many sites in the LSR are deficient in large down woody material.

3. Planned starts in untreated areas are not generally feasible in most of the area due to topography and aspect. Planned starts in understory reinitiation stands could hasten the development of these stands to the late successional stage. Consequently, planned ignition in untreated areas will be considered only on a site specific basis.

4. Planned starts in high elevation meadows, Walton Ranch and the Wausau track managed pasture sites, may occur to maintain or improve special habitats or meet other resource objectives.

5. Thinning may take place in stem exclusion and understory reinitiation areas to promote late successional stand characteristics. Prescribed fires may take place in these areas to reduce fuel loads, or enhance late successional structure in these managed stands. Development of fuel breaks should be considered in both the layout and the fuels treatment in these areas.

Treatment Criteria

The following criteria, governing potential management activities in the LSR during the next decade, are based on seral stage classifications developed during the Analysis.

1. All seral stages will be managed to maintain or enhance Aquatic Conservation Strategy objectives for Riparian Reserves.

2. Stand Initiation areas: Management will be directed to enhancing over story growth and native species diversity common to early seral plant communities. Harvest of Special Forest Products will be neutral or beneficial to the above criteria and carried out where appropriate.

3. Stem Exclusion areas: Management activities will enhance tree diameter growth, stand structure diversity and insure native species diversity during thinning operations. Harvest of Special Forest Products will be neutral or beneficial to the above criteria and carried out where appropriate.

4. Understory Reinitiation areas: Management activities will speed the development of Late Successional/Old-Growth structure in those areas that are in the early phases of understory reinitiation stage and are less structurally diverse. The stagnant 60-year old stands in Sevenmile subwatershed are a good example of this situation. Harvest of certain Special Forest Products may be appropriate in specific areas especially when a Product is common to Stand Initiation and Stem Exclusion areas.

5. Late Successional/Old-Growth areas: Management activities will take place only in site specific areas to create critical, missing structural components. Harvest of Special Forest Products is generally not appropriate in Late Successional/Old-Growth areas.

Treatment Areas

Realizing that our crystal ball is murky at best, other projects may come along which are not covered in this discussion. Given that, employing the above criteria and considering the conclusions developed in the Analysis, the following areas were identified which could be treated through site specific management activities. For a more in-depth discussion for each area, see the Analysis. Proper NEPA documentation will of course be completed prior to any projects starts.

Projects within this LSR that should be implemented in the next ten years:

1. Because of their small size and locations existing uses such as roads, Falls Creek power plant, campgrounds and fishing platforms, as well as any foreseeable changes to them will not affect the functioning of this LSR.

   Roads: Many of the roads within the LSR are cost-share and will remain open. Other roads are required to access proposed projects. Consequently road management objectives will be governed by other factors than overall LSR objectives.

2. Gordon Meadows improvements.

3. Sevenmile Environmental Assessment Planning Area.

4. Stand manipulation in Stand Initiation and Stem Exclusion stands.

5. Land exchange in T14S, R05E, Sections 5 and 9.

6. Snag creation in those Sevenmile area stands which are stagnant.

7. Channel restoration projects in the South Santiam River.

Monitoring and Evaluation

Monitoring and evaluation within the LSR is based on the work developed for the Sevenmile Environmental Assessment, and is fully discussed in that document on file at the Sweet Home Ranger District. What follows is a brief synopsis of that discussion.

Implementation (IM), Effectiveness (EM) and Validation (VM) monitoring will check to see if we meet the management objectives for this LSR.

Silviculture Monitoring

1. Are the stand densities within the ranges we said they would be? (IM)

2. How did each different prescription tend toward late-successional structure ? (EM)

3. How long does it take to get canopy closure after thinning? (EM)

Botany/Wildlife Monitoring

1. Were snags and down wood retained (numbers, distribution, and class correct)? (IM)

2. Were Riparian Reserve widths managed as identified above and in the Analysis? (IM)

3. Do the thinning prescriptions result in accelerated development of late-successional species habitat? (EM)

4. Does wildlife tree creation result in effective wildlife trees for cavity dependant species?(EM)

5. Are non-native and noxious plant control measures effective?(EM)

LSR Monitoring

1. Do the treatment criteria involving Riparian Reserves meet the Aquatic Conservation Strategy objectives for the maintenance and or restoration of aquatic, riparian and terrestrial habitats? (EM)

References

USDA Forest Service. 1994. South Fork McKenzie watershed analysis. Blue River, OR.

South Santiam Watershed
Subwatershed Overlay