SALMON-NESKOWIN WATERSHED ANALYSIS

Prepared for:

USDA Forest Service
Siuslaw National Forest
Hebo Ranger District
31525 Hwy 22
Hebo, OR 97122

and

US Department of Interior
Bureau of Land Management
Salem District
1717 Fabry Rd. S.E.
Salem, OR 97306

Prepared by:

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8005 S.E. 28th Street
Mercer Island, WA 98040

June 1999

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CHAPTER 1

CHARACTERIZATION

1.1 INTRODUCTION

This watershed analysis was conducted under direction of the April 1994 Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl (USDA and USDI 1994), also known as the Northwest Forest Plan (NFP). Watershed analysis is one of four major components of the Aquatic Conservation Strategy (ACS) within the NFP. The other components are Riparian Reserves, Key Watersheds, and Watershed Restoration. "These components are designed to operate together to maintain and restore the productivity and resiliency of riparian and aquatic ecosystems" (USDA and USDI 1994: B-12). Watershed Analysis plays a role beyond the ACS by providing the principal analysis of terrestrial and aquatic ecosystems that will be used to meet ecosystem management objectives for the watershed (USDA and USDI 1994: E-20).

The Federal Guide for Watershed Analysis, Version 2.2, describes the six-step process that was used to conduct the analysis. The six steps are:

1. Characterization
2. Issues and Key Questions
3. Current Conditions
4. Reference Conditions
5. Synthesis and Interpretation
6. Recommendations

These six steps were completed by a team of resource professionals using previously documented information about the watershed. The Federal Guide also encourages early, open, and frequent participation in the process by public stakeholders. During Step 2 (Issues and Key Questions), a mailing was sent to members of the public on the Siuslaw National Forest's mailing list informing them of the analysis and inviting them to share information and concerns. Copies of the mailed brochure were also placed in local public libraries and at the Hebo Ranger District office. Several responses to this outreach were received and information from some of the respondents was included in the analysis.

The Salmon-Neskowin Watershed Analysis refers to and takes guidance from other planning documents that provide a larger context for this area. The Siuslaw National Forest Land and Resource Management Plan (LRMP) and Salem District, BLM, Resource Management Plan (RMP) provide management direction for all federally managed forest land. These plans have been significantly amended by the NFP. The Late-Successional Reserve Assessment (LSRA) for Oregon's Northern Coast Range Adaptive Management Area (USDA and USDI 1997) provides management guidelines for Late-Successional Reserves within the watershed.

1.2 LOCATION AND OWNERSHIP

The Salmon River lies approximately four miles north of Lincoln City, Oregon, flowing west from the Oregon Coast Range into the Pacific Ocean. Neskowin Creek lies approximately four miles north of the Salmon River and eight miles south of Pacific City, Oregon, also draining into the Pacific. Together, the two watersheds occupy approximately 64,000 acres (Figure 1-1). About two-thirds of the combined watershed is privately owned, while the remainder is managed by various federal and state agencies.

Federal land in the watershed falls within the Northern Coast Range Adaptive Management Area. The Cascade Head Scenic Research Area and Cascade Head Experimental Forest in the lower Salmon River watershed are administratively withdrawn and are managed by the USDA Forest Service. Most of the remaining federal lands fall into one of two designated Late-Successional Reserves (LSR R0807 on National Forest lands and LSR R0269 on BLM lands). There are two special management areas on BLM land. Lost Prairie is a 60-acre Area of Critical

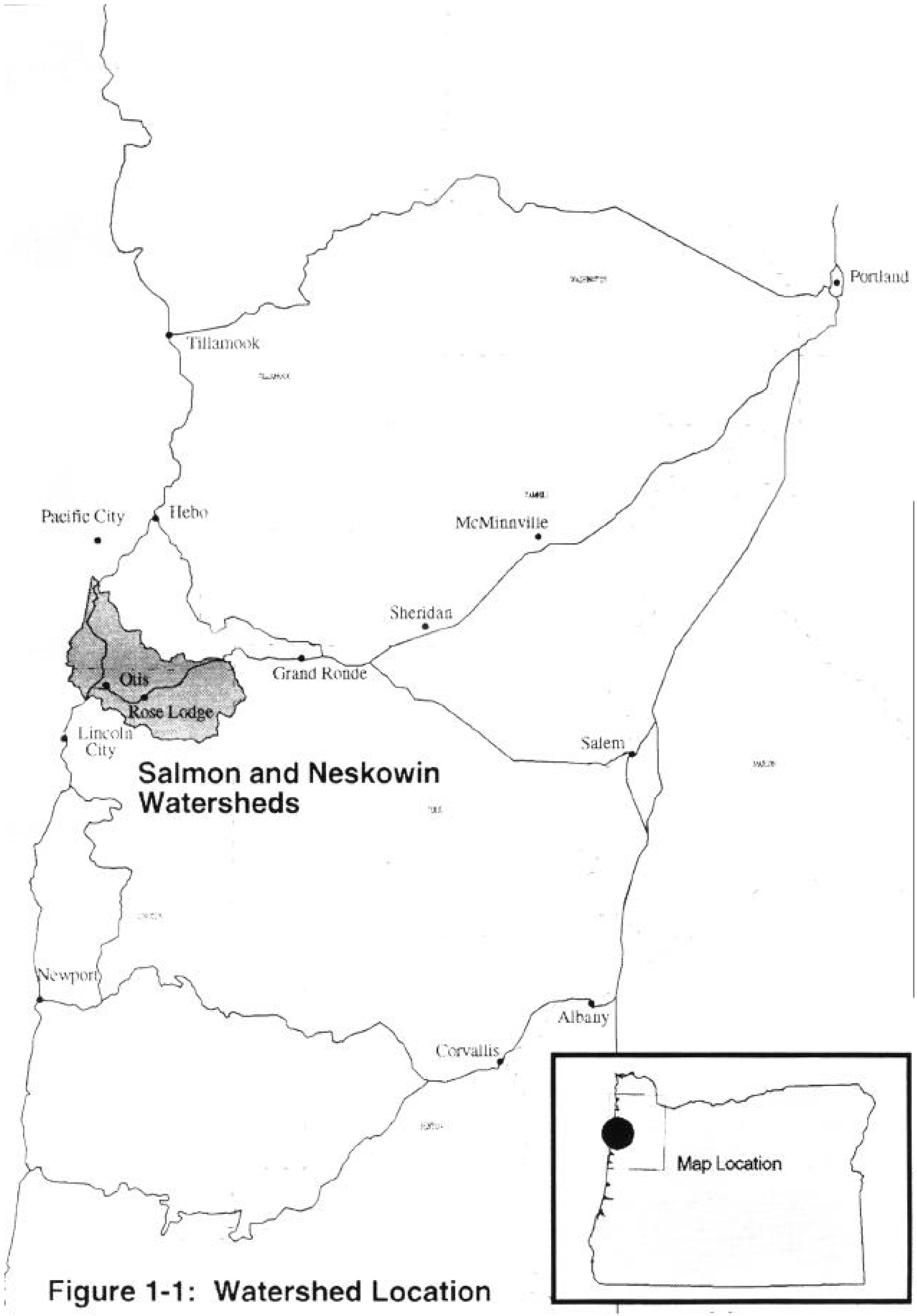


Figure 1-1: Watershed Location

Environmental Concern (ACEC) within LSR in the upper Salmon River watershed. Saddleback Mountain is both a Research Natural Area and ACEC, also in the upper Salmon River watershed.

TABLE 1-1. LAND OWNERSHIP WITHIN SALMON AND NESKOWIN WATERSHEDS

LAND OWNER	APPROX. ACRES
Private	40,090
USFS	20,155
BLM	2,990
State Park	903
State Forest	26
State of Oregon	33

1.3 GEOLOGY

Bedrock geology in the study area consists of mafic volcanic rocks and marine sediments. The volcanic rocks were initially deposited along a chain of volcanic centers as submarine pillow lavas and breccias during the Paleocene Era. In locations where eruptions built seamounts above sea level, submarine rocks are overlain by ash and subaerial lavas. In the study area, these rocks are represented by the Siletz River Volcanics, which crop out in the south-central portion of the study area.

In Lower to Middle Eocene times the chain of volcanic seamounts and islands began to subside, the Cascade Mountains began to rise to the east, and a thick sequence of marine sediments were deposited atop the subsiding Siletz River Volcanics. These sediments typically consist of massive claystone to siltstone, tuffaceous siltstones, arkosic turbidite sandstone, and other rocks derived from parent rocks to the east. These rock types are present in the study area as the Middle to Upper Eocene Yamhill Formation, Tyee Formation, and Nestucca Formation.

The Upper Eocene is marked by the subaerial eruption of the Cascade Head Volcanics, which are to some extent contemporaneous with the Nestucca Formation. This formation underlies the study area along its western side. The Basaltic Sandstone of Pacific City, present in the northwestern-most portion of the study area, was derived from this unit.

Alkalic mafic volcanic rocks intruded the Siletz River Volcanics, Yamhill Formation, and Tyee Formation from Eocene through Miocene times. Basalts that intrude the sedimentary units in the study area, primarily as sills, may represent distal portions of the massive Middle Miocene Columbia River basalts which sank into and flowed between the less dense sediments. The eastern-most portion of the study area is underlain by granophyric gabbro, intruded into the Yamill and Tyee formations during Oligocene times.

Bedrock strongly influences topography, slope stability, and sediment production rates in the study area. The softer, less durable sedimentary formations such as the Yamhill, Tyee, and Nestucca Formations which crop out in the center of the study area, tend to form rounded, more gentle terrains than do the volcanic units. Sediments derived from these formations typically comprise silt, sand and gravel. The more durable volcanic units are an important source of pebbles, cobbles, and small boulders; and provide an important source of road rock. The presence of volcanic dikes and sills complicates the picture by forming resistant ridges and stepped streams where headward erosion has been impeded.

Earthflows, slides, and debris torrents are not uncommon in the watershed, especially where the conditions of slope shape, steepness, and low competence bedrock combine to create unstable conditions. Ancient earthflows have not yet been mapped on the ground in the study area, although four flows were evident in the Nestucca and Yamhill Formations in aerial photographs.

1.4 SOILS AND CLIMATE

1.4.1 Coastal Fog Zone

The western two-thirds of the study area is in the Coastal Fog Zone which is characterized by high winter winds and very high winter rainfall. Fog and low clouds result in small differences between summer and winter air and soil temperatures (isomesic), and increase effective soil moisture in summer. Soil moisture in summer is high and soils develop high accumulations of organic matter.

The eastern third of the analysis area is divided among three climate zones including the Central Interior, Northern Interior, and Valley Margin zones (Map 3). The zones are characterized below.

1.4.2 Central Interior Zone

The Central Interior Zone is characterized by wet winters and moist summers with occasional high winds in winter. There are significant differences in soil temperatures from winter to summer. Soil moisture fluctuates moderately from winter to summer with summer soil moisture levels varying from very high on lower slopes to moderately dry on upper sideslopes. High biologic activity is accompanied by high decomposition rates and moderate accumulations of soil organic matter. Deep to very deep, moderately fine-textured soils overlie slowly to moderately permeable bedrock.

1.4.3 Northern Interior Zone

The Northern Interior Zone is characterized by very wet winters and moist summers with occasional high winds in winter. Significant differences in soil temperatures exist from winter to summer below 3000 feet. Soil moisture is generally high with moderate soil moisture fluctuations from winter to summer. High biologic activity is accompanied by high decomposition rates and moderate to high accumulations of soil organic matter. Very deep fine-textured soils overlie slowly to highly permeable bedrock.

1.4.4 Valley Margin Zone

The Valley Margin Zone is characterized by moist winters and dry summers. High winds are uncommon. There are significant differences in soil moisture and temperature from summer to winter, with low soil moisture common during summers. Moderately high biologic activity and moderate decomposition rates are accompanied by low to moderate accumulations of soil organic matter.

1.5 TERRESTRIAL ENVIRONMENT

The soil climate zones are reflected in the distribution of plant communities and plant associations across the landscape. Moist sites in the Coastal Fog zone are dominated by Sitka spruce and western hemlock. Further inland, Douglas fir communities become more common. Noble fir communities occur on the upper slopes of the peaks of the coastal mountain range.

Large blocks of private industrial timberland occur in the upper reaches of the Salmon Watershed. Most stands are even-aged. No old-growth stands were identified.

The majority of federally-owned lands in the Salmon-Neskowin Watershed Analysis area are concentrated in the Cliff, Lower Neskowin, Upper Neskowin, Salmon, and Deer subwatersheds. Here, a large contiguous block with several late-seral stands occurs.

Smaller blocks of federal ownership occur in the Lower Salmon River, Middle Salmon River, Panther, Widow, Bear2, Trout1, Slickrock2, Treat/Alder Brook, and Butte/Hawk subwatersheds. Here, stands are more fragmented. Although mature conifer stands occur (trees over 80 years of age), these stands are generally small and somewhat isolated from each other.

A large block of late-seral forest known as the Van Duzer Forest Corridor occurs in the Upper Salmon River subwatershed and is managed by Oregon State Parks.

Current conditions were compared with reference or historical conditions derived from 1950s vegetation data. The percentage of pure hardwood stands has increased over historical levels (1950s) from approximately 7 percent to 14 percent. Slightly more stands are in the stand initiation stage (0 to 49 years old) now (34 percent vs. a historic level of 29 percent). Fewer stands are classified as old-growth (none vs. a historical level of 10 percent).

A diversity of flora and fauna occurs within the two watersheds. Late-seral associated species occur primarily on federal and state lands. They include marbled murrelets, spotted owls, and a diversity of plants, fungi, lichens, and liverworts. The threatened Oregon silverspot butterfly occurs in the Cascade Head area. Several rare plants and cryptogams (mosses, lichens, and liverworts) occur in Lost Prairie in the upper Salmon River watershed. Other species of note in the watershed include bald eagles, peregrine falcons, brown pelicans, elk, red tree voles, fringed myotis, and Townsend’s big-eared bats. Habitat for many of these species is in decline and many are listed as threatened or endangered, or are candidates for listing.

1.6 AQUATIC ENVIRONMENT

The Salmon River and Neskowin Creek are typical of Oregon coastal streams with headwaters originating in the Coast Range Mountains and emptying into the Pacific Ocean to the west. Forest management has been extensive in the watershed and the practice of large woody debris (LWD) removal during the 1960s and 1970s has left streams lacking in habitat complexity. Logging of riparian vegetation has resulted in an increase in water temperatures, causing the Salmon River to be listed for temperature on the 303(d) list. Extensive road-building for logging operations has caused an increase in landslides and sediment input to streams. Agricultural and farming practices have contributed pesticides and fecal coliform bacteria to water quality degradation.

Stream flows are also typical of Oregon coastal streams, which are "flashy" during storm events with flows rising rapidly. Stream flows for the Salmon River vary from highs of over 6,000 cubic feet per second (cfs) to lows of 22 cfs. Although there is no stream gauge on Neskowin Creek, the average annual flow has been estimated at 92 cfs with spot checks recording low flows of 2 cfs (USEPA 1991).

1.6.1 Salmon River

The Salmon River is about 25 miles long and has a basin area of 77 square miles. The headwaters originate on Saddleback Mountain at an elevation of approximately 2,500 feet. The upper portion of the basin is characterized by steep slopes with narrow valleys and tributary streams with moderately steep to very steep gradients. These areas have been extensively logged and are prone to landslides.

The Salmon River Estuary covers an area of 204 acres at high tide (ODFW 1997). Most of this is within the Cascade Head Scenic Research Area. Much of the original estuary was diked and drained during the 1950s and 1960s for agricultural use and highway development. Recent restoration work has removed some of the dikes in an attempt to restore wetland functions.

The Oregon Department of Fish and Wildlife estimates a total of 121.5 miles of fish habitat in the drainage (ODFW 1997). Native fish populations are generally in decline due to habitat degradation, fishing pressure, and competition from hatchery stocks from the Salmon River Hatchery. Habitat inventories indicate a loss of pools, LWD, and riparian function. Increased sediment input contributes to the loss of pools and may impact spawning gravel quality as well. Habitat and water quality data is limited for the system and a monitoring program is needed to better determine the condition of the habitat and needs for restoration.

The Salmon River is managed for hatchery and wild stocks, and supports a recreational fishery for wild and hatchery fall Chinook, hatchery coho, and wild winter steelhead.

1.6.2 Neskowin Creek

Neskowin Creek has a basin area of approximately 12 square miles. The headwaters originate on the western slope of Neskowin Ridge at an altitude of 1,400 feet. The mouths of Neskowin and

Hawk Creeks are classified as estuaries, but they are small in comparison to the Salmon River Estuary. The 260-acre Neskowin Marsh is located at the head of Meadow Creek.

Neskowin experienced water quality problems in the late 1970s when the community's water supply, which was taken from Hawk Creek, was declared a health hazard. An upgrade to the water system in the early 1980s and the installation of a wastewater treatment plant in 1995 have improved the water supply quality.

Habitat inventories indicate a loss of pools, LWD, and riparian function. Increased sedimentation is not as severe as in the Salmon River, but is likely impacting habitat. Habitat and water quality data are lacking and a monitoring program is needed to identify problems and potential restoration projects.

Native fish stocks in Neskowin Creek have declined considerably from historic levels. Although the basin is currently managed for wild fish, previous hatchery releases into the system may have impacted the gene pool of native fish. Currently there is no sport fishing for salmon allowed, but there is a catch and release fishery for steelhead and cutthroat trout.

1.7 HUMAN ENVIRONMENT

The Salmon River watershed is the more developed of the two watersheds in the study area. Two major highways, State Highway 18 and U.S. Highway 101, traverse the Salmon River watershed. Development in the watershed includes the villages of Rose Lodge, Otis, Three Rocks, and numerous cottages and houses along Bear Creek. Logging, primarily on private land, is the predominant use of the Salmon River watershed. Recreational developments in the watershed include a trailer park, the Westwind YWCA camp, and seasonal and year-round homes in Three Rocks.

The Neskowin Creek watershed is less developed, although the trend is toward increasing development. Existing development in the watershed, which is primarily along Neskowin Creek and the coast at Neskowin, includes year-round and vacation homes, an RV park, a motel, and two golf courses. Forestry is an ongoing activity in the interior portions of the watershed. Access to the Neskowin Creek watershed is by U.S. Highway 101, and Old U.S. Highway 101, now designated Forest Service Road 12.

Much of the western portion of the analysis area is included in the Cascade Head Scenic Research Area (CHSRA), and the Cascade Head Experimental Forest (CHEF). The two areas are administratively withdrawn from timber harvest. The area is excellent for hiking, biking, enjoying forest scenery, and other forms of outdoor recreation.

CHAPTER 2
ISSUES AND KEY QUESTIONS

This step identifies the issues that the team decided would form the focus for this iteration of the watershed analysis. This step also identifies key questions to be answered in the course of the analysis. Public input was solicited prior to finalization of the issues and key questions through mailings and brochures placed at local libraries and the Hebo Ranger District. The answers to these questions will provide managers with information needed to make decisions, implement resource programs, and design projects.

2.1 ISSUE 1. CONDITION OF NATIONAL FOREST AND BUREAU OF LAND MANAGEMENT LATE-SUCCESSIONAL RESERVE LANDS AS FUNCTIONING LATE-SUCCESSIONAL ECOSYSTEMS.

Background Statement

Federal land within the Salmon River and Neskowin Creek watersheds lies within the Northern Coast Range Adaptive Management Area (AMA). Within the AMA, a network of Late-Successional Reserves (LSR) has been established. Much of the area within the LSR is currently not late-successional habitat or lacks some of the features important to fully functioning late-successional habitat. Areas that currently are late-successional habitat are fragmented. Techniques exist for adding or enhancing individual late-seral habitat features to existing forests, and for accelerating the natural development of such features. Areas that would most benefit from treatments in order to reach the long-term goals of the LSR have yet to be prioritized. Such prioritization would facilitate project planning within the watershed.

Key Questions:

a) What are the current conditions with respect to stand structure and species composition, snags, coarse woody debris (CWD), and fragmentation?
b) What habitat improvement activities (e.g. silvicultural treatment, snag creation, CWD placement, road decommissioning) would be beneficial for promoting late-successional characteristics?
c) Where would the above habitat improvement activities be beneficial?
d) What areas should be treated first and for what reasons?

2.2 ISSUE 2. CONDITION OF AQUATIC AND RIPARIAN RESOURCES.

Background Statement

Concern for the downward trend of fish stocks in the Pacific Northwest and the Oregon Coast is reflected in the Northwest Forest Plan’s Aquatic Conservation Strategy and in Oregon’s Coastal Salmon Recovery Initiative. More specific concerns for the Salmon River are identified in Oregon Department of Fish and Wildlife’s Salmon River Basin Fish Management Plan. Objectives of the Aquatic Conservation Strategy (ACS) in the Northwest Forest Plan are focused on maintaining and restoring components and processes critical to a healthy, functioning aquatic ecosystem. Future land management on federal lands will be conducted to meet the objectives of the ACS.

Key Questions:

a) What is the current condition of the aquatic habitat with respect to riparian structure and function, water quality, peak flows, and large woody debris?
b) Where is current high quality habitat located?
c) How have human activities affected habitat for threatened and endangered salmonids and other aquatic species of concern?
d) What management activities would benefit aquatic and riparian resources and how should they be prioritized within the watersheds?

2.3 ISSUE 3. ESTUARY

Background Statement

The Salmon River estuary is a unique feature of the watershed and has been recognized as such under the designation of the Cascade Head Scenic Research Area. As with all estuaries, it provides vital fish and wildlife habitat for many species, including nursery habitat for species such as salmon and steelhead. Estuarine habitat has been severely impacted by agricultural practices within the watershed. Other land use practices with potential to impact the estuary include development and forestry. Human activities such as recreation, sport fishing, non-motorized pleasure boating, waterfowl hunting, and research and education are ongoing in the CHSRA. The long-term goal of the plan is "... revitalization and restoration of the Salmon River estuary and its associated wetlands to a functioning estuarine system free from the influences of man."

Key Questions:

a) What is the current condition of estuarine habitat and how does it compare with historical conditions?
b) How do land-use activities upstream from the estuary impact water and habitat quality within the estuary?
c) What is the current status of the estuary with regards to the long-term goal of the management plan?
d) Where are additional management activities needed?
e) What additional restoration activities are needed?

2.4 ISSUE 4. ROADS

Background Statement

Road densities within the watershed range from 3.5 to 8 miles of road per square mile of area. On federal lands, the function of the road network primarily for timber harvest has declined, as have road maintenance funds. Impacts to aquatic and terrestrial resources are of concern. Among the issues of highest concern for aquatic habitat are increased sediment input to streams and increased rates and amounts of runoff. High runoff leads to increased peak flows and increased potential for scour and fill of channel substrate, subsequently impacting developing fish eggs and alevins in the gravel. Roads are also a major cause of shallow-rapid landslides, which contribute sediment to streams. Terrestrial wildlife are equally impacted by roads, particularly through increased human disturbance and fragmentation of habitat. Under the current management direction, most of the federal land will be managed to promote late-successional habitat. Some timber management will occur within the AMA. Streams and riparian areas will be managed to meet ACS objectives. The need for road maintenance and/or reduction will be driven by these factors, as well as by the current Access and Travel Management (ATM) plan, which specifies that all primary and secondary roads will remain open to vehicle travel.

Key Questions:

a) What are the anticipated future needs for roads under the current management direction of the watershed?
b) How does the current road situation affect erosional processes and what are the impacts to aquatic resources?
c) How does the current road situation affect late-successional species and habitats?
d) How does the current road situation affect anadromous salmonid habitat?
e) How should non-primary and secondary roads be managed within the watershed to achieve AMA and LSR objectives? Items to consider include: the needs of fish, wildlife, and human resources, and development of criteria for selecting roads for upgrading or decommissioning.

CHAPTER 3

CURRENT AND REFERENCE CONDITIONS

3.1 HUMAN USES

3.1.1 Settlement by Native Americans

Native Americans have lived in the Salmon and Neskowin watersheds for thousands of years. Anecdotal information from Ms. M.A. Rothman (Barrett 1993) indicates that artifacts excavated during a Linfield College sponsored "dig" on the Salmon River Estuary (called the "White Dig") were approximately 2000 years old. Another archeological site, a midden, was obliterated when the motel was built at Neskowin.

Indians of the Salmon River drainage, known as the Nechesne, were lumped with the Siletz Indians by early historians; and the native peoples living in the Neskowin Creek area and farther north were considered Tillamook Indians. The local natives lived in plank-slab houses, emphasized the accumulation of wealth as an individual goal, and subsisted on salmon, elk, deer, bear, whales, sea lions, rabbits, berries, seaweed, and other local edible plants. Dugout canoes were a major means of transportation, and early settlers recall seeing burial canoes in the trees along the south side of the Salmon River Estuary.

The first recorded impact of the coming of the whites was a "fever" which swept through the natives then classified as "Indians of the Lower Columbia River", killing 80 to 90 percent of the population. There is some evidence that the epidemic affected the Tillamook Indians and possibly those living in the analysis area. On November 9, 1855, President Franklin Pierce designated the Siletz or Coast Reservation, which extended from Cape Lookout south to the Siltcoos River, and eastward from the coast to the western boundary of Range 8, Willamette Meridian, thus including over 95 percent of the two watersheds. The reservation, which comprised over one million acres, housed aboriginal natives as well as natives from southwestern Oregon who had been vanquished in a war in 1856. The impact of the reservation on the Indians living on the Salmon River was negligible through the 1860s, and the Bureau of Indian Affairs was only vaguely aware of their existence. In 1869 an Indian Agent stationed at Grand Ronde indicated that there were about 30 Indians living on the Salmon River.

As the many natural resources of the area, including oysters and deep water harbors, became important to the European settlers, large portions of the reservation were closed or otherwise expropriated by executive order starting in 1865. In 1875, half of the reservation was closed, including most of the watershed from the Salmon River northward. The next major reduction came in 1892 when allotments were made under the Dawes Act of 1887. The Act set aside 44,000 acres in specific parcels as trust properties for the Indians. Under the terms of the allotment agreement of 1892, many of the Indians selected lands along the Salmon River estuary. Almost all of the land along the Salmon River, from Rose Lodge to the coast, was in allotments by 1884. By 1889 many of the Indians had sold their allotments or had lost them for not paying taxes.

Two Native American cemeteries, Logan Cemetery and Curl-Bob-Baxter Cemetery are present in the area. Although additional cultural sites or resources were not specifically identified during this study, the Confederated Tribes of Siletz Indians of Oregon have cultural ties to the region. It is Forest Service policy to consult them prior to implementation of federal land management activities.

3.1.2 Settlement by European Pioneers

The first white people to see the Oregon coast were probably the Spanish and English explorers who were searching for the fabled "Northwest Passage" in the late 1700s. Cook sailed off the Oregon coast in 1775, and Vancouver passed by in 1792. Some of the first non-native people to actually set foot in the area did so unwillingly when their Spanish exploration and plunder ship, the *San Vicente*, was driven ashore in a fierce storm. Descriptions of the calamity suggest the shipwreck occurred at the mouth of the Salmon River. From this event were born legends of buried treasure and a giant black man who was most likely the slave of the ship's captain, Jose de Cordoba. The shipwreck is echoed in Indian legends that tell of a giant "winged canoe" that came ashore in the area. In 1788, Captain Robert Gray visited the area on his sloop *Lady Washington*, before continuing northward to become the first American ship to enter the Strait of Juan de Fuca.

The first white person to travel the area appears to have been Reverend Jason Lee who visited the area in 1837, and later founded Willamette University. Another early settler in the area was probably James Quick who arrived in 1852. Richmond Burton arrived in 1875 as Congress was redrawing the boundaries of the reservation lands. Burton claimed 160 acres on the south side of Cascade Head where he raised his family of eight children, five of whom died from diphtheria in 1878. In 1885, John W. Crowley bought 157 acres of the open outer meadow of Cascade Head which he later sold to his brother James.

Creek names are a good clue to homesteading activity, and names that can be tied to local homesteaders in the Salmon River watershed include Crowley Creek, Calkins Creek, and Tooze Creek. Other settler families of note included those of E.P. Dodson, Charles and David Calkins, and John Church. James and Jesse Taggart operated a small farm near the mouth of Chitwood Creek at Hart's Cove.

Neskowin Creek was originally called Slab Creek because of a shipwreck in the area that left a load of lumber slabs on the beach. Early settlers used the slabs to floor their cabins. The first settlers came to Neskowin Creek in 1876 when the reservation was closed. Prominent early settlers in the Neskowin Creek watershed included L.S. Schiller, A.G. Bertell, and the Affolter family. John W. Hellenbrand, who farmed acreage that included Neskowin Marsh, established the Neskowin Post Office in 1886. By the 1920s, part of Neskowin had become a beach resort with cabins and campsites.

White settlement began in earnest in 1895 when the area was thrown open to homesteading. Prior to that, land could be acquired under the 1862 Homestead Act or the 1878 Timber and Stone Act. As the Timber and Stone Act did not allow anyone to acquire blocks of land large enough to make commercial logging economical, "dummy entrymen" fraudulently posed as legitimate homesteaders to acquire large blocks.

Most of the National Forest land in the area was withdrawn on March 2, 1907 by proclamation as the Tillamook Forest Reserve. The reserve was eliminated a year later on June 11, 1908 when the Siuslaw National Forest (and 20 additional national forests) was created. At that time, the Forest Homestead Act was in effect, allowing homesteading on forest reserve land with high agricultural value. The forest was closed to further homesteading in 1910 on grounds that all agricultural lands had already been claimed. Public protest reopened the forest for homesteading from 1913 to 1916. Homesteading on what is now National Forest land was a failure and the acreage remains part of the Siuslaw National Forest. Lands that were never deeded were eventually transferred to the Bureau of Land Management (BLM). Slick Rock, Bear, and McMillen Creeks appear to have been heavily homesteaded.

The homesteading era closed in the 1930s. Other than "fern burning," which was done to maintain pasture land, homesteading left little mark on the land until consolidated parcels were logged off.

3.1.3 Development of Towns

Several small towns and villages developed in the area. These include Neskowin, Three Rocks, Rose Lodge, Otis, and Thompson's Landing.

3.1.3.1 Neskowin

The Neskowin Post Office was opened in 1886. In 1909 the former Henry Page Ranch was platted at the mouth of Neskowin Creek as a beach resort town. The principal owners, James and Lizette Walton, immediately began the sale of lots. By 1925 the Page home had become the Neskowin Inn. A large community kitchen served campers who spent their summers here in 1927. The 1992 census places the population of Neskowin at 2,158, although the population of permanent residents is probably closer to 500 (C. Bickford, USDA Forest Service, pers. comm.).

3.1.3.2 Three Rocks (3 Rox)

Three Rocks was originally platted in 1933 on the north shore of the Salmon River Estuary, and was named for the three prominent rocks standing offshore. An old tourist poster touted that the area was an old potlatch ground marked by mounds of shells. Activities promoted included fishing, clamming, crabbing, oystering, hunting, boating, and safe bathing with no undertow.

Present in the town in the 1930s were a school house, a general store, Calkins Boathouse and Dry Dock and a pontoon bridge across the Salmon River. The Calkins family is reported to have hauled in from Portland a number of streetcars for use as cabins. Rumor has it that they were later disposed of by dumping them into the river. Metal pieces of the street cars may have been responsible for some exciting "discoveries" for local treasure hunters using metal detectors in their search for the lost treasure of the *San Vicente*.

Today the community of Three Rocks consists largely of scattered summer and retirement homes.

3.1.3.3 Otis

The original Otis Post Office was opened in 1900 by Archibald Thomson at the site now known as Neotsu. Later, the current community of Otis was founded at the head of tidewater in 1913 on the Salmon River by Oscar T. Hellenbrand, who took the name of the former Neotsu post office. (Other accounts suggest that Thomson named the post office for his brother's son, Otis.)

Old timers insist that the Salmon River was deeper than it is now, and sailing vessels could go as far inland as Thomson's Landing in Otis to take on loads of fish from the cannery there.

Otis was the location of the second school house on the Salmon River. By 1932 a gas station had been built. In 1965, 57 acres of land near the junction of Highway 18 and Highway 101 were acquired by Jerry Parks for development as a pioneer town tourist attraction. The facility instead became Pixieland, a recreation park, and then American Adventures, an RV Park. A 100-unit trailer park called Tamara Quays was added in 1972.

3.1.3.4 Rose Lodge

Rose Lodge is the largest of the several small communities on the Salmon River. Founded in 1908 with the opening of the Rose Lodge Post Office, the town catered to the local homesteaders.

3.1.4 Roads and Trails

During prehistoric and early settlement times, travel through the area was probably by scarce trails, and early travel from Neskowin north was by beach. Some historians suggest that since early prehistoric times the main route from the Willamette River Basin into the area was the Elk Creek Trail along the Salmon River, which was originally called Elk Creek. The last miles of the road are known to have passed along the north bank of the Salmon River, forded at Otis, and terminated at Roads End north of Lincoln City. The major route to Neskowin was from Grand Ronde to Dolph, down the Little Nestucca to Meda, and then south to Neskowin.

The Old Elk Trail was improved from Grand Ronde Agency near Fort Yamhill by Philip H. Sheridan (of later Civil War fame) from 1855 to 1861 while he was stationed in the area. As a result, the improved trail became known as the Phil Sheridan Road. The "road" primarily passed along the south side of the river, and was for many years the best access into the area. The trail was used to drive cattle to market in the Willamette Valley, and not surprisingly was virtually impass-able during the rainy season.

Another important trail in the study area was the Linewebber Trail, which connected the Nestucca Bay Cannery and Salmon River. The trail, which crossed the east side of Cascade Head and descended Salmon Creek, was used to haul fish caught in the Salmon River to the cannery. Other important trails connected Rose Lodge to Taft via Schooner Creek, and the Salmon River Ranger Station to the Bald Mountain Ranger Station on Cougar Mountain.

In 1909, John Boyer improved the main road along the Salmon River and operated it as a toll road until 1920. In 1922 the road was surfaced from Otis to Rose Lodge. In 1913, Boyer launched a campaign to build a highway down the Salmon River, and construction was started in 1926. The road was completed in July, 1930, and was known then as the "Salmon River Cutoff."

In 1935, 37 acres of timber along the highway was set aside for preservation, and named the Van Duzer Corridor after the Oregon Highway Commission Chairman. Through subsequent acquisitions, the corridor now totals 1,511 acres. The corridor width varies from 400 to 2000 feet, and consists of two stretches 4.1 and 6.8 miles long. The corridor represents one of the few remaining stands of old-growth forest along Oregon highways.

Important to the region's growing tourist trade was the construction of the "Coast Highway" (a.k.a. Highway 101) which was known for years as the Roosevelt Highway. By 1923 the highway had been built from Otis to Neskowin. By 1937, the highway had been completed along the entire coast, linking other important connections such as Neskowin with Oretown and Cloverdale to the north. Prior to the construction of Highway 101 and its bridges (built in 1934 and 1935), the state maintained ferries at the principal estuary crossings. In the early 1960s, Neskowin Creek was moved from its natural channel and rip-rapped to accommodate new Highway 101, which was built a few miles farther west of the original Highway 101 corridor. A dike cutting off Frazier and Salmon Creeks was also built at the new highway crossing of the Salmon River estuary and a bridge was built across the Salmon River. The portion of old Highway 101 that it replaced then became Road 12, or Old Scenic Highway 101.

Both Highways 18 and 101 are listed as Scenic Corridors in the 1995 Federal Lands Assessment. The same document recognizes Highways 18 and 101 as "the best known and most traveled bicycle route in Oregon" (USDA 1995a). Highway 101 is also listed as a National Scenic Byway.

As the region has continued to attract tourists and retirees, traffic on the highways has continued to increase. Currently, daily traffic volumes on Highway 18, 0.4 miles east of its junction with Highway 101, is 4,700 to 5,900 vehicles per day, with the summer season peak accounting for 123 percent of average. Traffic volume is estimated to be growing at a rate of approximately two percent per year. Daily traffic is expected to approach 15,000 vehicles per day by 2020 A.D. (J. Detar, ODOT, pers. comm.).

Highway 101 volume varies seasonally from a low of 4,700 vehicles per day to a high of 10,700 during peak season. Annual growth is estimated at three percent per year.

No major highway construction work is planned as yet, although ODOT recognizes that with increasing pressures from tourism, highway expansion is inevitable. Repaving is planned for the year 2000 from Neskowin through Otis Junction. Much of the anticipated expansion is likely to occur piece-by-piece as passing lanes are added as needed. Immediate improvements may include expanding intersections and adding deceleration lanes within current ODOT rights-of-way.

The development of many local access roads largely mirrors the logging history of the area. Maps compiled in 1959 show a rapid expansion of logging roads on private and federal lands in the Coast Range. Analysis of aerial photographs taken in 1972 suggests that essentially all of the roads mapped today on National Forest land had been built by 1972, many of them built to provide access for timber harvesting.

3.1.5 Agriculture and Harvest of Natural Products

In the late 1800s and early 1900s, dairy farming was of major importance in the lower Neskowin watershed. This occurred in spite of the hard work involved with clearing land, and a climate that was not conducive to agriculture. The U.S. government even attempted to turn the natives from fishermen into farmers in 1856.

One of the greatest challenges facing those who attempted to cultivate the land was the presence of bracken fern which tended to overrun the fields. Superintendent James Nesmith wrote "It infests all the lands there, both wild and cultivated, and astonishes the farmer by sending up shoots nearly a foot high in a single night" (Beckham et al. 1982). Years of hard labor felling trees, clearing stumps, grubbing roots, and fighting bracken were required. The lands east of Highway 101 along the Salmon River may have been a spruce/alder swamp that was cleared for grazing in this manner.

In 1884 a cheese maker from Canada named Peter McIntosh arrived in the region, bringing the know-how of cheddar cheese-making with him. Within a decade, cheese-making had become a major industry in Tillamook County. Cheese-making is documented at Bauer Farm on Neskowin Creek and at least one cheese factory between Butte and Hawk Creeks. Dairy farms occupied the Hawk Creek Golf Course and Neskowin Marsh. Alexander and Pearl made cheese in the Salmon River watershed after 1913, and Merl McMillen opened a creamery in Rose Lodge in 1932.

Natural products harvested from the region included ferns, cascara bark, moss, and foxglove (*Digitalis purpurea*) leaves. A local fern company reported shipping 85,000 bundles of sword-ferns to florists during the first five weeks of 1940. By 1946 the sale of foxglove leaves and cascara bark exceeded $123,000 per year. Prudhomme wrote "Hundreds of workers hike into the hills nearly every month of the year to pick sword-ferns or to cut huckleberry or salal brush. During an average year two trains of more than 50 cars each carry Lincoln (County) evergreens to Midwest and eastern markets" (Beckham et al. 1982). The harvest of natural products such as cascara bark, moss, ferns, Christmas trees, and boughs continues to play a part in the local economy; however, there is only a minor harvest of these products from federal lands within the Salmon and Neskowin watersheds. Permits are issued to members of the Siletz tribe each year for collection of ferns in the Cascade Head Scenic Research Area. Annual harvest is estimated at approximately 1,000 pounds (R. Babcock, USDA Forest Service, pers. comm.). A minor amount of salal and fern collection, and occassional firewood salvage, also occurs on federal lands in the watershed, outside of the CHSRA (R. Babcock, USDA Forest Service, pers. comm.).

Crops grown in the area included potatoes, carrots, cabbage, hops, and rutabagas, although farming does not appear to have been self-sustaining. As a result, the early settlers were required to spend part of the year fishing, trapping, and picking ferns to supplement their livelihoods. Some traveled to the Willamette Valley to pick hops as well.

The rich bottomlands along Neskowin Creek were farmed at one time, and Neskowin Marsh (a.k.a. Meadow Creek) was an experimental (and apparently unsuccessful) cranberry bog for a short time (1912-1913). Cattle and sheep were grazed in Neskowin Marsh, in the meadows of Salmon Creek, and on the grasslands north of the mouth of the Salmon River including the Cascade Head headland now owned by the Nature Conservancy. Today, a few cattle use the meadows along the Salmon River and some small farming continues along Neskowin Creek. Sheep are brought from Albany to graze near the Salmon River on a seasonal basis.

3.1.6 Fishing

Fishing, as practiced by the Indians, was probably the first real industry in the study area. The first salmon cannery was built in Waldport in 1886, and within ten years canneries are reported to have been built on all the major rivers along the Oregon Coast, including the Salmon. Fish were caught in fish wheels, gill nets, V-shaped traps of piles and netting, etc. Harvesting pressures on the local fish resulted in a significant decrease in fish populations and the subsequent closure of most of the canneries by the 1920s. A small salmon hatchery was operated on Neskowin Creek in the mid-1900s. A state hatchery was built on the Salmon River in 1975 in an attempt to bolster the declining fishery.

Samuel Elmore operated a fish wheel on the Salmon River and a cannery at Woods on the Nestucca. The catch was hauled over the Linewebber Trail to the cannery. The Thomson brothers, George and Winfred, operated a cannery at Thomson's Landing near Otis until it burned down.

With the decline in salmon runs in the 1920s, the focus of regional commercial fishing turned to the oceans (Beckham et al. 1982). Prudhomme reported in 1950 that the 1947 Lincoln County catch included 2.3 million pounds of albacore tuna, 1.3 million pounds of Chinook salmon, 1.2 million pounds of rock cod, and varying quantities of coho salmon, petrale sole, ling cod, halibut, flounder, anchovies, and sable (Beckham et al. 1982). The clam harvest in 1947 totaled 35,917 pounds, and over 500,000 pounds of crab were caught.

James Gentry recalls running a 150 foot long gill net one-third of the way across the Salmon River Estuary, and filling a boat with salmon on one tide. Chinook, coho, and chum salmon dominated the catch. One of Francis Ames´, who wrote hundreds of articles for *Field and Stream* based on his experiences going back to 1928, favorite fishing spots was the Salmon River, where he began living in 1950. One of the "secrets" Ames shared with his readers was the spotting of the first sea-run cutthroats of the season from the Rose Lodge Bridge. Ames also described Chinook and silver jacks boiling through a narrow riffle below the Rose Lodge bridge.

3.1.7 Logging

Logging and lumbering, from the 1870s until recent times, have dominated as the major industry in the region. Poor transportation hampered the early lumber trade in the area. As a result, it was more efficient to move the sawmills to the timber instead of the timber to the mills. Small mills and logging companies were called "gyppo" loggers (short for gypsy) because of their continuous movement.

No permanent mills are documented as having operated in the Salmon River or Neskowin Creek watersheds. There was a mill up Hawk Creek that was owned and operated by Grant Layer, and another nearby operated by Ogle. On Neskowin Ridge there was an area called the "gravy patch" because there was so much timber per acre and the trees were some of the largest in the area.

As discussed earlier, large tracts of land were acquired by industry through purchase and by the fraudulent operation of "dummy entrymen" who posed as homesteaders. The Polk Operating Company acquired large holdings during the early 1900s. Another large private landholder was the Miami Corporation, which operated a mill near the current casino in Grand Ronde. Most of Miami's land was harvested in the 1940s. Longview Fiber also operated in the area.

In the 1920s loggers built short railroad spurs off the historical Willamina-Grand Ronde rail line to bring lumber out of the woods. Loggers began using trucks in the 1930s, and thus began the construction of roads to facilitate the harvest of timber.

Management of federal lands for timber began in the late 1940s. The Hebo Ranger District owes its existence, in part, to fire. Because its blackened condition made it unsuitable to commercial loggers, the land was instead placed in federal reserve in an effort to reclaim the burnt hillsides. From the beginning of programmed harvesting in the late 1940s to the mid 1950s, clearcut areas were broadcast burned and planted. In 1985 the districts went to cooler burns or not burning at all. By the early 1960s, harvested areas were reforested by planting and aerial seeding. Seed fall from surrounding mature natural stands played an important role in reforestation (USDA 1995a).

Aerial application of herbicides began in the mid 1960s for site preparation and to release conifer seedlings from brush and alder. The application of herbicides on federal lands was discontinued in 1983.

Since the adoption of the Northwest Forest Plan, timber harvest on federal land has declined. Most of the federal land within the watershed is in Late-Successional Reserve where no regeneration harvest is allowed. Future timber production will be primarily from thinning of second-growth stands.

3.1.8 Recreation

Most of the recreational developments and/or infrastructure such as trails, roads, and campgrounds within the Neskowin Creek and Salmon River watersheds are currently not on federal lands. Recreational opportunities on federal lands within the study area include hiking (discussed later) in the Cascade Head Scenic Research Area, camping on Neskowin Creek, and driving or bicycling on the many forest access roads in the area.

Some of the first tourists to visit the region were the Reverend Jason Lee and his bride along with Cyrus Shepard and his wife, who spent their honeymoon camping near the mouth of the Salmon River in 1837. Neskowin has been a camping area for travelers from the Willamette Valley since as early as 1872. Since the 1920s, when more tourists began traveling to Neskowin, the area has continued to grow as a recreational destination. Recreational activities within the study area include hiking, camping, picnicking, freshwater bank fishing, upland game hunting, viewing wildlife, horseback riding, mountain biking, off-road ATV and 4-wheel driving, and golfing. Most of these activities occur in the less heavily logged and more scenic western portions of the study area. Additionally, the small communities in the study area are growing as people build second homes or retire to the area. Of the activities surveyed, day hiking is expected to show the greatest growth, increasing 107 percent from 1987 to 2000, wildlife observation is expected to grow 57 percent, and RV camping 54 percent during that same time period in the Northern Coast Range AMA (Wong 1997).

In 1938 the YWCA's 380 acre Camp Westwind opened on the south shore of the Salmon River Estuary. The camp is reached by barges that ferry people across the estuary from Knight Park. Since 1938 the camp has expanded to approximately 700 acres. The camp was used as a furlough base for East Coast servicemen during World War II.

Wong (1997) cites the Pinnacle, the Cascade Head Scenic Research Area, Salmon River, Van Duzer Wayside, Hart's Cove, Neskowin Creek, and Proposal Rock as geographic points of interest within the analysis area.

Within the study area, Neskowin attracts the lion's share of recreationists. The Oregon Parks and Recreation Department reported that over 300,000 people visited Neskowin Beach in 1990-91, and over 177,000 people visited in 1994-95. Recreational attractions include the RV Park and Day Use Area at Neskowin, and the George Vogel Group Site on Neskowin Creek. There are two (2) golf courses in Neskowin: one in the Hawk Creek drainage, and one on the wetlands between the Community of Neskowin and Highway 101.

Additional attractions in the area include Knight Park and boat launch on the Salmon River estuary, and the nearby Sitka Center for Art located on the grounds of the Cascade Head Ranch in Three Rocks.

There are several trails available for hikers in the Cascade Head area. The Hart's Cove Trail, which begins near the Cascade Head summit, descends to Hart's Cove from Road 1861. The trail is open from July 16 through December 31 each year. The Cascade Head Trail follows nearly parallel to the west side of Highway 101. The Nature Conservancy Trail follows the headland above Three Rocks and connects Three Rocks Road to Road 1861. There are few, if any, other trails in the study area suitable for recreational use.

3.1.9 <u>Special Designation Areas</u>

A large portion of the federal lands within the study area are enclosed within the Cascade Head Experimental Forest (CHEF), Cascade Head Scenic Research Area (CHSRA), Cascade Head

Natural Area, and Neskowin Crest Research Natural Area. Management practices vary by area. Details of management policies and practices are well documented in the Siuslaw National Forest Plan (USDA 1990).

3.1.9.1 Cascade Head Experimental Forest

The 11,890-acre Cascade Head Experimental Forest (CHEF) was established in May 1934 for studies in silviculture, forest protection, ecology, forest utilization, and related subjects pertinent to Sitka spruce and hemlock timber types. The CHEF lies largely to the east of Highway 101 between the Salmon River to the south, and Neskowin Creek to the North. The area overlaps the Cascade Head Scenic Research Area to the west.

The overall Management of the CHEF is the responsibility of the Pacific Northwest Research Station (PNW, Research Work Unit 4356). Certain maintenance activities are administered by the National Forest. The CHSRA Management Plan describes how activities are coordinated between the two agencies. All lands within the CHEF are deemed "unsuitable for timber production" in the Siuslaw National Forest Land and Resource Management Plan.

3.1.9.2 Cascade Head Scenic Research Area

Public Law 93-535, dated December 22, 1974 established the Cascade Head Scenic Research Area (CHSRA). It was the first Scenic Research Area designated in the United States. The Forest Service developed an EIS and Management Plan for the area in 1976. The area comprises 9,670 acres of land, of which approximately 6,400 are National Forest lands and the remainder are privately owned. Congress has authorized acquisition of additional land. Approximately one third of the CHEF (discussed above), and the entire Neskowin Crest Research Natural Area are contained within the CHSRA.

The purpose of the area is "to provide present and future generations with the use and enjoyment of certain ocean headlands, rivers, streams, estuaries, and forested areas; to ensure the protection and encourage the study of significant areas for research and scientific purposes; and to promote a more sensitive relationship between humans and their adjacent environment..." (USDA 1990). All land in the CHSRA is categorized as "unsuitable for timber production" (Public Law 93-535).

3.1.9.3 Cascade Head Natural Area

The 280-acre Cascade Head Natural Area, located north and west of Three Rocks, is owned and managed by the Nature Conservancy. The area was once used for grazing. The purpose of the Natural Area is to balance public use and to preserve an ecologically significant area hosting rare plants, animals, and entire ecosystems. Cascade Head is unusual for the extent of its prairies dominated by native grasses, red fescue, wild rye, and Pacific reedgrass. The preserve also supports a threatened species of butterfly and two rare plant species: the Cascade Head catchfly and the hairy-stemmed checkermallow. Funds for research and management of the area are provided by an endowment established for Cascade Head in 1981.

3.1.9.4 Neskowin Crest Research Natural Area

The Neskowin Crest Research Natural Area (RNA), which lies along the northwestern corner of the Cascade Head Scenic Research Area, is largely undisturbed, with Sitka spruce and western hemlock being the dominant trees. Specialized ecosystems within the RNA include ocean cliffs, streamside zones, and a grassy headland. A goal of the RNA is to sustain natural ecological processes.

3.1.9.5 Saddleback Mountain Area of Critical Environmental Concern and Research Natural Area

The Saddleback Mountain Area of Critical Environmental Concern (ACEC) and Research Natural Area (RNA) occupies 135 acres of BLM-managed lands in the upper Salmon River watershed (T.7 S, R. 9 W, Sec.3). It contains what is believed to be the last old-growth Pacific silver fir-western hemlock stand in public ownership in the Oregon Coast Range. The ACEC's Pacific silver fir is a relict population near the southern extent of its distribution in the Coast Range. The population has been reproductively isolated for centuries and could be quite distinct genetically. Noble fir on the site has also been isolated and may be genetically distinct as well.

The 29-acre RNA containing the unique vegetation was established in the early 1980s. An ACEC was established around the RNA to provide a wind buffer to the unique stand. The entire area is designated LSR under the Northwest Forest Plan. Management objectives include maintaining, protecting, and restoring ecological processes, native species, and relevant and important values of the site.

3.1.9.6 Lost Prairie Area of Critical Environmental Concern

The Lost Prairie ACEC occupies an isolated segment of BLM land in the upper Salmon River Watershed, 1 mile east of Saddleback Mountain (T. 7 S, R. 9 W, Sec. 2). The 60-acre ACEC contains one of the few natural high elevation (2,700 ft) peat bogs in western Oregon. This rare habitat includes a rich variety of sedges, bog herbs, and wildflowers, graded into a mixture of beargrass, bog huckleberry shrub, and scattered western white pine. The highest edges and "islands" of the bog are covered by western redcedar-western hemlock forest. Rare cryptogams (mosses, lichens, and liverworts) can also be found.

In 1978, a previously undescribed lily (*Erythronium elegans*) was discovered at the site. This species is now a candidate for federal listing. Management objectives for Lost Prairie include: maintaining, protecting or restoring relevant and important values, preserving habitat diversity for wildlife, and preserving plant diversity for educational and scientific purposes.

3.2 TERRESTRIAL ECOSYSTEM

3.2.1 Vegetation

3.2.1.1 Soil Climate Zones

Soil-climate zones describe the broad patterns of vegetation across the landscape. Four distinct soil-climate zones occur within the analysis area. The Coastal Fog Zone lies along the coast and extends approximately nine miles inland. The Northern Interior Zone and the Central Interior Zones are adjacent to the Coastal Fog Zone. The Valley Margin Zone extends into the north-eastern corner of the watershed analysis area (Map 3).

In general, Sitka spruce series occur in the maritime Coastal Fog Zone and on wetter aspects in the Interior Zones. Western hemlock series thrive in the Valley Margin Zone, the Northern Interior Zone, and portions of the Central Interior Zone. Within the Central Interior Zone, true fir series are found at higher elevations. Noble fir is most common; silver fir associations are found in the Saddleback Mountain and Lost Prairie areas.

Coastal Fog Zone

Dominant plant communities: Sitka spruce and western hemlock

Dominant plant associations: Spruce/salmonberry, western hemlock/salmonberry, spruce/swordfern, spruce/salal, western hemlock/swordfern, and western hemlock/salal

Very high winter rainfall accompanied by high winds, or fog and low clouds, characterize this zone. The width of the Coastal Fog Zone varies with elevation because the extent of fog penetration depends upon heat loss to the atmosphere at night, which varies by elevation (Ruth and Harris 1979). Fog often forms during clear weather in the summer when the heat loss from the land is greater than that of the ocean.

Soils within this zone are characterized by high accumulations of organic matter. They are high in amorphous clays and are often thixotropic (USDA 1995a). Thixotropic soils have the properties of a solid when undisturbed, but become fluid when disturbed though agitation, shearing, or vibration.

Fog and low clouds increase effective soil moisture during summer months. At Otis, a trace or more of precipitation occurs from eight to fifteen days per month from July to September (Ruth and Harris 1979). During these months, fog and moist maritime air apparently play a particularly important role in influencing the distribution of vegetation types (Ruth and Harris 1979).

Within the Coastal Fog Zone, soil temperatures rarely fall below freezing. Soils are considered isomeric (slight differences from winter to summer in soil and air temperatures). This creates ideal conditions for Sitka spruce, western redcedar, and western hemlock.

Interior Zones

Dominant plant communities: Douglas-fir and western hemlock

Dominant plant association: Hemlock/swordfern, hemlock/salal, and hemlock/salmonberry

Further inland of the fog zone, two interior soil-climate zones occur, the Northern Interior Zone and the Central Interior Zone. The location of these zones coincides with the location of the first peaks of the coastal mountain range.

The climate within these zones is generally maritime; however, summer fog is not as common as in the Coastal Fog Zone. High winds are frequent. According to Hemstrom and Logan (1986), slopes are steeper and soils are usually well drained. Slope aspect has a more pronounced effect on species distribution. Because these zones are more mountainous, they have greater climatic variability. Heavy rains and occasional snow create high soil moisture levels in the winter. Summers are moist.

Soils are mesic; soil temperatures are significantly different from summer to winter. Soils are characterized by high biologic activity accompanied by high decomposition rates and moderate to high accumulations of soil organic matter (USDA 1995a). Summer soil moisture levels on upper slopes south of the Salmon River are somewhat drier than those found north of the Salmon River.

In the analysis area, the Central Interior Zone reaches elevations of approximately 900 feet. The deep to very deep moderately fine-textured soils in this zone overlay slowly to moderately permeable bedrock.

Douglas-fir and western hemlock compose the majority of forest communities (USDA 1995a). In the analysis area, hemlock/swordfern plant associations are most common on lower slopes. Some noble fir plant associations may occur on higher elevation upper slopes.

Northern aspects prevail in the Northern Interior Zone, which lies adjacent to and above the Salmon and Little Salmon Rivers. The very deep fine-textured soils in this zone overlay highly permeable bedrock.

Like the Central Interior Zone, Douglas-fir and western hemlock are the dominant conifers. However, within this zone, mixed deciduous/conifer stands occupy most forested sites (USDA 1995a). Within the analysis area, hemlock/salmonberry, hemlock/salal, and hemlock/swordfern plant associations are most common.

Valley Margin Zone

Dominant plant communities: Douglas fir, red alder and western hemlock

Dominant plant associations: Hemlock/salmonberry and hemlock/salal with inclusions of hemlock/swordfern along the Salmon River

A finger of the broad-reaching Valley Margin Zone intrudes into the northeastern corner of the Salmon-Neskowin Watershed Analysis area. Here, in the river valley of the Salmon and Little Salmon Rivers, slopes are gentler.

Maritime influences are less pronounced. Unlike the other soil zones within the analysis area, high winds are uncommon in the Valley Margin Zone. Soils are significantly drier and warmer during summer months, which limits plant growth (USDA and USDI 1998). Winters are moist. Soils have moderately high biologic activity and moderate decomposition rates. Accumulations of soil organic matter are low to moderate (USDA 1995a).

3.2.1.2 Plant Association Groups

Within each of the soil-climate zones, specific plant association groups (PAGs) are likely to occur. PAGs are combinations of common plant associations based upon common elevations, slopes, aspects, and land shapes.

On the Siuslaw National Forest, PAGs were determined by applying a computer model to a projection of plot data. The model extrapolated the plot data against a set of rules to group similar plant association types. Within each PAG, several plant associations may actually occur on the ground. The plant association map shows the distribution of the nine PAGs found in the analysis area. Table 3-1 shows the relationship of those plant associations to the subseries environment by series and soil-climate zone.

TABLE 3-1. DISTRIBUTION OF SUBSERIES ENVIRONMENTS AND PAGS IN THE WATERSHED

Soil-Climate Zones	Series	Subseries Environment	PAGs Comprising the Subseries Environment
Coastal Fog Zone (40,391 acres)	S. spruce (38,380 ac.)	Wet spruce (29,863 ac.)	Spruce/salmonberry (29,501 ac.)
			Spruce/salmonberry-salal (362 ac.)
		Moist spruce (8,517 ac.)	Spruce/swordfern (6,804 ac.)
			Spruce/menziesia (1,713 ac.)
	W. hemlock (2,005 ac.)	Wet hemlock (1,158 ac.)	Hemlock/salmonberry (1,158 ac.)
		Moist hemlock (822 ac.)	Hemlock/swordfern (822 ac.)
		Dry hemlock (25 ac.)	Hemlock/salal (25 ac.)
Northern Interior Zone (6,561 acres)	S. spruce (5,523 ac.)	Wet spruce (3,560 ac.)	Spruce/salmonberry (3,449 ac.)
			Spruce/salmonberry-salal (111 ac.)
		Moist spruce (1,963 ac.)	Spruce/swordfern (1,825 ac.)
			Spruce/menziesia (138 ac.)
	W. hemlock (1,038 ac.)	Wet hemlock (548 ac.)	Hemlock/salmonberry (548 ac.)
		Moist hemlock (447 ac.)	Hemlock/swordfern (447 ac.)
		Dry hemlock (43 ac.)	Hemlock/salal (43ac.)
Central Interior Zone (14,637 acres)	S. spruce (3,066 ac.)	Wet spruce (459 ac.)	Spruce/salmonberry (459 ac.)
		Moist spruce (2,607 ac.)	Spruce/swordfern (2,586 ac.)
			Spruce/menziesia (21 ac.)
	W. hemlock (6,959 ac.)	Wet hemlock (439 ac.)	Hemlock/salmonberry (439 ac.)
		Moist hemlock (4,427 ac.)	Hemlock/swordfern (4,388 ac.)
			Hemlock/oxalis (39 ac.)
		Dry hemlock (2,093 ac.)	Hemlock/salal (2,093 ac.)
	Noble fir (4,609 ac.)		Noble fir (4,609 ac.)
			No data (3 ac.)
Valley Margin Zone (2,166 acres)	W. hemlock (2,166 ac.)	Wet hemlock (1,986 ac.)	Hemlock/salmonberry (1,986 ac.)
		Moist hemlock (169 ac.)	Hemlock/swordfern (169 ac.)
		Dry hemlock (11 ac.)	Hemlock/salal (11 ac.)
Open Water and Tidelands (528 acres)			
Total (64,283 acres)			

Sources: SNF GIS layers: Soil climate zones (SOILCLIZ); plant association grid (PAG, January 1999)

3.2.1.3 Disturbance Processes

Within the analysis area, the key natural disturbance processes include fire, wind, insects, and disease. Timber harvest, land clearing for agriculture and development, and human-caused fires are the most significant human-related disturbance processes.

Physical Disturbance Processes

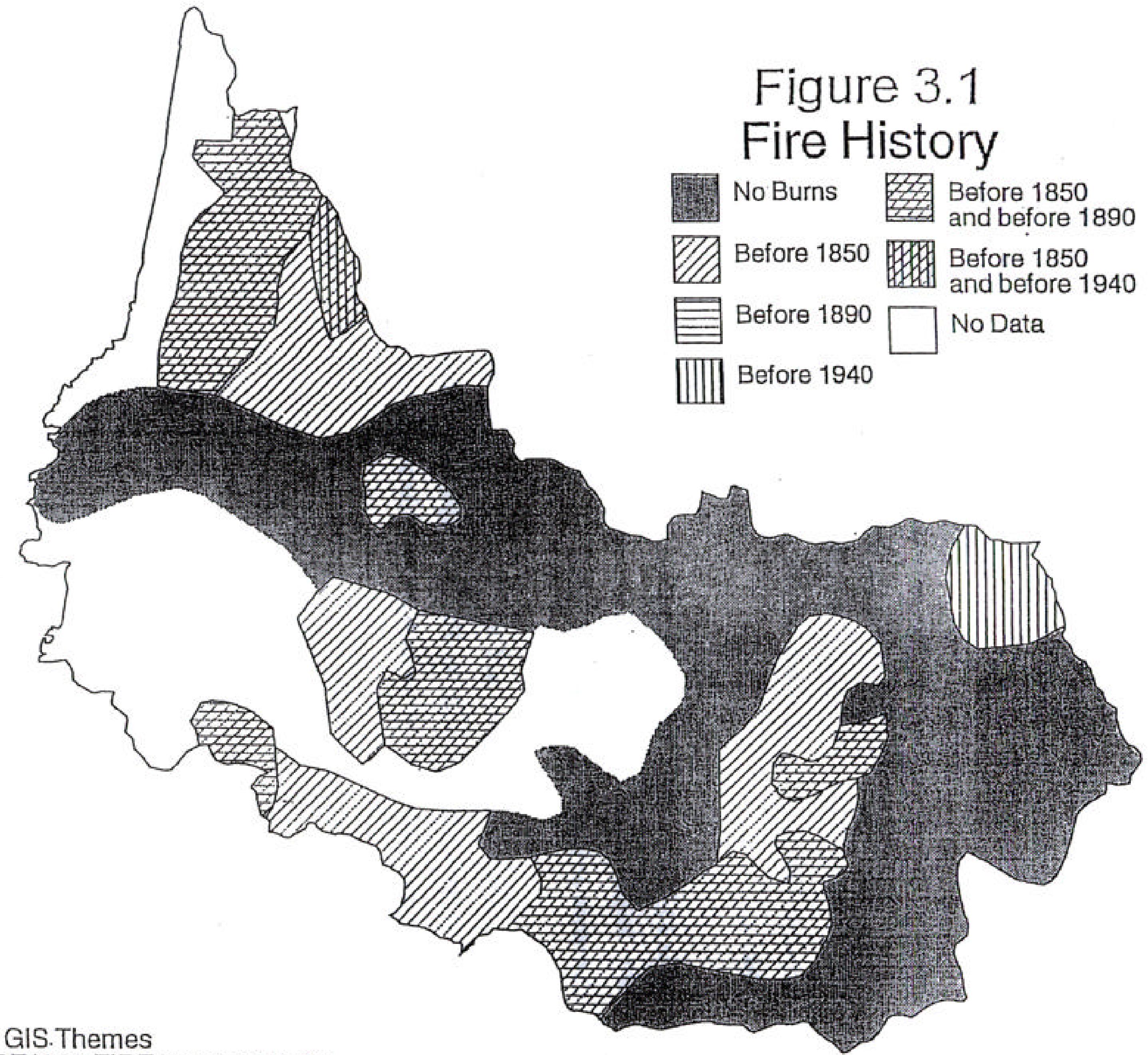
Fire

Historically, fire was the most important stand-initiating event in the Coast Range (Harcombe 1986). The historic fire-return interval has been calculated at a mean of 434 years, with a range of 226 to 2,583 years. This long interval between disturbances allowed the development of old-growth stands.

Since European settlement, fires have occurred more frequently and many have been human-caused. According to Harcombe (1986) the major Coast Range crown fires of the late 19th and early 20th centuries were all thought to be human-caused. The result of increased fire is that few unharvested stands in the watershed are over 120 years old. Not all fires, however, were stand replacing.

Figure 3.1 (Fire History) shows the approximate areas that burned just prior to 1850, 1890, and 1940. These maps were compiled from various sources and represent the best available information on vegetation ages (USDA 1998).

According to the data represented on the 1850 fire map, approximately 42 percent of the watershed burned in the mid-1800s. The 1940 vegetation age map indicates that additional areas burned between 1920 and 1940 including some of the area that burned in the previous century.



Source: SNF GIS Themes
FIRE1850,FIRE1890,FIRE1920,FIRE1940

Fire frequency increases further inland due to dry east winds that decrease fire fuel moisture and provide the major force that pushes fires. Summer fog apparently plays a role in minimizing fires (Ruth and Harris 1979). A comparison of soil climate zones and vegetation age maps from 1850, 1890, 1920, and 1940 indicates a weak correlation between soil climate zones and age class. This relationship appears to be tempered by slope, aspect and vegetation communities.

Harcombe (1986) found that restocking following crown fires is rapid. Although no data on restocking following fires were available, the rate of restocking following disturbance in the watershed has been shown to be rapid. For example, at Cascade Head, one study found that within 6 years of logging, an area was 81 percent stocked. Harcombe attributes the rapid restocking to frequent and prolific seed production by both spruce and hemlock. Similar responses would be expected following a crown fire.

Many sites go through a red alder dominated stage following fire. Franklin and Dyrness recognized two major kinds of seral stands in coastal hemlock-spruce plant series: 1) coniferous forests with varying mixtures of spruce, hemlock and Douglas-fir and 2) red alder or other hardwood dominated stands. (Ruth and Harris 1979). Which type occurs depends upon the amount of site disturbance and available seed. Greater disturbance favors red alder (Ruth and Harris 1979).

In the Little Nestucca drainage, a correlation between multiple burns since 1850 and alder stands was observed (USDA 1998). Although this correlation may exist in the analysis area, the existing data do not readily support it. In general, there were fewer and less recent burns in this area than in the Little Nestucca, and the fire history shows only one burn since 1850 in areas of greatest hardwood concentration. The increase in alder over historical levels may be related to logging, the most notable disturbance in the watershed. Other disturbances that could have caused the perpetuation of alder include windthrow and disease.

Red alder seeds germinate and grow rapidly on exposed mineral soils in full sunlight. Early, rapid height growth allows alder to overtop and suppress conifers. Over an extended period of time, perhaps as long as 150 years, shade tolerant conifers will accumulate in the understory, and eventually break into the canopy (Hemstrom and Logan 1986).

As a nitrogen fixer, red alder may play a role in restoring site-fertility and in checking the spread of *Phellinus weirii* root rot (Hemstrom and Logan 1986). Studies in Canada have indicated that the presence of paper birch, which, like alder, plays a significant successional role following fire, can reduce the size and number of root disease centers in Douglas-fir (Simard and Vyse 1993). Like birch, alder roots contain high levels of phenols. These compounds may play a role in limiting the spread of root disease.

<u>Wind</u>

East winds are funneled from the Willamette Valley down the Salmon River and Neskowin Creek valleys to the coast, bringing cold, clear weather in winter and dry, hot weather in summer. Wind is the most significant disturbance agent in the Coastal Fog zone and least significant in the Valley Margin Zone. The amount of stand disturbance created by wind can vary depending upon stand location, age, slope, dominant species, soil depth, soil moisture, incidence of root rot or other weakening agents, proximity to openings, and adjacent opening size (Ruth and Yoder 1953; Nowacki and Kramer 1998).

Wind damage can be spectacular or subtle. Its effects change over a continuum, grading from areas where chronic, single or small, multiple-tree openings prevail to areas exposed to recurrent, large-scale blowdown events (Nowacki and Kramer 1998).

The highest velocity winds with the greatest damaging impact are the south and southwest winds of an approaching storm. Studies at Cascade Head found that on average, storm winds come from the southwest at an approximate azimuth of 210 degrees (Ruth and Yoder 1953). Gale force winds approach the shoreline with increasing frequency in October and November, reach a peak in December and January, and then decrease in February and March (Ruth and Harris 1979). Blow-down events have occurred within the analysis area. In 1891, approximately 5 ha (12.4 acres) blew down on Cascade Head (Harcombe 1986). Two extensive blowdown events in western Oregon, one in 1951 and another in 1962, (Ruth and Harris 1979 and Harcombe 1986) likely affected portions of the watershed as well.

Small pockets of blowdown have occurred in the watershed, particularly along Old Scenic Highway 101, where down trees are salvaged by the Forest Service every winter. Where trees have been suddenly exposed to the force of the wind along the edges of clearcuts, blowdown also increases. Because logging activity increases the number of exposed edges, the number of significant blowdown patches has probably increased over historic levels. Fires may have created larger openings; however, the ratio of edge to opening decreases as opening size increases. Additionally, logging activity has occurred at regular, frequent intervals. The interval between natural fires would have been much greater. More frequent disturbance activities expose susceptible stand edges to a greater number of storm events.

Scattered blowdown, where individual trees topple or break within the canopy, occurs even without catastrophic storms. Trees weakened by primary agents such as root rot or dwarf mistletoe may blow down in storms that are not particularly severe (Ruth and Harris 1979). Small-scale canopy disturbances like these are typical in older forests with high structural complexity (Nowacki and Kramer 1998). It is likely that the rate of occurrence of scattered blowdown events has not changed significantly over historic levels.

Wind damage to needles, twigs, and branches may reduce the photosynthetic area of a forest, and thus reduce productivity. Root damage occurs when roots work up and down in the soil during wind sway. This also slows growth. Additionally, root damage may increase susceptibility to blowdown in future storm events and may provide an entryway for disease organisms (Ruth and Harris 1979). Such reductions in productivity are likely to have occurred, and to occur again, in the analysis area.

Stands most at risk to all types of wind damage, especially blowdown, are closer to the ocean, on ridges or high on the northeast side of ridges, and composed predominantly of western hemlock or Sitka spruce.

Biological Disturbance Processes

<u>Foliage Diseases</u>

Swiss Needle Cast. Swiss Needle Cast (*Phaeocryptopus gaeumannii*) occurs throughout the range of Douglas-fir. Until recently, this fungus was thought to be unimportant. Historically, the disease has not caused appreciable damage. Even in the late 1970s and early 1980s, the disease was reported only in a few plantations in western Oregon. However, by the late 1980s, Swiss Needle Cast had become increasingly more severe in plantations and naturally established stands (Oregon Department of Forestry 1998).

In 1996, Oregon Department of Forestry surveys showed that the disease was most widespread in the Coastal Fog Zone. Most of the discoloration associated with Swiss Needle Cast occurred within 15 miles of the coast. In 1997, surveys indicated a three-fold increase over 1996. Trees with symptoms of the disease were observed 24 miles inland (Oregon Department of Forestry 1998).

Although Swiss Needle Cast occurs throughout the Salmon and Neskowin watersheds, the most severely infected areas lie north of the Salmon River in the Coastal Fog Zone. Very few areas within the Central Interior Zone appear to be affected (Map 4).

In the Lower Neskowin, Salmon, and Widow subwatersheds, the most significant areas of infection occur in older stands. In the Deer, Butte/Hawk, and Upper Salmon subwatersheds, the most significant levels occur in younger stands. Both younger and older stands are infected in the Treat/Alder Brook subwatershed. The Upper Neskowin subwatershed shows the areas of highest infection. Here, both younger and older stands show evidence of discoloration.

Tree growth reductions due to Swiss Needle Cast have been estimated at as high as 22 percent. It is unknown if this growth decrease will increase, decrease, or remain constant over time. (Oregon Department of Forestry 1998). In addition to reductions in growth, the disease is now beginning to cause mortality in some infected stands.

If sustained, Swiss Needle Cast infections may reduce opportunities to manipulate stands into desired structures and compositions. For example, it is not known how infected stands will respond to thinning. Swiss Needle Cast causes a reduction in foliage and decreases crown closure in severely affected stands. This in turn increases the growth of understory vegetation. If Swiss Needle Cast-induced mortality occurs, the canopy may be reduced to a level too low to achieve the desired late-successional characteristics. This result will not be known until experimentation has taken place.

Root Rot. A number of different root rot diseases are found in the analysis area. Root rots are endemic in most forested areas and are not likely to cause significant problems on their own. However, root rots can become a significant concern in areas where other factors such as drought, insects, or other disease factors have weakened trees. Swiss Needle Cast may set the stage for an increase in root rot infection over the next decade.

Laminated Root Rot. Laminated root rot (*Phellinus weirii*) attacks trees of all ages, but is most common in Douglas-fir stands between 25 and 125 years old. The disease is spread by root-to-root contact. The fungus can live for years in dead stumps and logging residue. This makes the disease particularly difficult to control. Pockets of infected trees are likely to occur throughout the analysis area. No specific areas with significant infection levels were noted.

Annosus Root Disease. The weak saprophyte, *Heterobasidion annosum,* is most successful in attacking trees that have been weakened by drought or other factors. This root disease occurs at endemic levels throughout western Oregon. It can survive for more than 50 years in the dead roots of some tree species. Western hemlock is susceptible to infection.

Because of the role of stumps and wounds in spreading the disease, repeated thinning entries will increase Annosus infection levels. Care needs to be taken to ensure the long-term health of hemlock-dominated stands, particularly if multiple harvest entries are planned to promote the development of late-successional characteristics (USDA 1998).

Armillaria Root Rot. Also known as mushroom rot and shoestring root rot, the root rots caused by species in the genus *Armillaria* have a wide host range. *Armillaria* is ubiquitous. It commonly occurs in woody debris in the soil. In the Coast Range, *Armillaria* primarily affects plantations less than 25 years old and off-site trees. Healthy trees have the best resistance to *Armillaria*.

Insects

Bark beetles, particularly the Douglas-fir beetle (*Dendroctonus pseudotsugae*) and the Spruce beetle (*Dendroctonus rufipennis*) are of concern in the Salmon-Neskowin watershed analysis area. Both are often associated with root disease, blowdown events, and other large-scale disturbances that weaken trees.

Ruth and Yoder (1953) reported that a Douglas-fir beetle epidemic killed 455 million board feet of green timber the summer following a large blowdown event in the Oregon Coast Range (3.7 billion board feet blew down on December 4, 1951). The beetles built up populations in blowdown areas, then emerged to attack living trees.

The creation of downed wood as part of the late-successional management strategy has raised concerns about increasing beetle-caused mortality (USDA 1998). Concentrations of down wood may allow beetle populations to expand beyond current endemic levels.

Many other insects affect the growth of conifers in the Coast Range. A western hemlock looper (*Lambdina fiscellaria lubabrosa*) outbreak occurred between 1889 and 1891 in the Tillamook area. Western hemlock looper affects both hemlock and Douglas-fir. In 1998, a spruce aphid epidemic occurred along the Oregon coast, affecting Sitka spruce within the Coastal Fog Zone. The white pine weevil (*Pissodes strobi*) creates the greatest damage outside the Coastal Fog Zone and can affect young (8- to 30-year old) spruce by attacking terminal growth.

Dwarf Mistletoe

Dwarf Mistletoes (*Arceuthobium spp*.) depend upon conifer hosts for growth and survival. Mistletoes weaken trees and reduce growth. Additionally, dwarf mistletoe may provide entry points for decay organisms through broken stubs or old brooms. Mistletoes create brooms that are used as habitat by wildlife species.

Mistletoe affects western hemlock in the Coast Range. Sitka spruces are not affected. Infection is often concentrated within particular stands. The rate of spread of mistletoe is slow. Mistletoe is likely to occur at endemic levels in the Salmon and Neskowin watersheds.

3.2.1.4 Seral Stage Distribution

Plant communities gradually change in somewhat predictable patterns over time. This gradual change is punctuated by disturbances that destroy all or some of the vegetation. Large-scale disturbances such as fire or extensive blowdown significantly alter the plant communities and processes. Smaller-scale disturbances such as those created by insects, scattered blowdown, or wind damage subtly alter the species composition and structure of forested areas. The types of disturbances that occur in a particular region are often predictable based upon natural processes and social trends (Oliver and Larson 1990).

Four stand development stages are recognized (Oliver and Larson 1990). The stand initiation stage occurs after a disturbance when new individuals and species become established. Next, during the stem exclusion stage, new individuals no longer become established and some existing ones die. Surviving trees grow larger and begin to express height and diameter differences. The understory reinitiation phase begins when the openings created by dying trees create opportunities for understory vegetation to begin to develop once again. Finally, when trees begin to die in an irregular fashion, the stand enters the old-growth stage.

For this project, the stand initiation stage includes the pioneer, very early, and early-seral stages. Stands from 0 to 49 years of age with tree diameters under 18 inches fall within this category. The stem exclusion stage includes those stands classified as mid-seral that are generally 50 to 79 years old with tree diameters that range from 10 to 18 inches. Stands over 80 years old with tree diameters above 19 inches are classified as late-seral stands. This early portion of this stage is described as the understory reinitiation stage; the later portion is described as the old-growth stage.

The following table (Table 3-2.) shows the percent of the watershed within each of these stages. Both current and historic conditions are shown.

TABLE 3-2. STAND STAGES OF DEVELOPMENT (CURRENT AND HISTORIC CONDITIONS)

Development Stage	Current (%)	Historic (%)
Stand Initiation	34	29
Stem Exclusion	13	12
Understory Reinitiation	24	27

Old-growth	0	10
Hardwood	14	7
Unknown	15	15
Total	100	100

Current seral stage data came from the Siuslaw National Forest " Allvegetation" GIS layer. Table 3-3 shows the distribution of current seral stages in the watershed. Table 3-4 shows the distribution of current seral stages by subwatershed. Current seral stages for stands in the analysis area were determined from satellite data. A portion of this data was ground-truthed. Maps 5 and 6 and the tables included in Appendix A provide additional information about the current and historic seral stages within the Salmon and Neskowin watersheds.

TABLE 3-3. DISTRIBUTION OF CURRENT SERAL STAGES WITHIN THE WATERSHED

Seral Stage	General Age	Acres	Percent
Pioneer	0 to 10 yrs	3650	5.7%
Very Early	11 to 24 yrs	7820	12.2%
Very Early Mix	11 to 24 yrs	287	0.4%
Early	25 to 49 yrs	3864	6.0%
Early Mix	25 to 49 yrs	6595	10.3%
Mid	50 to 79 yrs	5292	8.2%
Mid Mix	50 to 79 yrs	5717	4.5%
Late	80 + yrs	9703	8.9%
Late Mix	80 + yrs	2921	15.1%
Pure Hardwood	variable	8698	13.5%
Unknown		9791	15.2%
Total		64,337	100.0%

TABLE 3-5. FEDERAL AND NON-FEDERAL OWNERSHIP BY SUBWATERSHED (SQUARE MILES)

Sub-Watershed	Non-fed	Federal	Total	Percent under Fed. Mgmt.
Bear2	2.85	2.73	5.58	49%
Butte/Hawk	7.41	0.71	8.11	9%
Cliff	0.08	2.10	2.18	96%
Deer	0.73	2.36	3.09	76%
L. Neskowin	2.52	5.35	7.87	68%
L. Salmon River	3.60	4.21	7.81	54%
M. Salmon River	4.32	1.97	6.30	31%
Panther1	1.11	1.24	2.36	53%
Salmon	0.99	3.87	4.85	80%
Slickrock2	6.84	2.14	8.98	24%
Treat/Alder Brook	7.26	0.70	7.95	9%
Trout1	2.79	2.70	5.49	49%
U. Neskowin	2.08	5.09	7.17	71%
U. Salmon River	19.48	0.20	19.68	1%
Widow	2.32	0.80	3.12	26%
Total	64.36	36.16	100.53	

Note: Subwatersheds with greater than 50 percent of their land base under federal management are highlighted in grey.

The largest concentrations of late-seral stands occur in the Cliff, Deer, Lower Neskowin, Salmon, and Upper Neskowin watersheds. The largest concentrations of very early and early-seral stages occur in the Bear2, Cliff, Neskowin, and Upper Salmon River subwatersheds. Only the Bear2 and Upper Salmon River subwatersheds have a high percentage of stands in mid-seral classes. Concentrations of pure hardwood stands are largest in the Deer, Lower Salmon, Middle Salmon River, Panther1, and Salmon subwatersheds.

Concentrations of late-seral stands coincide with federal ownership (Table 3-5). The Cliff, Deer, Lower Neskowin, Lower Salmon River, Panther1, Salmon, and Upper Neskowin subwatersheds have greater than 50 percent of their land base under federal management. Concentrations of very early and early-seral stages coincide with private or industrial ownership. The Bear2, Butte/Hawk, Middle Salmon River, Slickrock2, Treat/Alder Brook, Trout1, Upper Salmon River, and Widow subwatersheds have greater than 50 percent of their land base under private ownership.

The Siuslaw National Forest provided its Historic Vegetation GIS layer for the historic vegetation analysis. These data were derived from county maps published during three distinct time periods: prior to 1947, between 1947 and 1949, and after January 1, 1949. Most of the data for the Siuslaw National Forest falls into the third category and is dated 1955. It is unknown which of the three categories the remainder of the watershed falls under. These data are assumed to reflect vegetation patterns typical of those prior to extensive logging. They should, to some extent, reflect the watershed's fire history. More information on the data source is needed in order to better describe the time period represented.

Table 3-6 shows the distribution of historic seral stages in the watershed. Appendix A shows the distribution of historic seral stages by subwatershed. The historic distribution of seral classes reflects the watershed's fire history. Figure 3-3 compares the amounts of early, mid- and late-seral stages between historic conditions and present.

Historically, subwatersheds with high percentages of very early and early-seral classes include Bear2, Panther, Upper Salmon River, and Widow. Subwatersheds with a high percentage of mature conifer classes include Bear2, Cliff, Deer, Lower Neskowin, Salmon, Slickrock2, and Upper Neskowin. No subwatersheds had significant percentages of pure hardwood stands.

Both the current and historic vegetation GIS layers identify hardwood stands. Because the data sources for these two layers differed, the classification system for the current and historic periods differs slightly. The difference is not due to differences in vegetative patterns; rather, it is based upon differences in data and information.

TABLE 3-6. DISTRIBUTION OF HISTORIC SERAL STAGES WITHIN THE WATERSHED

Seral Stage	General Age	Acres	Percent
Grass/forb	Non-forest	973	2%
Very Early	11 to 24 yrs	13,999	22%
Early Pole	25 to 49 yrs	1,752	3%
Confmix Pole	25 to 49 yrs	1,523	2%
Young Conifer	50 to 79 yrs	5,842	9%
Young Confmix	50 to 79 yrs	2,248	3%
Mature Conifer	80 + yrs	21,939	34%
Mature Confmix	80 + yrs	1,871	3%
Deciduous Mix	Variable	3,380	5%
Pure Hardwood	Variable	1,342	2%
Untyped		9,467	15%
Total		**64,337**	**100%**

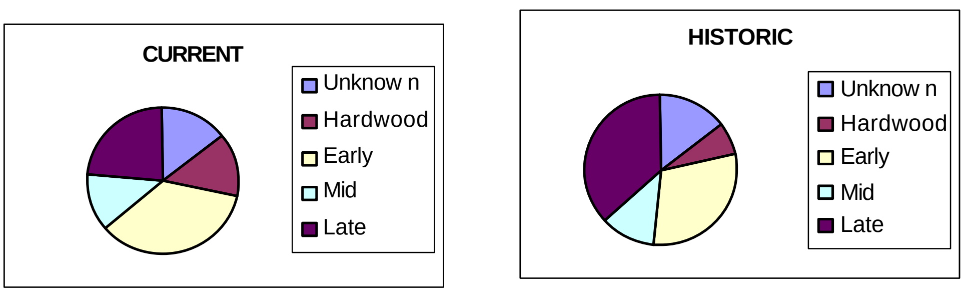


Figure 3-2: Seral Stage Distribution

This comparison indicates that the disturbance regime in the watershed differs from historic patterns. The typical historic pattern of disturbance appears to have been long periods of no disturbance punctuated by large events. This disturbance regime has been replaced by smaller, more frequent events (primarily logging).

This conclusion is supported by the known logging history, the primary recent disturbance agent within the Salmon-Neskowin watershed analysis area. Research in the Cascade Head Experimental Forest also supports this conclusion. A more accurate data set provides greater detail on seral stages on federal lands and some non-federal lands. However, this data set does not include most of the non-federal lands in the watershed. This information is presented in Appendix A. Appendix A also shows the percentage of land (both federal and non-federal) by seral class and subwatershed.

3.2.2 Wildlife and Plants

3.2.2.1 Late-seral Habitat

Late-seral habitat has been defined in the Northwest Forest Plan (USDA and USDI 1994) as mature and old-growth forest stands. This definition was also used in the Late-Successional Reserve Assessment for Oregon's Northern Coast Range Adaptive Management Area (LSRA) (USDA and USDI 1998). Similar to what was described in the LSRA for the entire AMA, most of the late-seral stands in this watershed are mature forest 80 to 120 years old. Fifty-one percent of all late-seral habitat (6,438 of 12,620 acres) in the watershed occurs in the CHSRA/CHEF complex which constitutes only about 20% of the watershed. This distribution is little changed from the early 1950s when approximately 53% of the estimated 15,250 acres of late-seral habitat occurred in the CHSRA/CHEF complex.

Conversion of private land to other uses (e.g. farming, residential), as well as forest management activities on industrial forest land, have resulted in the remaining late-seral habitat stands on non-federal land consisting of very small patches with a very high degree of fragmentation. These remaining patches occur as widely spaced islands with an average size of approximately six acres compared to approximately 75 acres in the early 1950s. The one significant exception to the current small size is the Van Duzer State Wayside Corridor that retains two linear but large, contiguous blocks of 160 and 300 acres. While the remaining late-seral stands on federal lands are generally larger (average 117 acres) than on non-federal lands, forest management activities here have also resulted in fragmentation of habitat. The average size of late-seral blocks on federal land in the early 1950s was nearly 900 acres. While habitat changes have occurred, it should be recognized that some of the differences are due to different levels of detail available for the analyses. Hence, the degree to which they have occurred may be somewhat overstated.

The quality of habitat in late-seral forest is affected by adjacent stands that are in earlier seral stages. Changes in moisture regimes, microclimate, vegetation and species occurrence have been found to occur as a result of edge effect where moderate to large scale disturbances (e.g., clearcut blocks) alter or remove habitat. The distance into a stand at which edge effects have been documented varies depending on the variable measured. Edge effects in Douglas-fir old-growth fragments can occur within 525 to 656 feet (160 to 200 meters; Lehmkuhl and Ruggerio unpublished report). Adverse effects on interior forest species can result in avoidance of areas and/or increased mortality risk from predation.

Linear clearings such as roads can also affect late-seral habitat. The degree to which edge effects occur as a result of linear clearings (20 to 50 feet wide) has not been investigated in the western United States, however studies elsewhere and the professional opinion of researchers suggest that changes in habitat, species composition, and nest predation are likely to occur in the Pacific Northwest. Rich et al. (1994) studied edge effects along paved roads (roughly 50 feet in width), unpaved roads (roughly 24 feet wide), and transmission corridors in the eastern United States. They found that fragmentation effects occurred with clearing widths as small as 24 feet by attracting cowbirds and nest predators to forest interiors. Paton (1994) suggested that road corridors should have been considered as edges in a review of Angelstam's (1986) edge effect study. Based on a review of numerous nest predation studies, Paton (1994) concluded that nest predation increased within 50 meters of forest edges.

To evaluate the extent of existing interior forest (late-seral forest not affected by edge), the distances of edge effect modeled in the LSRA were used (500 feet from high-contrast edges [pioneer and early-seral stands]; 100 feet from low-contrast edges [mid-seral and hardwood stands]). In addition to edge effects from large scale stand conditions, the effects of roads were also assessed. While the edge produced by most forest roads (20 to 50 feet clearing width) would be considered a high-contrast edge, the effect is generally buffered to some extent by the forest stand on the other side of the road. Roads were therefore assumed to produce an edge effect extending 250 feet into an adjacent late-seral stand. (Where the habitat on the other side of the road was early-seral, however, the edge was taken to be high-contrast and the edge-effect distance of 500 feet was used.) Since historic information was not readily available, roads were not considered in the analysis of historic interior forest. Roads were likely much less numerous, but since the effects weren't assessed, historic interior forest may be slightly overestimated in this analysis.

The results of the interior forest analysis (Map 7) show that of the 12,600 acres of late-seral habitat currently in the watershed only 4,000 acres (32%) constitute interior forest habitat, the remaining 68% being affected by edge. Of the edge-affected area 7,600 acres (89%) are the result of adjacency to early- or mid-seral stands, whereas 900 acres (11%) are affected by roads. The aver-age block size of remaining interior forest is 45 acres compared to 470 acres in the early 1950s (Map 8). The largest three blocks are currently 1,490, 860 and 500 acres compared to 6,720, 1,460 and 450 in the early 1950s. As discussed earlier, some of these differences are attributable to the different levels of detail available for the two analyses. There has nonetheless been a signi-ficant reduction in the size and contiguity of blocks of late-seral and interior late-seral forest from historical levels. As in the 1950s the most significant remaining blocks still occur in the CHEF/ CHSRA complex and vicinity. Larger blocks that previously existed in the southern and eastern portions of the watershed have been highly fragmented or eliminated.

3.2.2.2 Other Habitat Components and Considerations

Hardwood stands. Hardwood stands are particularly prevalent in riparian areas. These stands provide important habitat for several species including many Survey and Manage invertebrates, the white-footed vole, and some neotropical birds with declining populations such as the western wood peewee and Wilson's warbler.

Snags and coarse woody debris. Snags and coarse woody debris (CWD) are important components of forested habitats in all seral stages. They provide key habitat for numerous species. The watershed is generally characterized by a shortage of these components, especially in managed stands.

Roads. In addition to the effects on late-seral species and habitat from the existence of roads discussed earlier, vehicle use of roads can also result in disturbance to wildlife species. Human disturbance can cause avoidance of disturbed areas (resulting in crowding into adjacent habitats), create barriers to movement, adversely affect reproductive success, and result in increased mortal-ity from collisions or legal and illegal hunting. Reproductive and populational effects have been shown for many bird and mammal species (Bart 1977; Elison and Cleary 1978; Fraser 1984;

Jon-kel 1980; Laws 1973). Avoidance of roads or reduced use of the area around roads has also been demonstrated for many wildlife species including elk (Lyon 1984), blacktailed deer (Perry and Overly 1976), fisher, marten and wolverine (Ruggerio et al. 1994), wolf (Mech et al. 1988, Thiel 1985) and grizzly bear (McLellan and Shackelton 1988; Jonkel 1980). While some of these spe-cies aren't expected to occur in the watershed (e.g., wolf, grizzly bear), the results may provide indications of expected behavior of related species (e.g., canids, black bear).

Open road (roads open to vehicular traffic) density for the entire watershed is currently 3.47 miles per square mile, and 2.51 miles/square mile on federal land. The BLM Resource Management Plan recommends road densities not exceed 1.5 miles per square mile in elk habitat. Other wild-life managers have recommended that road densities not exceed 1 mile per square mile (Frederick 1991; Tucker et al. 1990). Open road densities were measured for each fifth-field watershed and are displayed in Table 3-7a. Table 3-7b displays the relative percents of land area that exhibit different road densities in the entire watershed and on federal lands only. Ninety-three percent of the subwatersheds contain open road densities greater than 1.5 miles/square mile, and 37 percent display road densities greater than 4 miles/square mile. On federal lands 80 percent of the sub-watersheds exceed 1.5 mile/square mile, and 8 percent exceed 4 miles/square mile.

TABLE 3-7A. OPEN ROAD DENSITIES BY FIFTH-FIELD WATERSHED

Watershed	Density All Lands (mi/sq. mi.)	Density Federal Lands (mi/sq. mi.)
Bear2	3.13	4.56
Butte/Hawk	4.05	0.84
Cliff	1.26	1.32
Deer	2.57	2.84
L. Neskowin	2.57	1.50
L. Salmon River	3.20	2.44
M. Salmon River	4.61	2.69
Panther1	4.83	2.46
Salmon	2.01	1.78
Slickrock2	4.69	2.42
Treat/Alder Brook	4.20	2.90
Trout1	3.02	1.77
U. Neskowin	3.67	3.87
U. Salmon River	3.78	2.37
Widow	4.06	3.24
Total	**3.47**	**2.51**

TABLE 3-7B. OPEN ROAD DENSITY DISTRIBUTION WITHIN WATERSHED

Open Road Density (miles/square mile)	Percent of Watershed (%)	Percent of Federal Land (%)
0-1	0.0	2.0

1-2	2.2	38.8
2-3	15.7	35.5
3-4	45.5	16.3
>4	36.6	7.5

3.2.2.3 Threatened and Endangered Species

Late-seral associated species

Spotted owls

Northern spotted owls inhabit the Salmon and Neskowin watersheds. There are six identified pair or resident single activity centers, five of which occur in the CHSRA/CHEF complex and the Neskowin Creek watershed to the north. The other activity center occurs within the Van Duzer State Wayside Corridor. Spotted owl surveys are conducted each year for all sites. Both LSRs within the watershed, as well as the CHSRA and CHEF, are designated as Critical Habitat by the USDI Fish and Wildlife Service (USFWS). Management direction requires delineation of Reserved Pair Areas (RPAs) for spotted owls within the Northern Coast Range AMA. The proposed RPA on federal land adjacent to the CHSRA/CHEF is shown on Map 2. Not all late-seral habitat areas within the watershed constitute suitable habitat for northern spotted owls. Map 9 shows existing owl habitat based on aerial photo interpretation and habitat knowledge of Forest Service and BLM biologists.

Marbled murrelets

Murrelets have been detected throughout most of the watershed. The primary requirement for murrelet nesting is the occurrence of suitable nest platforms. As such, they usually nest in older stands where trees support branches of at least 4 inches in diameter, but may also nest in mid-seral stands where deformities such as dwarf-mistletoe infestations create platforms. There are 16 occupied stands that have been identified within the watershed, distributed throughout most late-seral stands. Since complete surveys have not been conducted, all suitable habitat is expected to be occupied. All LSR areas within the watershed, as well as murrelet occupied sites within the CHSRA and CHEF, are within Critical Habitat Units designated by USFWS.

Other species

The Oregon silverspot butterfly (*Speyeria zerene hippolyta*) is known to exist in only six areas in the world (VanBuskirk 1995), one of which is in the vicinity of Cascade Head. Due to conversion of native meadows to pasture and other uses, as well as invasion of introduced non-native plant species (primarily grasses), the two native plant species (*Festuca rubra* and *Viola adunca* var.

adunca) that the Oregon silverspot requires have declined significantly in the Cascade Head grassland as well as throughout the range of the butterfly.

A peregrine falcon nest is known to occur within the watershed. Peregrines require cliffs for nesting that are within flying distance of food sources. They hunt for waterfowl and seabirds along the coast, in the Salmon River Estuary, and in the Neskowin Wetlands. Two bald eagle nests are on Cascade Head. Bald eagles require large trees with openings in the branches for nesting. The adults feed primarily on waterfowl and fish in the Salmon River, Salmon and Neskowin estuaries, Neskowin Golf Course, and along the coast.

Brown pelicans use the coastline and the Salmon River Estuary for feeding. Aleutian Canada geese may use the estuary or marsh areas on occasion but do not winter in the estuary. Potential habitat for snowy plover nesting used to occur along the beaches in the watershed, but there has been no documented use in recent history.

3.2.2.4 Other Species

Small herds of Roosevelt elk gather and forage in and around the Salmon River Estuary in winter. The herds travel between the estuary and Devil's Lake Golf Course, Cascade Head and Neskowin Creek (C. Bickford, USDA Forest Service, pers. comm.). Much of the elk use in the estuary is on private land. Elk were nearly eliminated from the area by the 1920s, but were reintroduced in nearby watersheds in 1950 and 1951. Herds were augmented several times during the 1970s and 1980s. Oregon Department of Fish and Wildlife (ODFW) recently opened two weeks of special elk hunts in the estuary to reduce the herd size. Foraging habitat for elk is currently declining in areas of estuarine restoration.

Fringed myotis (*Myotis thysanodes*) and Townsend's big-eared bat (*Coryorhinus townsendii*) have both been documented in the Cascade Head area. Both species use primarily caves, mines and buildings for day and night roosts (Christy and West 1993 and Nagorsen and Brigham 1993), although no caves or mines occur in the watershed; they may also roost under bridges. Both are Federal Species of Special Concern and *Coryorhinus* is listed as Sensitive on the Regional Forester's Sensitive Species List.

One marten sighting was reported in the southern portion of the watershed in 1983. Both fisher and marten are expected to have occurred throughout the Coast Range, but recent documented sightings are lacking. Both species are commonly associated with late-seral forests but also use other habitats. In other parts of the coast, marten occur in shore pine habitat.

White-footed vole (*Arborimus albipes*) is listed as a Region 6 Sensitive species and is expected to occur in the watershed although there are no documented sightings. They are primarily associated with red alder riparian habitats.

Red-legged frog (*Rana aurora*) is a Region 6 Sensitive species and is found throughout the Hebo Ranger District. They are primarily associated with riparian areas but also use habitats at considerable distances from streams.

Survey and Manage Species. The red tree vole (*Arborimus longicaudis*) is assumed to be present wherever adequate Douglas-fir forests occur, although surveys have not been conducted in the watershed. No listed amphibians are expected to occur since the watershed is outside the range of these species.

Invertebrate surveys have not been conducted in the watershed. During surveys that have been conducted on the Hebo Ranger District outside of the watershed the warty jumping slug, blue-gray tail-dropper and papilose tail-dropper were found. One of the listed snails was found north-west of the analysis area. Deciduous forests, especially big-leaf maple, down logs and leaf litter are important habitat components for most of the Survey and Manage invertebrate species, but they are found in a wide variety of habitats.

3.2.2.5 Plants

Sensitive plants and Survey and Manage species. Four sensitive plant species have been documented in the watershed. *Sidalcea hirtipes* (hairy-stemmed checker mallow) and *Silene douglasii* var. *oraria* (Cascade Head catchfly) are found in grassy areas and coastal bluffs. *Erythronium elegans* (elegant fawn-lily) occurs in high elevation meadows, bogs, rock cliffs and open forest. *Pohlia sphagnicola* (pohlia moss) is known from sphagnum hummocks. *Sidalcea* and *Erythronium* have both been found on federal lands within the watersheds.

Protocol surveys for Survey and Manage plant species have not been conducted. Some of the fungi, lichen and liverwort species have been found at Cascade Head and the Van Duzer State Wayside Corridor. Fungi species include *Bondarzewia mesenterica*, *Cantharellus formosa*, *Chamonixia caespitosa*, *Endogone oregonensis*, *Martellia maculata*, *Neolentinus kauffmanii*, *Tylopilus pseudoscaber,* and several species of *Phaeocollybia.* Lichens known in the watershed are *Lobaria pulmonaria*, *Nephroma laevigatum*, *Pseudocphellaria anomala*, *P. anthraspis*, *Sticta fuliginosa*, *S. limbata* and *Cetrelia cetrarioides*. Liverwort species found are *Antitrichia curtipendula* and *Diplophyllum albicans*.

Noxious and invasive plants. Numerous noxious and invasive plants exist in the watershed. Many of these plants displace native species or are poisonous to livestock. Control methods are used as federal, state, and county funds are available. Scot's broom (*Cytisus scoparius*) occurs throughout the watershed. On the south side of the Salmon River Estuary the Forest Service treats it by cutting. This occurs only on an occasional basis. Bull thistle (*Cirsium vulgare*) and Canada thistle (*C. arvense*) are most common east of Highway 101. In some areas, they are regularly mowed or cut with weedeaters (C. Bickford, U.S. Forest Service, pers. comm.), while other land-owners spray or do not treat at all (B. Miller, and C. Bickford, U.S. Forest Service, pers. comm.). Giant or Japanese knotweed (*Polygonum cuspidatum* or *P. sachalinense*) is also aggressive and difficult to control. There are at least two knotweed populations on the north side of the Salmon River and several along Slab Creek Road in the Neskowin watershed. Curly-leaf dock (*Rumex crispus*), teasel (*Dipsacus sylvestris*) and reed canarygrass (*Phalaris arundinacea*) are all mowed or cut. Invasive blackberry (*Rubus* sp.) species are prevalent throughout both watersheds. Tansy ragwort (*Senecio jacobaea*) is fairly well controlled by the use of Cinnabar moths and flea beetles.

Most noxious and invasive species pose little threat to areas with dense forest canopy because they do not tolerate shade. The threat exists in clearcut areas until the canopy closes, and along roads. Holly (*Ilex aquifolium*) and English ivy (*Hedera helix*), however, are shade tolerant and present potential threats to forested areas. Risk of introduction of these species could increase locally during silvicultural management activities (i.e., thinning).

3.2.3 **Hillslope Processes**

Natural and human disturbance processes affect hillslopes and their contribution of sediment and logs to streams and rivers in the study area. Landslides, especially, affect streams and fish habitat in the Coast Range because they introduce sediment in the form of gravel, sand, and silt which can alter spawning habitat. Large trees carried to and deposited in stream channels act as energy dissipaters, and create sediment storage sites and fish habitat in stream channels.

3.2.3.1 Process Types

Three major natural geologic processes affect the transport of sediment downslope toward stream channels. These include shallow-seated debris slides, deep-seated slumps and earth flows, and overland transport in disturbed areas. Each is briefly discussed in the following subsections. Factors affecting the susceptibility of slopes to failure include slope steepness, slope shape, bedrock competence, and hydrologic factors such as soil saturation and piping.

Areas prone to debris slides and earth flows are important to recognize for their management implications, primarily as they affect roads. Thirty-nine percent of the Neskowin watershed and 28 percent of the Salmon River watershed is identified by the Forest Service (USDA 1995a) as prone to slumping. Road maintenance efforts, and subsequently costs, are anticipated to be greater in these areas.

Debris Slides. Debris slides are caused when soils on steep slopes lose cohesion due to very high soil pore water pressure after periods of high intensity rains. Land types with a high frequency of debris slides are usually steep, highly dissected, even-faceted slopes with shallow to moderately deep soils overlying an impermeable substrate. Landtype Associations (LTAs) in the Coast Range with a high risk for debris slides are 2P, 2PSR1, 2PSR2, 3B, 3C, 3C1, 3E1, 3F, 3F1, 3M, 4F, and 4G (USDA 1995b). None of these LTAs occur in the analysis area, and only subsection 2 occurs on the Hebo Ranger District. Subsections 3 and 4 are found south of the Siletz River.

Deep-Seated Slumps and Earthflows. Deep-seated slumps and earthflows occur when deep, high cohesion soils and areas with high perennial groundwater on moderate to steep slopes fail and move as large blocks. Movement is often along a rotational slip plane. Slumps are typically hummocky, uneven, broken and deeply incised by stream channels, and the slopes are typically convex. Soils within slumps are usually very deep, and consist of shattered, weak, highly permeable bedrock. LTAs in the Coast Range most prone to slumping and earthflows include 2B, 2C, 2PSR3, 2T, 3Q, 3S, and 3T (USDA 1995b). Only LTA 2T is present in the study area. This area, which covers 19, 615 acres or 30 percent of the study area, roughly corresponds to the Yamhill and Nestucca Formations (Map 13), which are known for their lack of competence.

Watersheds with a high risk for slumping in the Neskowin Basin include Lewis Creek, Sloan Creek, and Upper Neskowin Creek. In the Salmon River Basin, Calkins Creek, Salmon Creek, Deer Creek, Treat River, Sulfur Creek, Prairie Creek, and the Upper Salmon River between Prairie Creek and Alderbrook are at high risk for slumping and earthflows.

Slumps, slides, and earthflows are not yet shown on published geologic maps of the study area as of this writing. Several slumps were evident in aerial photographs of the area, and are shown on the geology map (Map 13). These features should be field checked to verify the aerial photograph interpretation. The four failures noted are in the headwaters of the Deer Creek watershed, the Salmon Creek watershed, Tooze Creek watershed, and an unnamed creek southwest of Caulkins Creek. Other slides not apparent in aerial photographs have occurred. In the late 1900s, a road-related slide occurred across Highway 101 from Hawk Creek Hills Motel in the Neskowin watershed. Since then, several small slides have occurred at Hawk Creek Hills and Butte Creek Cliffs at the southern end of Neskowin where soils have become water-saturated. The southern portion of Cascade Head experienced a major debris flow in 1996 on the east side of Highway 101. Chronic sliding and/or debris flows occur at Whiskey Creek (a tributary of Neskowin Ck.) and from the west side of Highway 101 onto the road over Cascade Head, particularly on the north side (C. Bickford, U.S. Forest Service, pers. comm.).

Overland Transport. Overland transport is rare in the Coast Range. It occurs where soils are compacted, resulting in unimpeded flow of precipitation in sheets that gather momentum and sediment as they move down slope. While less catastrophic and less visible than debris slides, slumps, and earthflows, significant volumes of sediment may be transported to stream channels by this surface process. Overland transport is exacerbated by logging, road construction, and other processes that remove ground cover and compact soils. Such processes occur in the watershed, although overland transport has not been identified.

3.2.3.2 Impacts

Historically in the Coast Range, slope failures and increased sediment transport have been attributed to periodic large scale fires and wind storms which killed trees on critically unstable slopes (USDA 1995a). These failures introduced massive volumes of sediment and trees into stream systems altering their equilibrium and disrupting the life cycles of fish and other aquatic life forms. Such events punctuated otherwise stable periods of enhanced stream and fish habitat conditions (USDA 1995a).

Logging practices and road construction have compounded the effects of natural processes. Removal of vegetation and road building can increase landslides, channel erosion, soil compaction, and water temperature (USDA 1995a). One result of past clearcut logging through riparian areas is the lack of large trees available for introduction to stream systems. For several decades this, combined with increased input of sediment into stream channels, resulted in the alteration of stream channel shape and function. Instead of complex step/pool profiles with multiple side channels, many watercourses in heavily logged areas have become simple bedrock chutes with few pools or channels. New management guidelines, including decreased clearcutting and increased riparian buffers on streams, have been established in response to these impacts on federal lands.

3.2.3.3 Effects of the 1996 Flood

In February 1996, a series of intense surges of subtropical moisture struck western Oregon inundating the area with between 140 and 180 percent of normal precipitation for the first four months of the winter season (October-January). This influx of precipitation raised stream levels and saturated soils to the point where numerous landslides and debris flows occurred throughout the coast range.

The "Assessment of the Effects of the 1996 Flood on the Siuslaw National Forest" (USDA 1997) provides a detailed accounting and assessment of the locations, causes, and effects of slides caused by the 1996 Flood. Data for Neskowin Creek was not compiled separately in the study as was data for the Salmon River Basin. Salmon River slide data probably closely reflects the effects of the flood in the Neskowin Creek watershed, however.

In the Salmon River Basin, a total of 57 slides were noted. Of these 57 slides, nine were natural, 16 were timber harvest-related, and 32 were road-related. The effects of the 1996 flood may be put into perspective by comparing the number of slides visible in aerial photographs taken in 1972 and 1993 with the number resulting from the flood. A total of 17 slides were visible in photographs prior to 1996, compared to the 57 detected by photographic analysis after the flood. While an increase in slides due to land management practices is implied, only three of the identified slides were on National Forest land. The report concluded that management practices on National Forest lands have served to reduce the potential for management-related slides.

3.3 AQUATIC ECOSYSTEM

3.3.1 Instream Habitat

Instream habitat was more complex prior to impacts from development, agriculture, logging, road building and other land management activities, which have reduced the quality and quantity of pools, large woody debris (LWD), wetlands, and off-channel habitat including side channels, backwater areas and beaver ponds. The simplification of habitat has resulted from the removal of LWD from channels, loss of riparian vegetation, diking and draining wetlands, increased sediment input, bank armoring and channel straightening. Pre-settlement habitat included more and deeper pools, which provide cover and refuge from high water temperatures. Complex pools, with associated LWD, provide cover and reduce competition for territory. Off-channel habitat provides important over-winter nursery areas for salmonids and refuge from high-water currents.

Water quality prior to human disturbance likely included fewer bacteria and chemical pesticides, lower turbidity during storm events, and lower summer water temperatures. Natural disturbance by fire may have caused temporary increases in turbidity and possibly stream temperature. The fact that riparian vegetation is less susceptible to fire may have lessened this impact. Water quantity would have been greater during low flows before there were water withdrawals for agriculture and human use. Peak flows were likely lower prior to widespread land clearing activities, which allowed more rapid run-off, and loss of wetlands, which act as buffers by releasing stormwater more slowly.

Spawning gravels are expected to have included less fine sediment prior to logging, which contributes fines from surface runoff from roads, and landslides triggered by roads and other logging practices. Fine sediment fills the interstices between gravel particles, reducing the oxygen flow to developing eggs and alevins and even causing entombment.

The Oregon Coastal Salmon Restoration Initiative lists Core Areas containing key habitat for both the Salmon River and Neskowin Creek. Core Areas are defined as reaches or watersheds within coastal basins that are judged to be of critical importance to the persistence of salmon populations that inhabit those basins. The Salmon River has Core Areas listed for chum, fall Chinook and steelhead, while Neskowin Creek has a Core Area listed for chum. Mapped locations of these areas were not available for this analysis.

Key habitat for this analysis was approximated using gradient and channel confinement. Habitat with a gradient less than four percent and unconfined or moderately confined channels are shown in Map 10. These areas are most likely to contain the highest quality habitat.

Assemblages of aquatic insect populations are an indication of relative health of a stream. Analysis of aquatic insect samples taken by Oregon Department of Environmental Quality (ODEQ) rated both the Salmon River and Neskowin Creek high and both streams were considered unimpaired (Rick Hafele, ODEQ, pers. comm.).

Although good habitat still exists in the Salmon River and Neskowin Creek, habitat deficiencies have been noted in watershed plans for both basins. The following goals for habitat conditions in the Salmon River were identified by Oregon Department of Fish and Wildlife (ODFW) in the Fish Management Plan for the Salmon River Basin (ODFW 1997):

1. Maintain or increase instream flows during summer low flow periods in the Salmon River Basin.

2. Reduce summer water temperatures where artificial warming occurs that is detrimental to fish.

3. Increase instream channel complexity in the Salmon River Basin.

4. Reduce artificially accelerated erosion rates and inputs of sediments into waterways in the Salmon River Basin.

5. Prevent man-made contaminants from degrading water quality in the Salmon River Basin.

6. Restore natural fish passage conditions in the Salmon River Basin.

7. Increase habitat area available to fish in the Salmon River Basin.

The Nestucca/Neskowin Watershed Council notes concerns for Neskowin Creek in their Watershed Assessment; these include the lack of LWD, pools, and off-channel habitat, along with increased pesticides and sediment (Barczak 1998).

3.3.1.1 Channel Complexity

Current habitat conditions are clearly not as complex as pristine conditions. Log removal from streams during the 1970s greatly reduced the amount and size of LWD. The limited data available indicates that LWD is lacking in most of the reaches surveyed (Tables 3-8a and 3-8b). Five of the 21 stream reaches surveyed on National Forest land by the Hebo Ranger District (Table 3-8) had no LWD larger than 24 inches in diameter and 50 feet long. Similarly, four of the twenty reaches surveyed on private lands by ODFW had no LWD larger than 0.6 meters in diameter and 10 meters long. Sixteen of the 21 reaches surveyed by the Forest Service (76 percent) were classified as not properly functioning (30 pieces or less per mile of LWD greater than 24 inches in diameter and 50 feet long) using criteria established by the National Marine Fisheries Service (NMFS). Only 2 of the same 21 reaches surveyed (10 percent) met the NMFS criteria for properly functioning habitat (80 pieces or more per mile of LWD greater than 24 inches in diameter and 50 feet long) (Smith 1995). At least nineteen of 20 reaches surveyed by ODFW are classified as not properly functioning using NMFS criteria, and none of the reaches meet criteria for properly functioning habitat. Potential for future LWD recruitment appears to be poor due to lack of mature conifers in riparian zones. (See Section 3.3.2 Riparian Habitat).

Instream LWD is important for formation of pools, log jams, and sand bars, which store sediment. It provides cover, habitat complexity and reduces competition for territory among fish. Log jams trap spawning gravels and create off-channel habitat which is important for juvenile salmonids. Systems that are lacking in LWD have reduced habitat complexity and pool habitat with a corresponding lower number, average size, and biomass of coldwater fish species (Dolloff 1994).

Pools are lacking in depth and quantity. Only one of the 21 reaches (5 percent) surveyed by the Forest Service satisfied NMFS criteria for properly functioning habitat (50 percent or more of habitat area in pools). None of the reaches surveyed by ODFW met this criteria. Fourteen of the 21 reaches (67 percent) surveyed by the Forest Service and 16 of the 20 reaches (75 percent) surveyed by ODFW were classified as not properly functioning (30 percent or less of habitat area in pools). Thirteen of the 21 reaches surveyed by the Forest Service (62 percent) had no pools with depths greater than three feet. Half of the ODFW-surveyed reaches had no pools greater than one meter (3.3 feet). Only two Forest Service reaches (10 percent) and two ODFW reaches (10 per-cent) qualified as properly functioning with 20 percent or more of the habitat units with depths greater than three feet (Tables 3-8a and 3-8b).

Side channel habitat was lacking as well. Only three of the 21 USFS reaches (14 percent) qualified as properly functioning with 10 percent or more of the habitat in off-channel areas, while 16 of the same reaches (76 percent) fell into the not properly functioning category of five percent or less in off-channel areas (Table 3-8a).

TABLE 3-8A. SUMMARY OF USFS HABITAT SURVEY DATA

			Percent Area					LWD/Mile				Pools/ Mile
NAME	Reach	Mi.	P	R	G	S	P>3'	12"x25'	24"x50'	36"x50'	>24"x50'	
Crowley	1	1.2	20	77		3	2	2	0	0	0	34
Crowley	2	0.6	7	93				0	0	0	0	40
Crowley T1	1	0.3	14	86				15	0	0	0	67
Deer	1	0.7	75	25			47	19	1	0	1	60
Deer	2	1.3	37	63		1	13	16	8	2	9	38
Deer	3	0.2	9	91				17	13	4	17	25
Toketa	1	0.3	12	87		1		73	27	3	30	36
Fall	1	0.2	49	51			34	45	0	0	0	38
Fall	2	0.6	10	87	2	2		23	0	0	0	38
Fall	3	0.6	6	82		12		21	9	0	9	30
Fall T4	1	0.1	15	85				246	51	10	62	92
Jim	1	0.7	26	65		9	1	15	10	3	13	69
Jim	2	0.1	52	48				47	82	70	152	128
Jim T1	1	0.1	36	64			5	32	64	112	176	128
Lewis	1	1.3	31	61		8	1	21	4	2	5	96
Lewis	2	0.6	33	57		10	1	5	5	4	9	72
Prospect	1	0.9	18	80		3		24	11	4	15	102
Prospect T1	1	0.2	17	81		2		43	10	5	14	124
Sloan	1	0.7	17	81		1		11	4	10	14	72
Sloan	2	0.5	8	81		11		42	29	23	52	67
Sloan	3	0.3	4	91		5		38	19	4	23	34

P=Pool; R=Riffle; G=Glide; S=Side Channel; P>3'=Pools with max. depth greater than three feet.

TABLE 3.8B. SUMMARY OF ODFW HABITAT SURVEY DATA

NAME	REACH	KM	% IN POOLS	% IN POOLS > 1 M DEPTH	LWD > .15m x 3m per 100m	LWD > .6m x 10m per 100m	POOLS/KM
Bear Creek	1	4.1	31.5	6.5	10.1	0.1	25.4

Bear Creek	2	0.8	44.0	14.2	10.8	0.0	36.5
Bear Creek	3	1.6	32.0	0.0	6.5	0.2	25.4
Bear Creek	4	2.5	2.3	5.8	18.0	0.8	12.8
Salmon River	1	5.7	21.0	17.5	8.8	0.3	17.8
Salmon River	2	3.3	11.6	39.3	11.8	0.6	13.8
Salmon R. Trib A	1	0.5	47.3	12.8	7.8	0.6	15.6
Salmon R. Trib A	2	0.3	0.0	0.0	18.9	1.2	0.0
Salmon R. Trib A	3	0.1	0.0	0.0	136.4	0.0	0.0
Salmon R. Trib B	1	2	2.8	0.0	11.9	1.8	0.5
Salmon R. Trib C	1	0.6	0.0	0.0	78.1	4.5	0.0
Trout Creek	1	0.8	9.2	87.9	3.7	0.0	10.3
Trout Creek	2	1.9	25.7	15.4	5.1	0.1	28.4
Trout Creek Trib 1	1	0.4	10.3	16.5	15.9	0.8	16.2
Trout Creek Trib 1	2	1	6.1	0.0	24.7	1.4	5.9
Widow Creek	1	3.4	19.3	5.6	6.6	0.1	21.4
Widow Creek	2	1.5	3.0	0.0	47.8	1.1	5.3
Hawk Creek	1	1.2	17.1	0.0	1.0	0.0	15.0
Hawk Creek	2	2.4	8.9	0.0	11.0	0.3	12.6
Hawk Creek	3	1.6	3.8	0.0	26.0	1.3	4.3

3.3.1.2 Water Quality

The Salmon River from mouth to headwaters is listed on the Environmental Protection Agency's (EPA) 303(d) List of Water Quality Impaired Stream Segments for high water temperature based on data collected at the Salmon River Fish Hatchery. Water temperatures up to 70 °F have been recorded there. Growth of juvenile coho ceases at this temperature due to increased metabolic rate (Bell 1986). Increased metabolism in non-feeding adult fish holding in fresh water causes more rapid utilization of energy stores, which can result in reduced fecundity and pre-spawning mortality (Bell 1986). Temperatures of 75 °F been shown to be lethal to juvenile coho (Thomas et al. 1986).

There are no other 303(d) listings for the Salmon River or Neskowin Creek. Monitoring appears to be lacking for all other water quality parameters (fecal coliform, turbidity, dissolved oxygen, pH) on the Salmon River. There are no water quality monitoring stations listed in the EPA 305(b) report for either the Salmon River or Neskowin Creek. Although it is suspected that spot checks are conducted by ODEQ, no data were made available for this analysis.

Dairy cattle and failing septic systems are sources of fecal coliform organisms. The water supply for the community of Neskowin, which is taken from Hawk Creek, was declared a health hazard in 1979 due to high fecal coliform counts. A wastewater treatment plant, which discharges up to 250 thousand gallons per day (winter maximum) into Hawk Creek, was built in 1995 for the community of Neskowin to mitigate failing septic systems. Water samples taken from several sites in 1985 indicated high levels of bacteria were coming from non-human sources as well (USEPA 1991). Although human sources were reduced by the treatment plant, there are no data indicating that non-human sources have been reduced significantly.

Pesticide use is common in Tillamook County (Neskowin Watershed), and it is a concern that "pesticide residues could be widespread throughout the watershed" (Barczak 1998). No data were available for Lincoln County (Salmon River Watershed).

Although there were no data available on suspended sediments, turbidity is also thought to be a problem. Turbidity, which is an indicator of suspended sediments, measures the amount of light that penetrates water. Moderate levels of suspended sediment can cause reduced feeding and growth as well as increased avoidance behavior in newly emergent salmonid fry. Higher levels can cause emigration in older juveniles and even stop adult migrations. Deposition of suspended sediments can reduce egg and alevin survival and deplete habitat for aquatic insects causing a reduction in food supplies for fish (Hicks et al. 1991). The Salmon River Hatchery reports that juveniles at the hatchery stop feeding for several days after storm events and landslides because of turbid water (Charley Stanley, Salmon River Hatchery Manager, pers. comm.). Anecdotal reports indicate that salmon populations in Neskowin Creek declined during a period of turbidity result-ing from the construction of Highway 101 around Cascade Head (Russell Lindbloom, local fisherman, pers. comm.).

3.3.1.3 Water Quantity

Low summer flows can cause fish stranding by de-watering, increased predation and susceptibility to high water temperatures. Concern over the number of applications for water withdrawals caused ODFW to file for instream water rights beginning in 1987. Although these instream rights would have priority over applications filed later, they are still junior to previously granted water rights (Greg Beamer, ODWR, pers. comm.). As development increases in the area, the pressure for more water withdrawals will also increase. The stream gage at Otis has recorded flows on the Salmon River as low as 22 cubic feet per second on several occasions. Flows as low as 2 cubic feet per second (USEPA 1991) and de-watering have been reported on Neskowin Creek (Melissa Madenski, local resident, pers. comm.).

Peak flows may also affect habitat quality by impacting eggs developing in the gravels with scour and fill of channel substrate. Developing eggs are extremely fragile during the early stages of development and any shock can cause mortality. Peak flows along with lack of side channel habitat would make juveniles vulnerable to strong currents with a potential to wash them out of the system. Oregon coastal streams are known to be "flashy." Flow records from 1972 to 1995 for the Salmon River from the stream gage at Otis document flows increasing four-fold within a 24-hour period. Clearcutting and roads have been shown to increase peak flows for a basin (Jones and Grant 1993a, 1993b).

3.3.2 Riparian Habitat

Although there are no detailed data available for historic composition of riparian vegetation, it is possible to make some general assumptions concerning historic riparian vegetation patterns. Vegetative composition in the estuaries and marshes has changed from historic conditions and the extent of estuaries has diminished due to diking and draining for farmland and other land uses (see Estuary, section 3.3.4). Further upstream above the estuarine zone, riparian composition likely existed as deciduous or mixed deciduous/coniferous forest with dominant species including red alder, big leaf maple and Sitka spruce. Coniferous species probably became more dominant in the mid-to-upper stream reaches with Douglas-fir, hemlock and cedar becoming more frequent. Since effects of fire are greatly reduced in riparian areas, much of this vegetation likely existed in mature seral stages. Natural disturbances such as fire, windthrow, landslides and floods provided patches of deciduous trees among conifer-dominated stands.

Anthropogenic effects caused by land-use activities such as timber harvest, agriculture, and development have greatly altered the species age and composition of riparian zones. Old-growth conifer stands have been replaced by deciduous stands, young to mid-seral stage conifer plantations, or meadows/fields. Analysis of Geographic Information System (GIS) data shows that mature and late-seral stage riparian vegetation is lacking for both Salmon River and Neskowin Creek (Table 3-9). Mature conifer and late-seral stages were only found on 8.3 percent of the river miles for the Salmon River and 21.4 percent of the river miles for Neskowin Creek. By adding the ma-ture mix and late mix seral stages the totals come to only 14.9 percent for the Salmon River and 24.6 percent for Neskowin Creek. Analysis for federal lands only shows a total of 34.0 percent of the stream miles on federal lands for the Salmon River and 47.8 percent for Neskowin Creek have riparian vegetation classified in the four seral stages mentioned above (Table 3-10). Examination of aerial photos indicate that these figures are probably high as stands classified as mature conifer or late-seral often had hardwood vegetation in the riparian zone. This indicates a low potential for LWD recruitment in the near future to streams that are currently lacking in LWD and complexity.

TABLE 3-9. MILES OF STREAM ON FEDERAL AND NON-FEDERAL LANDS WITH POTENTIAL FOR LWD RECRUITMENT GREATER THAN 18 INCHES BASED ON SERAL STAGE OF RIPARIAN VEGETATION

	Salmon River		Neskowin Creek		Both Basins	
Seral Stage	**Miles**	**Percent***	**Miles**	**Percent***	**Miles**	**Percent****
Late	10.5	2.2	4.3	3.6	14.8	2.6
Late Mix	16.8	3.5	0	0	16.8	2.9
Mature Conifer	29.1	6.1	21.1	17.8	50.2	8.7
Mature Mix	14.9	3.1	3.7	3.7	18.6	3.2
Total	**71.3**	**14.9**	**29.1**	**29.1**	**100.4**	**17.3**

* Percent of total stream miles for basin
** Percent of total stream miles for both basins

TABLE 3-10. MILES OF STREAM ON FEDERAL LANDS ONLY WITH POTENTIAL FOR LWD RECRUITMENT GREATER THAN 18 INCHES BASED ON SERAL STAGE OF RIPARIAN VEGETATION

	Salmon River		Neskowin Creek		Both Basins	
Seral Stage	**Miles**	**Percent***	**Miles**	**Percent***	**Miles**	**Percent****
Late	5.4	3.7	4.3	7.4	9.7	4.8
Late Mix	0	0	0	0	0	0
Mature Conifer	31.4	21.6	20.4	35.2	51.8	25.5
Mature Mix	12.6	8.7	3.0	5.2	15.6	7.7
Total	**49.4**	**34.0**	**27.7**	**47.8**	**77.1**	**37.9**

* Percent of total stream miles on federal lands only for basin
** Percent of total stream miles on federal lands only for both basins

The structural change and fragmentation of riparian zones has reduced their ability to provide microclimate and other habitat conditions necessary for riparian-dependent species. The high water temperatures for the Salmon River discussed above are an indication of the lack of riparian function for that basin. Further fragmentation of riparian vegetation and encroachment on the stream channel has resulted from road building in the flood plain and valley floor. This not only results in the permanent loss of riparian vegetation in the road corridor, but also may contribute to additional blowdown of surrounding riparian vegetation.

3.3.3 Fish Populations

Historically fish were abundant in both the Salmon River and Neskowin Creek watersheds. "Ne-chesne," the name given by local tribes to Neskowin Creek, means "many fish." Chum, fall Chinook, coho, winter steelhead and cutthroat trout (anadromous, potadromous, and adfluvial) are all native to the Salmon River and Neskowin Creek. Other species found in the watersheds include brook lamprey, river lamprey, Pacific lamprey, dace and sculpins (ODFW 1997). At one time a run of smelt occurred in Neskowin Creek (C. Bickford, U.S. Forest Service, pers. comm.).

In 1887 a cannery was constructed on the east side of Nestucca Bay to harvest the abundant crop of fish in nearby streams. It became a busy industrial center and employed many of the local residents. After a few good years salmon became scarce and the cannery closed down (Rock 1949). Anecdotal accounts claim fish were so abundant they were harvested with pitchforks (Gordon Whitehead, Neskowin Valley School, pers. comm.). Local sports fisherman estimate that current populations in Neskowin Creek are only five to ten percent of what they were in the 1940s when "there were fish everywhere" (Russell Lindbloom, local recreationist, pers. comm.). Although there are no data to support those claims, ODFW concurs that coho populations are estimated to be only 10 percent of historic levels (Steve Jacobs, ODFW, pers. comm.). Records of commercial net fisheries in the Salmon River from 1923 to 1940 report an average catch of about 184 chum per year (ODFW 1997). The estimated return of wild Chinook to the Salmon River in 1976, prior to hatchery releases, was about 1,100 and wild coho were estimated at 1,500 returning adults (Mullen 1979).

Most salmonid species have been in decline in the Pacific Northwest for decades. Oregon coast coho are currently listed as threatened and Oregon coast steelhead is a candidate for listing as threatened under the Endangered Species Act (ESA). Both ODFW and the USFS list chum salmon as a sensitive species. Anadromous cutthroat are also listed as sensitive by the USFS (Bob Miller, USFS, pers. comm.). In addition to the salmonid listings, Pacific lamprey has been listed as a sensitive species by ODFW (1997) and as a species of concern by U.S. Fish and Wildlife Service.

The Salmon River is currently managed for wild stocks of chum salmon, and steelhead and cutthroat trout. Fall Chinook and coho are managed for wild and hatchery stocks, which are released from the Salmon River Hatchery. There was also a hatchery release of cutthroat until 1996 and a hatchery release of winter steelhead, which was discontinued in 1994.

Salmon River fall Chinook is considered to be a healthy stock and is used as an indicator group to represent all north-migrating Oregon coastal fall Chinook in ocean harvest management under the U.S.-Canada Treaty. Total runs of hatchery and wild Chinook have ranged from 2,700 to 7,800 adults during 1986-95. An estimated 40 percent of these are natural spawners and 60 percent hatchery fish. An estimated 60 percent of the natural spawners are hatchery strays (ODFW 1997). This leaves only 16 percent of the run from wild stocks with a range of 432 to 1,248 from 1986 to 1995 compared to a pre-hatchery wild run of 1,100 in 1976 (Mullen 1979).

Salmon River coho are almost entirely from hatchery stock origin, and it is doubtful that a self-sustaining wild stock still exists. The target for hatchery coho releases is 300,000 smolts. Surplus adults returning to the hatchery are released to spawn naturally upstream. An estimated 91 percent of naturally spawning coho in the Salmon River basin are from hatchery origin. Although the in-river catch of coho has doubled to about 280 fish per year since the hatchery program began in the late 1970s, the fishing pressure has increased almost ten-fold during that time (ODFW 1997). This, along with the competition from hatchery releases, has contributed to the decimation of the wild coho and undoubtedly impacted other wild stocks in the basin as well.

Chum salmon are native to the Salmon River Basin. Small numbers of chum occur in the mainstem and a few tributaries in the lower basin. Spawner counts for chum are sporadic, but 1986 was the high year on record with 106 fish recorded for the basin. A total of two fish were recorded in 1996 for the basin (ODFW 1997).

Wild winter steelhead in the Salmon River Basin are depressed and currently under review for listing under the ESA along with other coastal steelhead. The basin was stocked with Alsea Hatchery Stock from 1964 to 1994, which has compromised the genetic integrity of the wild stock. Initially the sport catch of steelhead increased with the release of hatchery fish, but has declined until it is lower than pre-hatchery levels. From 1982 to 1992 only 16 percent of steelhead caught were wild while 84 percent were hatchery fish. Although hatchery releases were discontinued in 1994, the management plan may include hatchery supplementation in the future.

Cutthroat trout are native to the Salmon River basin, and as in the Alsea basin, are thought to be in decline. An average of 4,100 Alsea hatchery fish were stocked in the Salmon River Basin from 1962 to 1996, with a range from 1,200 to 9,000 (ODFW 1997). The hatchery program for cutthroat was discontinued in 1996. The current management plan is for wild stocks only and maintains a catch-and-release fishery for cutthroat.

Information on fish populations in Neskowin Creek is limited, but populations are considered to be similar to those on the Salmon River with fall Chinook healthy and other stocks depressed. Fall Chinook are known to have spawned in Meadow Creek historically, and were reported spawning on the Neskowin Golf Course in the 1950s (Bill Murdock, pers. comm.). Snorkel surveys in Sloan Creek, a tributary to Neskowin Creek, found low numbers of coho juveniles and fair to low numbers of cutthroat trout (Tim Dalton, ODFW, pers. comm.). Spawner counts on Neskowin Creek are typically single digit numbers. ODFW estimates the population of coho in Neskowin Creek to have averaged 118 adults from 1990 to 1997 (ODFW, unpublished data, 1998). In 1999 coho smolt were found in Neskowin Marsh. Coho, sea run cutthroat, and steelhead are found in Hawk and Butte Creeks (C. Bickford, U.S. Forest Service, pers. comm.). Steelhead redds were found in the Hawk Creek wetland in 1998 (S. Hinton, Oregon Trout, pers. comm.). In 1991, ODFW estimated approximately 50 fish of each species returned annually to spawn in the Neskowin Creek watershed (USEPA 1991). The watershed is currently managed for wild fish with no sport fishing for salmon allowed. There is a catch and release fishery for steelhead and cutthroat trout.

3.3.4 Estuary

Estuaries are among the most productive natural systems. They provide key habitat for a multitude of wildlife vertebrate and invertebrate species. For fish they are important nursery areas that provide food, refuge from predation, and valuable habitat for many species. The Salmon River estuary is the preferred habitat of 112 vertebrate wildlife species, is used by 69 others, and is used by 51 fish species (USDA 1977).

Among fish species, estuarine habitat is particularly important to salmonids. It allows juvenile salmonids to acclimate to salt water gradually and provides food and cover during this critical period. Chum juveniles rear for up to several months in the estuary (Healy 1982). This appears to be a critical period in the life cycle and can affect the number of returning adults (Bakkala 1970; Bax 1983). Estuaries are also vital for Chinook juveniles and have been documented for rearing up to 189 days in estuarine habitat (Simenstad et al. 1982). Coho may use estuaries for several months (Emmet et al. 1991).

ODFW studies have found coho and Chinook juveniles using the Salmon River Estuary from February through July. Spring freshets reduce the salinity in the estuary during these months allowing the juveniles to acclimate to salt water (Dan Bottom, ODFW, pers. comm.).

Salt marshes in the Salmon River Estuary were diked in the 1950s for agriculture and again in the 1960s for the construction of Highway 101 across the estuary. Before diking most of the tidal marshlands were high marshes of tall rushes and grasses including *Juncus balticus* and *Festuca rubra* (Mitchell 1978). Diking converted these areas to upland plant species and pasture grasses such as *Agrostis alba, Potentilla pacifica, Holcus lanatus, Trifolium repens* and *Poa trivialis* (Frenkel and Morlan 1990). Only 27.5% of the original high salt marsh remained undiked by 1978 (Frenkel and Morlan 1990).

During construction of Highway 101, the headwaters of Salmon Creek were cut off from the portion downstream of the highway. The upper portion of Salmon Creek was rerouted into a ditch that empties into the Salmon River. A recently completed study examined the feasibility of reconnecting Salmon Creek by placing a bridge or culvert at the crossing under Highway 101 and reconnecting Frazier Creek by placing a box culvert under Highway 101 (B. Ellis-Sugai and C. Bickford, U.S. Forest Service, pers. comm.).

Upland areas around the periphery of the estuary have also undergone changes with European settlement. These areas are thought to have consisted of a much larger component of spruce/alder forest than what currently exists. Much of this habitat has been converted to pastures and other human uses.

The management plan for the CHSRA (USDA 1977) established "a long term goal of restoring the Salmon River Estuary and its associated wetlands to a natural estuarine system free from man's developments." The USFS has acquired approximately 450 acres of the estuary since the CHSRA was designated (C. Bickford, USFS, pers. comm.). In 1978 a dike protecting a 21 hec-tare (54 acre) pasture was breached on the north shore. In 1987 a dike protecting a 63 hectare (156 acre) pasture was removed from the south shore by the Forest Service (ODFW 1997). Addi-tional dike and tide gate removals occurred in 1996, also by the Forest Service, that returned another 57 acres to tidal influence. Estimates of the total amount of estuary vary widely (204 acres [USDA 1975]; 1260 acres [USDA 1977]; 1980 acres [Frenkel and Morlan 1990]), making proportional assessments of habitat conditions for the estuary as a whole quite difficult. However, using an estimate of original salt marsh of 746 acres (calculated from Frenkel and Morlan 1990), approximately 36% of the original marsh is still in a diked condition, mostly to the east and southeast of Highway 101.

Although the recent dike removals have attempted to restore lost habitat, some of the structure and function has been lost from the previously diked areas. Small feeder streams to salt marshes that provide important habitat for juvenile salmonids have been lost to ditching. Some of the salt marsh areas that were diked have sunk 40 centimeters due to oxidation and settling of soils. Even though dikes were removed to allow inundation again, the habitat has changed and may take years to recover to its original condition (Dan Bottom, ODFW, pers. comm.). Vegetation in these areas has also not returned fully to pre-dike conditions. Areas where dikes have been removed that were formerly high marsh have come back as low marsh with sedges, succulent plants and salt grass (Frenkel and Morlan 1990). It seems likely this is related to the soil conditions, and it is not known when or if the original high marsh conditions will return.

Although the Neskowin Creek Estuary is not as large as the one on the Salmon River, there are also extensive wetlands in the lower watershed. The saltwater wedge appears to influence vegetation for several hundred meters upstream from the confluence with Hawk Creek (USEPA 1991). Tidal influence also extends up Butte Creek to the tide gates at the Neskowin Golf Course. Neskowin Wetland at the head of Meadow Creek is the largest unprotected palustrine (freshwater) wetland on the Oregon coast (Roy Lowe, U.S. Fish and Wildlife Service, pers. comm.). It is currently proposed for addition to the Nestucca Bay National Wildlife Refuge. Some of the wetland habitat on Neskowin Creek has been lost to development. Two golf courses and the new wastewater treatment plant were constructed on wetland areas. The wastewater treatment plant was constructed on Hawk Creek in 1995 and discharges up to 250,000 gallons per day during high flows in winter. Meadow Creek, a lowland tributary to Neskowin Creek has been almost completely channelized by agriculture and the golf course along its banks. The golf course is the site of a major waterfowl concentration in winter. Use of herbicides and fertilizers on the golf course is limited, but does exist. The golf course is flooded for a major part of the winter, allowing residues to be washed into the stream.

3.4 ROADS

3.4.1 Access Requirements and Considerations

Many of the roads in the Salmon River watershed were built to provide public access to towns, homes, and recreational destinations. A significant portion of roads in the watershed were also built to facilitate the management of both public and private forest lands, timber harvesting playing a large role. The major portion of the roads in the Neskowin Creek watershed were built for forest management purposes, some of which are now being improved to facilitate residential development. With changing federal land management direction, the need for some of these roads has changed.

3.4.1.1 Highways and Main Access Routes

Between 6,900 and 7,500 vehicles use State Highway 18 every day between the west end of the Van Duzer Corridor and Highway 101. Traffic is projected to increase to 11,000 to 12,400 vehicles per day by 2010. On the east end of the Highway 18 corridor, from the junction of Highway 22 to the west end of the Van Duzer Corridor, traffic volumes range from 7,900 to 10,500 vehicles per day. By 2010, traffic volumes may increase to 12,000 to 16,000 vehicles per day (Wong 1997). State Highway 18 is a also designated bike route on the Oregon Bicycle Route System, and is also part of the Oregon Trans-American Trail.

Average daily traffic volumes on Hwy 101 range from 4,700 to 10,770 in the peak tourist season. The highway is expected to experience an increased traffic demand in the range of 130 – 225 percent by 2015. Highway 101 is one of the best known and most traveled bicycled corridors in Oregon. It is part of the Oregon Coast Bicycle Route, and ODOT classifies Highway 101 as “most suitable” for bicycle travel.

As Highway 101 and Highway 18 both accommodate substantial bicycle traffic, especially during the summer months, bicycle traffic must be seriously considered in addition to vehicular traffic in this corridor. Lack of shoulder for riding and lack of designated campgrounds have been identified as problems for cyclists.

The Slickrock Creek Road (1802) and Bear Creek Road both provide access to permanent and seasonal residents of the many cabins and small homes built along the lower reaches of Slickrock Creek and Bear Creek. Both are county roads and will undoubtedly require maintenance in the future.

3.4.1.2 Roads on Federal Lands

The management plan for Forest Service roads is outlined in the Siuslaw National Forest Access and Travel Management (ATM) Guide (USDA 1994). The Guide emphasizes the recent decline in the Forest's timber program and associated road maintenance funding. As a result, the ATM vision includes a "less extensive road system and an expanded trails network" (USDA 1994). Management of BLM roads in western Oregon are guided by the Western Oregon Transportation Management Plan (TMP) (USDI 1996). The plan identifies resource-based goals and objectives to use in determining the need and maintenance level of roads. A less extensive road network is also envisioned by this plan.

The Forest Service, through a process that included public involvement, has identified primary and secondary roads on federal lands that will remain open for public access and administrative use. Roads other than primary and secondary will be treated according to resource protection concerns and access needs. Specifically "road maintenance (or) obliteration plans will be based on resource needs identified in watershed analysis and the Forest Plan" (USDA 1994).

The BLM is undergoing a similar process to finalize their road network based on resource and private access needs. Each primary, secondary, and local BLM controlled road segment will have an associated transportation management objective (TMO) showing the expected open or closed condition for that segment.

Many of these roads will be maintained to provide access for silvicultural treatments, fire suppression, private access, and research (such as in the Cascade Head Experimental Forest). Other roads may be stabilized or obliterated. The following analysis of roads and culverts at risk of failure will help prioritize roads for treatment on both National Forest and BLM lands. Information provided in the wildlife section of this document may also contribute to road management decisions.

3.4.2 Location of Roads With Highest Probability of Failure

A risk analysis was conducted to identify roads with high risk of failure on federal lands (Appendix B). The roads with the highest probability of failure are located in the Bear2, Deer, Lower Neskowin, Lower Salmon, Salmon Creek, Slickrock2, Trout, and Widow subwatersheds (Table 3-11, and Map 12). These roads scored 3.5 or higher in the slide risk analysis, tabulated in Appendix B. Prevalent conditions and/or characteristics placing the roads in these watersheds at risk include road construction methods, slope morphology, slope steepness, and geologic substrate.

TABLE 3-11. HIGH RISK ROADS ON FEDERAL LANDS LISTED BY SUBWATERSHED

Subwatershed	Total High Risk Miles*	Total Federal Road Miles	% High Risk Miles	Ownership
Bear2	4.04	15.9	25.4	USFS

Deer	0.78	6.79	11.4	USFS
Lower Neskowin	2.51	8.61	29.1	USFS
Lower Salmon	0.65	10.33	6.2	USFS
Salmon Creek	2.39	8.85	27.0	USFS
Slickrock2	0.48	5.19	9.3	BLM
Treat/Alder Brook	0.43	2.02	21.3	BLM
Trout	2.07	6.67	31.0	BLM
Widow	0.62	2.58	24.0	USFS

Note: *High risk roads defined as roads with risk score of 3.5 or greater in Roads Database (Appendix B).

3.4.3 Roads With Undersized Culverts

Culverts on National Forest (and BLM land) were evaluated to ascertain whether they are large enough to handle a 100-year storm event. The methodology of the analysis is outlined in "Forest Road Obliteration and Upgrade Guide" (USDA 1995b). Numerical processing was accomplished using a spreadsheet provided by Courtney Cloyd of the Siuslaw National Forest. Road data and risk factors are tabulated in Appendix B. Roads with undersized culverts, and which therefore pose a risk of creating debris torrents due to failure, are listed in Table 3-12, below.

TABLE 3-12. ROADS WITH UNDERSIZED CULVERTS

Ownership	Road Number	# of Undersized Culverts (GIS culvert #'s)	Stream at Risk	Subwatershed
USFS	1200-132	1 (170)	Upper Neskowin	Upper Neskowin
USFS	1200	5 (92, 95, 138, 109, 141)	Upper Neskowin	Upper Neskowin
USFS	1200-132	2 (170, 176)	Upper Neskowin	Kingston
USFS	Unnamed	5 (163, 164, 166, 167, 168)	Upper Neskowin	Kingston
USFS	1861-117	1 (128)	Upper Neskowin	Upper Neskowin
USFS	1200	5 (151, 153, 154, 156, 157)	Panther 1	North Panther
USFS	Unnamed	1 (5)	Bear2	Morton
USFS	1782-111	5, 62, 63, 64, 67, 69	Bear2	McMullen

CHAPTER 4

RECOMMENDATIONS

The following recommendations apply to National Forest and BLM lands in the Salmon River and Neskowin Creek Watersheds. These recommendations are consistent with the current management direction for LSR and AMA, as outlined in the ROD (USDA and USDI 1994).

4.1 ISSUE 1: CONDITION OF NATIONAL FOREST AND BUREAU OF LAND MANAGEMENT LATE-SUCCESSIONAL RESERVE LANDS AS FUNCTIONINGLATE-SUCCESSIONAL ECOSYSTEMS

Key Question: What habitat improvement activities (e.g. silvicultural treatment, snag creation, CWD placement, road decommissioning) would be beneficial in promoting late-successional characteristics?

Recommendation 1: Apply pre-commercial thinning treatment to stands that would benefit from such treatments. This includes stands in the early-seral class (ages 0 to 15), as well as some stands in the pole seral class (ages 15 to 30). In general, pre-commercial thinning would be most effective in stands less than 25 years old. Pre-commercial thins should favor under-represented species including hardwoods. See also Recommendation 11.

Rationale: The objective of pre-commercial thinning in this analysis area would be to promote the growth of the residual trees. Pre-commercial thinning increases height growth on residual trees and creates growing space for dominant and co-dominant trees. Over time, the diameter of trees in stands that have been pre-commercially thinned will generally be 10 to 15 percent larger than the diameter of trees in stands which have not been pre-commercially thinned (Reukema and Bruce 1977). It would benefit stands with high or uniform densities and with an inappropriate species mix for the site.

Recommendation 2: Commercially thin stands in two categories:

1) Early Commercial Thinning (stands less than 30-50 years of age), and
2) Late Commercial Thinning (stands between 80 and 110 years old).

(See also Recommendation 12.)

Rationale: Commercial thinning opportunities were divided into two categories: early and late commercial. This distinction primarily reflects differences in management objectives between stands that are under 80 years of age and stands that are between 80 and 110 years of age.

A December 17, 1997 memorandum from the Regional Ecosystem Office (REO) states, "The REO recognizes that silvicultural enhancement treatments may occur within LSRs in the Northern Coast Range AMA in stands up to 110 years old (USDA & USDI 1994:C-12) and exempts these treatments as described within the LSRA and consistent with the NFP, from future project-level review." However, the Salem District Record of Decision and Resource Management Plan (USDI

1995) determined that timber harvest in LSR R0270 (which includes all lands designated as LSR under BLM management in the Salmon-Neskowin watershed) will not occur in stands which are older than 80 years (USDA and USDI 1998).

Additionally, within the Northern Coast Range AMA, silvicultural enhancement treatments may be restricted by management concerns for wildlife species or other resource values. For example, within Reserve Pair Areas, thinning may occur only in stands up to 80 years of age. Regardless of age, all stands containing suitable marbled murrelet habitat must be protected according to U.S. Fish and Wildlife Service standards for protection of critical habitat and suitable nest trees.

In all LSR areas, regardless of stand age, commercial thinning prescriptions should be designed with the long-term objective of promoting late-seral stand characteristics and enhancing late-seral species. Within AMA areas, a primary technical objective is to integrate the development and maintenance of late-successional forest habitat with production of timber products (USDA and USDI 1998).

In both early and late thinnings, when possible, thinning designs should benefit stands with an inappropriate or undesirable species mix for the site. Although stands regenerated with off-site seed sources were not identified on federal lands, such stands may occur within the watershed. If stands with off-site seed sources are identified, prescriptions for these stands should favor other species and should discriminate against the off-site trees if possible.

Early commercial thinnings may be viable treatment options in stands whose ages range from 30 to 79 years. Multiple commercial thinnings may be appropriate for some stands, especially those that are currently near the young end of this range. Dense and/or uniform stands are candidates. Stand condition and other resource management concerns may limit the number of desirable entries. Avoid more than two thinning entries in western hemlock stands to avoid the spread of *Annosus* root disease. The objectives of early commercial thinnings are to promote the growth of large diameter trees, to encourage the development of some late-successional stand characteristics, and to increase wind-firmness.

Early commercial thinnings will encourage stand variability and spacing variability. This in turn will favor the development of large limbs on some trees and will hasten the development of desirable characteristics within the stand.

Late commercial thinnings may help move densely stocked stands from the competitive exclusion stage into the understory reinitiation phase. Doing so will help to expand existing blocks of late-seral forest and will create linkages between existing late-seral blocks.

Additionally, late commercial thinnings will hasten the development of multiple canopy layers and will promote wind-firmness, especially in stands with prior thinning entries. In many stands, some trees will be large enough to provide for down logs, woody debris, and snags.

<u>Recommendation 3</u>: For both early and late commercial thinnings, avoid creating low stand densities (less than 60 trees per acre) in areas prone to windthrow and blowdown. Susceptible

stands are located closer to the ocean, on ridges or high on the northeast side of ridges, and are composed predominantly of western hemlock or Sitka spruce. In areas where pit and mound micro-relief indicate a long blowdown history, leave higher residual stocking.

Rationale: Residual stand densities should be sufficient to prevent large-scale loss of remnant trees. Stands should be thinned to promote late-successional forest development. Generally, heavy thinning in wind-prone areas would not achieve this objective.

Recommendation 4: Design commercial thinning prescriptions to include retention of adequate standing trees to provide for future snag and CWD needs following the recommendations of the LSRA and the wildlife biologist.

Rationale: Snags and CWD are important components of late-seral habitat. They decline through natural processes (as snags decay and fall, and as CWD advances in decay class), and are further reduced as a result of logging activities. They can be replaced both naturally and artificially from the remaining trees in the stand. Artificial creation of snags and CWD should be accounted for when planning silvicultural treatments.

Recommendation 5: Create snags and CWD in areas (not associated with silvicultural treatments) that are currently deficient in these habitat components. Meet or exceed snag and CWD levels following the recommendations of the LSRA.

Rationale: The watershed is generally characterized by a shortage of snags and CWD. These are important components of late-seral habitat and younger stands.

Recommendation 6: Minimize damage to existing snags and CWD where they occur.

Rationale: Logging activities will result in some reduction of these components. Much of this loss will likely be of the larger and more decayed elements that cannot be replaced in the short-term and that provides high wildlife value.

Methods:

- Fully suspend logs over concentrations of CWD where possible.
- Locate logging corridors to avoid concentrations of snags where possible.
- Minimize ground equipment operations through concentrations of CWD.
- Provide sufficient shading to maintain the site's microclimate.
- Restrict salvage and firewood cutting to what is essential for hazard removal and to allow access on maintained roads.

Recommendation 7: Minimize construction of temporary roads to facilitate silvicultural treatments. See also Recommendation 38. Consider alternate methods such as helicopter where road construction would otherwise be necessary.

Rationale: The purpose of silvicultural treatment in LSR is to accelerate the development of late-seral interior forest habitat. Roads constitute linear corridors that contribute induced edge, fragment interior habitat, and improve habitat for predators and nest parasites. The addition of roads may negate the positive effects sought by the treatment.

Recommendation 8: Treat Swiss Needle Cast. Plantations with heavy infections should be evaluated to determine the need for treatment. Underplanting with resistant species (hemlock, cedar, and spruce) and selections against Douglas-fir in pre-commercial thinning are two treatment options. Promote planting with disease-resistant Douglas-fir stock when it becomes available.

Thinning may not be a treatment option in older stands infected by Swiss Needle Cast if thinning would reduce stocking levels below acceptable levels. If the stand density can support a thinning, species other than Douglas-fir should be favored. Oregon Department of Forestry recommends a higher treatment priority for stands that were regenerated with off-site Douglas fir. No such stands were identified on federal lands in this analysis. See also Recommendation 13.

Rationale: Swiss Needle Cast has dramatically increased in plantations and in some older stands within the watershed over the last few years. This disease drastically reduces diameter growth and may, over time, eliminate Douglas-fir on micro-sites favorable to the disease.

Recommendation 9: Convert hardwood-dominated stands where appropriate. Commercial thinning may be a viable treatment option in young red alder stands where alder is both the main stand component and is large enough to have commercial value. If conifers are not already established in the understory, underplanting with western hemlock, western red cedar, and Sitka spruce may be an option.

Where conifers could be released and where no merchantable trees occur in the overstory, other treatment options such as girdling or slashing may be viable. See also Recommendation 14.

Rationale: Historically, few stands within the watershed were dominated by hardwoods. Now, some extensive areas are hardwood-dominated. Conversion of some of stands within these areas may be appropriate; however, hardwood conversion does not have a high treatment priority in the watershed. Individual stands will need to be evaluated on a case-by-case basis.

Key Question: Where would habitat improvement activities be beneficial?

Note: Silvicultural treatment opportunities were identified through GIS analysis. Only areas under federal management were identified as potentially treatable areas. Stands within the CHEF and CHSRA were not evaluated for treatment.

Pre-commercial thinning, early commercial thinning, late commercial thinning, conifer release, and Swiss Needle Cast treatment areas were identified using seral class attribute from the Siuslaw National Forest's Vege GIS theme layer and the BLM's Forest Cover/Operations Inventory theme layer. They are displayed on the Potentially Treatable Areas Map (Map 14). The Vege theme layer does not include stand age for all stands; seral class was used as a surrogate for stand age.

Unfortunately, stand ages within each seral class do not correspond with treatment ages. This introduced two irreconcilable mapping errors:

- Only the early-seral class (ages 0 to 15) was used to identify potential precommercial thin opportunities. However, the youngest stands in the conifer pole and conifer mix pole seral classes may also be candidates for precommercial thinning. These stands may have been inappropriately identified as early commercial thin candidates.

- Candidate treatment areas for late commercial thinning (AMA A0907 and LSR R0807) were identified using the mature conifer and mature conifer mix seral classes (ages 80 to 149 years). However, stands over 110 years on areas within LSR R0807 are not to be thinned.

Additionally, the Vege theme layer does not include information about recent or planned treatments. Areas designated as potentially treatable may or may not be suitable for treatment — aerial photo analysis or on-the-ground reconnaissance will be required to verify proposed treatment strategies.

Recommendation 10: Conduct treatments in LSRs to accelerate the development of late-successional habitat only in areas that currently lack species and/or structural diversity.

Rationale: Silvicultural treatments in LSR are designed to improve or enhance structural and species diversity. Areas that are naturally developing such diversity should be allowed to continue the natural processes. Site-specific information on species and structural diversity is generally lacking. On-the-ground assessments should determine which areas would benefit from treatment and which would not.

Recommendation 11: Apply pre-commercial thinning. There may be an opportunity to pre-commercially thin two stands in the Butte/Hawk subwatershed (Section 20, T5S, R10W). Treatment here would increase the potential for connectivity to adjacent late-seral areas.

A number of pre-commercial thinning opportunities may exist in the Bald Mountain area on BLM-managed land in the Slickrock2, Trout1, and Treat/Alder Brook subwatersheds. Here, pre-commercial thinning should be considered when it does not pose a trade-off for other resource values.

Additional opportunities may exist on lands managed by the USFS in the Bear2, Middle Salmon River and Pather1 subwatersheds. Consider pre-commercial thinning if this activity does not pose a trade-off for other resource values.
A few additional pole-stage stands are found in the Upper Neskowin, Widow, and Panther1 subwatersheds. Evaluate these stands for treatment if they have not already been pre-commercially thinned.

Rationale: See Recommendation 1.

Recommendation 12: Apply commercial thinning. Potential early commercial thin (as defined under Recommendation 2) treatment areas were identified by evaluating GIS data for stands in the conifer pole, conifer mix pole, young conifer, and young conifer mix seral classes. These seral classes include stands up to 80 years old.

Potential treatment areas on BLM-managed lands occur in the Bald Mountain area. On USFS-managed lands, a number of areas occur within murrelet circles in the Bear2 and Middle Salmon River subwatersheds. These areas should not be treated if doing so would unfavorably impact suitable nest trees.

A few additional treatment opportunities may occur in the Upper Neskowin and Panther1 sub-watersheds. Here, all stands are in areas identified as Late-Successional Reserves. Treatments should be designed to achieve LSR objectives. Due to the Reserved Pair Area status, only stands up to 80 years old are allowed to be thinned.

Late commercial thin opportunities were identified by evaluating the mature conifer or mature conifer mix seral-classes (ages between 80 and 149 years). Potential treatment areas occur within the Trout1 watershed. Before selection for thinning, these stands should be evaluated to ensure that they are less than 110 years old, composed of dense and/or uniform conifers, and outside of RPA's.

A number of other stands that may be candidates for late commercial thin are found in the Middle Salmon River, Bear2, Trout1, and Slickrock2 subwatersheds. Many of these stands are within identified murrelet circles. Here, silvicultural activities are restricted. No suitable nest trees may be removed, and all other guidelines provided by U.S. Fish and Wildlife Service must be adhered to.

Rationale: See Recommendation 2.

<u>Recommendation 13:</u> Treat Swiss Needle Cast. Treat stands with the greatest potential for treatment opportunity as identified on the Potentially Treatable Areas Map. Ground-verify treatment areas prior to conducting treatments.

Rationale: Younger stands are more likely to have a wider variety of treatment options. These stands were identified by overlaying the Swiss Needle Cast GIS theme layer with the early, conifer pole, and conifer mix pole seral classes from the Vege GIS layer. However, because the Swiss Needle Cast layer does not contain information on current infection levels, treatment needs should be verified through a combination of ground and aerial reconnaissance.
<u>Recommendation 14:</u> Convert hardwood-dominated stands where appropriate. Treat areas identi-fied on the Potentially Treatable Areas Map.

Rationale: To identify stands that may contain a merchantable red alder component, stands with hardwood, hardwood mix, and hardwood mix pole seral classes were evaluated. Stands dominated by red alder have the highest priority for treatment. Stands under 10 acres in size were not included as viable treatment opportunities because smaller hardwood stands create landscape diversity and provide habitat for mollusks and other species.

Areas outside AMA could be considered for treatment, but are a lower priority. Although the Potentially Treatable Areas map only identifies stands that have a layer 1 species component of red alder (in the Vegetation GIS layer), other stands may be viable candidates. These areas should be identified through ground reconnaissance.

Two stands that may be candidates for treatment are located within AMA in Sections 17 and 18, T7S, R9W.

Recommendation 15: Apply silvicultural enhancement practices to promote overall forest health and vigor.

Rationale: In addition to promoting late-seral characteristics, silvicultural enhancement practices that enhance overall forest health and vigor are appropriate. These practices may include a variety of other treatments. For example, underplanting stand openings may be an effective technique for developing multiple canopy layers with the long-term goal of increasing species diversity and enhancing stand wind-firmness.

Recently harvested stands in AMA should be regenerated following accepted practices. Post- or pre-thinning fertilization and pruning could be prescribed in AMA. Animal protection and other stand protection or growth enhancement projects could be prescribed in AMA and possibly in younger stands in LSR where such treatments would encourage the development of late-seral characteristics. While these practices will often be prescribed in conjunction with a thinning regime, in some areas, these practices may be the only needed silvicultural enhancement activities.

Salvage and sanitation treatments may be appropriate in some areas, particularly after stand-replacing events, to reduce the threat of insect epidemics or to reduce a potential fire hazard. According to the NFP, "Direct silvicultural management is appropriate following disturbances such as extensive, high-severity fires" (USDA and USDI 1994:B-8). However, it is likely that these types of treatments will be uncommon unless a catastrophic disturbance affects the watershed. Underburning may be an appropriate treatment, especially in past harvest areas. Risk reduction efforts are appropriate when they are consistent with the overall recommendations for the watershed.

Key Question: What areas should be treated first and for what reasons?

Recommendation 16: Treatment areas should be prioritized based on their ability to contribute to future late-successional interior forest habitat, to increase the size of existing blocks of interior habitat, and to develop connections between existing blocks of interior forest.

Rationale: Silvicultural treatments in LSR are designed to improve habitat for late-seral associated species. Many of these species depend on, or prefer, large contiguous blocks of interior (unaffected by edge) late-seral forest. In developing the list of priorities, consider the effects from edge, adjacent lands, and roads.

4.2 ISSUE 2: CONDITION OF AQUATIC AND RIPARIAN RESOURCES

Key Question: What management activities would benefit aquatic and riparian resources?

Recommendation 17: Develop and implement a sampling and monitoring program to identify existing quality habitat as well as habitat and water quality deficiencies, and to prioritize restoration activities.

Rationale: Existing data are limited. Additional information would be useful to develop a management strategy to protect existing quality habitat and to restore lost or degraded habitat. More extensive spawner surveys would quantify productivity of streams and locate key spawning habitat. Gravel samples and scour monitors could detect developing egg mortality due to fine sediment deposition and/or peak flow scouring. Sampling of spawning gravel fines and scour would also help determine the extent of these impacts. Additional habitat inventories would help determine where pools and LWD are lacking, and identify suitable sites for restoration projects. Habitat inventories would also be useful in assessing riparian vegetation for shade and potential LWD recruitment, and identify areas where conifer release would be useful. Additional water temperature data would be useful for Neskowin Creek to determine trends for temperature in that watershed.

Recommendation 18: Manage riparian vegetation to protect existing late-successional stands and to maximize growth of earlier successional stands with the objective to provide LWD recruitment and stream shading.

Rationale: LWD is currently lacking in both the Salmon River and Neskowin Creek watersheds. High water temperatures in the Salmon River indicate that shade is lacking there as well. Restoration activities should prioritize stream reaches with quality fish habitat. Medium to large streams should receive higher priority since larger wood is needed to function as LWD in larger systems. Thinning activities should minimize loss of stream shading. Emphasis should be placed on management for large conifers, which are longer lasting than hardwood species.

Recommendation 19: Identify and remove man-made barriers to fish passage.

Rationale: Man-made barriers to fish passage, including culverts, can limit access to quality fish habitat. A culvert inventory using a methodology which measures culvert slope and flow as well as depth of plunge pool and height of outfall should be conducted to determine if existing culverts allow fish passage for adult and juvenile fish. New and replacement culverts should be installed to allow fish passage. Culverts that are currently barriers should be prioritized for replacement according to quality and accessibility of fish habitat upstream.

Recommendation 20: Reduce sediment input to streams by reducing the number of roads, by reducing the potential for roads to trigger landslides, and by reducing the surface erosion from existing roads.

Rationale: The deficiency in the number and depth of pools found in habitat surveys for the two watersheds suggest excess sediment may be impacting fish habitat. Excess sediment can cause loss of pools, channel widening and instability, bank erosion, increased water temperature, and egg mortality. Roads are generally considered to be a primary source of sediment. Other sources such as grazing and residential development with an associated reduction in vegetation also contribute. Chronic sediment sources such as unstable slopes and stream banks, and bare soils should be treated using bio-engineering techniques. These techniques provide additional root strength and ground cover to reduce surface erosion and mass wasting. Priority should be given to sites that are impacting quality fish habitat.

Recommendation 21: Reduce peak flows by reducing road density or installing additional culverts.

Rationale: Peak flows can impact juvenile fish by washing them out of the system when they are unable to find a refuge from high velocity currents. Peak flows also cause scour and fill of spawning gravels, which can impact developing eggs and alevins. Roads increase peak flows by increasing the stream network (i.e. ditches). This allows more rapid runoff. Road ditches intercept groundwater and convert it to surface water, which runs off more rapidly than ground water. Ditches also concentrate flows by intercepting ground and surface water from several micro-basins between culverts and diverting the flows to the next culvert below. This increases the flow in the micro-basin below the culvert outfall. This increase in flow can increase channel incising and/or soil saturation and destabilize slopes that were stable before the culvert installation. This should be remediated by installing additional culverts or removing the road to return flows to their original basin.

Recommendation 22: Increase key habitat availability by restoring wetlands, side channels and estuaries.

Rationale: Loss of key habitats can limit fish production. Wetlands, side channels and estuaries are important to juvenile fish because off-channel habitat provides a refuge from peak flows and estuaries enable anadromous juveniles an opportunity to acclimate to salt water before heading out to sea. Many of these areas have been lost due to levees and dikes in agricultural areas, road encroachment on stream channels, and loss of LWD in the form of log jams, which may provide side-channel habitat. Beaver ponds also provide important off-channel habitat. Beaver populations should be encouraged where possible. The dike removal program on the Salmon River Estuary should be continued, and off-channel habitat restored where possible. This could include artificial off-channel spawning or rearing channels.

<u>Recommendation 23</u>: Increase habitat complexity by installing instream structures where LWD is lacking.

Rationale: LWD provides cover for juveniles and adults, reduces competition among juveniles, helps form pools and log jams, traps spawning gravels and provides sediment storage. Artificial placement of wooden structures should not be considered as a substitute for natural LWD recruitment, but as a temporary stop-gap until natural LWD recruitment can restore habitat complexity. Key habitat areas should receive priority for projects. Small-to-medium-sized stream reaches are more successful for instream structures as the larger streams tend to wash out structures during flood events.

<u>Recommendation 24</u>: Work with ODFW to encourage management for wild stocks and reduce competition of hatchery stocks.

Rationale: Hatchery stocks compete with wild stocks for food and territory. Increased fishing pressure on hatchery stocks increases fishing pressure on wild stocks as well. Hatchery fish may carry diseases that could potentially spread to wild fish. Brood stock for hatchery fish are often brought in from another basin with different genetic characteristics. A long-term hatchery program may alter genetic make-up of native brood stocks from the same system as they adapt to hatchery conditions. Hatchery strays breeding with wild fish could alter the genetic makeup of wild stocks thereby reducing their ability to adapt to and survive in their natural environment. Minimizing hatchery/wild hybridization will ensure a more viable wild stock. Reduced competition from hatchery stocks will increase survival of wild stocks.

4.3 ISSUE 3: ESTUARY

<u>Key Questions</u>: Where are additional management activities needed? What additional restoration activities are needed?

<u>Recommendation 25</u>: Coordinate with Oregon Department of Transportation (ODOT) to move toward construction of bridges or culverts on Highway 101 where it impedes restoration of natural estuarine conditions.

Rationale: The long-term goal established in the CHSRA management plan is to restore the estuary to a natural system. Highway 101 currently dikes approximately one-third of the original estuary/wetland complex, preventing full recovery of estuarine conditions east of the highway. Although the Salmon River Bridge allows partial flow, additional mitigation measures should be explored. Reconnection of Salmon and Frazier Creeks under the highway would restore natural flow of these creeks. Restoration of the former American Adventures and Tamara Quays sites would increase habitat for fish and wildlife.

Recommendation 26: Continue acquisition of properties that allow restoration of the estuary and its associated wetlands to a natural system.

Rationale: Much of the estuary has not yet been returned to a natural condition. Some of this is due to private ownership and the resultant continued diking and use of estuarine habitat.

Recommendation 27: Negotiate conservation easements with landowners that are unwilling to sell.

Rationale: Where landowners are unwilling to sell, negotiation of conservation easements may accomplish the same result and at less cost.

Recommendation 28: Complete the removal and/or breaching of existing dikes to restore connections to salt water that existed prior to diking.

Rationale: The long-term goal established in the CHSRA management plan is to restore the estuary to a natural system. Much progress has been made toward this goal and a signed decision document exists to complete further efforts (USFS 1996). Planned efforts should be carried out and further work should be planned to continue progress toward the long-term goal.

Recommendation 29: Implement upland habitat improvements adjacent to the estuary to restore native vegetation and habitats.

Rationale: Upland areas are thought to have consisted of a much larger component of spruce/alder forest than currently exists. Existing habitats can be used as models for improvement projects to increase the abundance of this habitat where possible.

4.4 ISSUE 4: ROADS

Key Question: How should non-primary and non-secondary roads be managed in the watershed to achieve AMA and LSR objectives?

Recommendation 30: Decommission unneeded roads identified as having a high risk of failure.

Rationale: Slope failures such as landslides and debris torrents are a significant source of sediment in streams. Road-related slope failures typically contain more fine material and less woody debris than do failures originating from slopes with mature timber, thus creating greater adverse impacts to streams. The removal of unstable roads and/or the road segments identified in this report will reduce the risk of road-related slope failures.

The road segments recommended for decommissioning below are identified by segment number (attributed in the Hebo Ranger District GIS) and by Forest Service road number.

Specific Roads:

Road Segment 4: Road Segment 4 (USFS Road 1268), which traverses the headwaters of Jim Creek for 2.34 miles, has a risk score of 4. The segment should be decommissioned from the forest boundary south and east to its intersection with Road 1280.

Road Segment 12: Road Segment 12 consists of an un-numbered road that provides access to lower Jim Creek. The 0.17 mile long segment, which has a risk rating of 4, should be decommissioned from the Forest boundary, north to its end.

Road Segment 73: Road Segment 73 consists of 0.52 mile of USFS Road 1861 between Highway 101 and USFS Road 1861-120. The road has a risk rating of 4, largely due to its slope position and underlying unstable geologic substrate. As the road provides direct access from Highway 101 to much of the Salmon Creek subwatershed, upgrading may be more practical than decommissioning.

Road Segment 76: Road Segment 76 is an un-named road (possibly now abandoned) identified in aerial photographs. The road, which appears to connect the end of USFS Road 1861-120 back to USFS Road 1861, received a risk rating of 4.

Road Segment 87: Road Segment 87 (USFS 1200-136) is a 0.23-mile long spur off USFS Road 12 in the Toketa Creek subwatershed. The road received a risk score of 5, the highest risk rating in the study. Factors responsible for the high risk score include a previous history of slides and slope failure susceptibility factors such as slope shape, steepness, and weak geologic formations.

Road Segment 93: Road Segment 93 (USFS 1888 in the headwaters of Gardner Creek) is 0.55 miles long and received a risk rating of 3.5.

Road Segment 100: Road Segment 100 (USFS 1861-116) is a 0.41 long spur (116) off of USFS Road 1861-115 in the Widow Creek/West Fork Salmon River subwatershed. The road segment received a risk rating of 4 due primarily to slope failure susceptibility factors.

Road Segment 103: Road Segment 103 (USFS 1861-114) is a 0.21 long spur off USFS Road 1861 on the west side of the West Fork Salmon River subwatershed. Slope failure susceptibility factors were the primary contributing factor to the road's high risk score.

Road Segment 125: Road Segment 125 is a 0.34 mile long portion of USFS Road 1726 located in the Morton Creek drainage. The road has a risk rating of 4.

Road Segment 127: Road Segment 127 is a 1.28 mile long portion of USFS Road 1780 in Southman Creek. The road segment received a risk rating of 4.

Road Segment 135: Road Segment 135 (USFS 1781-111) is a 0.89 mile long spur in the Bear/McMullen subwatershed. The segment received a risk rating of 3.5.

Road Segment 170: Road Segment 170 is an unnumbered BLM spur road in the headwaters of Slickrock Creek. The segment received a risk rating of 3.5, primarily due to slope failure susceptibility factors. Site-specific information on the condition of this road may be used to determine final management.

Road Segment 171: Road Segment 171 is an un-numbered BLM spur road in the Slickrock Creek headwaters. The road received a risk rating of 4 primarily due to slope position and a past history of failure. Site-specific information indicates the road may be stabilized using appropriate maintenance measures.

Road Segment 176: Road Segment 176 is a BLM spur road in the Trout Creek headwaters. The road consists of steep gradients with drainage problems.

Road Segment 178: Road Segment 178 is a BLM spur road in the Trout Creek headwaters. The road consists of steep gradients with drainage problems.

Road Segment 180: Road Segment 180 is a BLM spur road in the Slick Rock Creek drainage. The road is in an area of known instability with current land movements.

Road 1729-19: This road, between roads 1726 and 1729 (Sections 3 and 4, T 7S, R 10W) should be decommissioned due to slumps, failing cut slopes and sidecast, and multiple stream crossings.

<u>Alternative Methods for all Roads</u>:

- Remove culverts and associated fills from stream crossings.

- Remove or re-grade sidecast road fill.

- Subsoil the roadbed as required to reduce runoff and increase infiltration. This activity is not appropriate for all situations and should be evaluated on a site by site basis.

- Use native seed and plants to provide surface stability and erosion control. The use of native seed minimizes the potential for introducing noxious species. If native seed is not readily available, use non-persistent erosion control species seed mixes. Consult with Forest botanist; some non-critical areas may be able to revegetate without seeding.

- Refer to the Siuslaw National Forest Road Obliteration and Upgrade Guide (1995) for additional information.

<u>Recommendation 31</u>: Upgrade or otherwise stabilize ATM roads as funds are available. Give priority to ATM roads identified as "high risk" roads.

Rationale: While primary and secondary ATM roads were not addressed by the key questions, they continue to require maintenance. Many of the ATM roads were built prior to 1972 when sidecast methods were used. Culverts used in their construction are now over 25 years old, and are also considered undersized by today's standards. Such roads, therefore, have a relatively high risk of failure, and must be vigilantly maintained. Priority for upgrading roads should be assigned as follows:

Priority 1: Roads identified as having a high risk of failure. These include:

Road Segment 59: Road Segment 59 is a 0.65 mile long portion of USFS Road 1861 located in the Crowley Creek subwatershed. The segment received a risk rating of 3.5.

Road Segment 67: Road Segment 67 is a 1.21 mile long portion of USFS Road 1861 which traverses the headwaters of Caulkins Creek, west of Highway 101. The road segment received a risk rating of 3.5.

Road Segment 152: Road Segment 152 is a 1.78 mile-long portion of BLM Road 7-10-24 which traverses the headwaters of Trout Creek near the southern edge of the Salmon River watershed. The road accesses many acres of BLM and private forest land for management activities. The segment receives annual maintenance and has a moderate risk rating.

Road Segment 158: Road Segment 158 is a 0.43 mile-long portion of BLM Road 6-9-27 which traverses between the Deer Creek and Treat River drainages in Section 33 of the Deer Creek subwatershed. The road is a primary access road to many acres of BLM and private timberland for management activities. The segment receives annual maintenance and has a moderate risk rating.

Priority 2: Roads that may affect aquatic resources if they fail.

Priority 3: Roads that require stabilization of massive slides or have sidecast and/or unstable headwall problems.

Priority 4: Roads that will allow an overall reduction of maintenance costs if abandoned.

Priority 5: Roads that have limited support during winter haul.

Methods:

- Replace undersized and deteriorated culverts.
- Maintain ditches and clean adequately sized culverts.
- Reconfigure roadway to allow better drainage (e.g. rolling dips, cross drains, and diversion devices such as water bars).
- Add additional ditch relief culverts.

- Seed bare road cut banks.

Recommendation 32: Complete or update road inventory to identify all culverts.

Rationale: Review of the Siuslaw National Forest GIS suggests that the current (1998) inventory of culverts on federal lands may be incomplete. Culverts not identified in the current GIS should be located and assessed to ensure that they are capable of handling a 100-year storm event.

Recommendation 33: Replace or maintain undersized culverts.

Rationale: Some undersized culverts have been identified in this analysis. Undersized culverts are prone to plug and then, along with the fill encompassing them, fail catastrophically. This results in the introduction of large volumes of fine sediment into streams. The potential for catastrophic culvert failures can be minimized by replacing undersized culverts. If replacement is not possible, they should be maintained in optimal operating condition.

Recommendation 34: Identify earthflows and slumps, and then update road failure risk analysis to identify additional roads at risk of failure.

Rationale: Earthflows and slumps were not identified in available geologic maps of the study area. Based on the common occurrence of these features in other nearby watersheds, earthflows and slumps are inferred to be present in the study area. Roads crossing these features are at higher risk of failure than was determined by this study, and need to be identified so that they may be either decommissioned or upgraded to minimize their potential for failure.

> Methods: The Modeled Slope Stability map was generated by ranking and compiling slope failure risk factors such as slope steepness, slope shape, and the relative competence (strength) of underlying geologic formations. High risk factors include steep slopes (>70% grade), concave slopes, and incompetent (weak) formations such as the Tyee and Nestucca Formations. Low risk factors include less steep slopes, convex and planar slope morphology, and competent (strong) formations such as the Cascade Head Basalt. Consult this map prior to planning and designing new roads.

Recommendation 35: After final silvicultural treatments are implemented to accelerate the development of late-successional interior forest habitat, decommission existing roads where they intersect the stand and where they limit the future development of interior forest.

Rationale: Roads constitute linear corridors that contribute induced edge, fragment interior habitat, and improve habitat for predators and nest parasites. Implementation of silvicultural treatments will not contribute to development of effective interior forest where the habitat is influenced by roads.

Recommendation 36: Minimize construction of temporary roads within LSR.

Rationale: Roads constitute linear corridors that contribute induced edge, fragment interior habitat, and improve habitat for predators and nest parasites. Standards and guidelines in the NFP (USDA and USDI 1994) recommend against construction of new roads.

Recommendation 37: Reduce existing open road densities to 1.5 miles per square mile or less where possible.

Rationale: Vehicular use of roads causes disturbance to wildlife species and can affect them in various ways. Human disturbance can cause avoidance of disturbed areas resulting in crowding into adjacent habitats, create barriers to movement, adversely affect reproductive success, and result in increased mortality from collisions or legal and illegal hunting. Road densities in the watershed average approximately 3.5 miles per square mile (approximately 2.5 miles per square mile on federal lands).

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APPENDIX A

ADDITIONAL VEGETATION INFORMATION

TABLE 3-13. DISTRIBUTION OF HISTORIC SERAL STAGES WITHIN THE WATERSHED BY SUBWATERSHED (ACRES/PERCENT)

	Grass/ forb	Very Early	Early Pole	Conf. mix Pole	Young Conifer	Young Conf. mix	Mature Conifer	Mature Conf. mix	Deciduous Mix	Pure Hardwood	Un-typed	Total
Bear2	1 0%	1257 35%	0 0%	0 0%	248 7%	63 2%	1444 40%	132 4%	39 1%	30 1%	354 10%	3568 100%
Butte/ Hawk	241 5%	1299 25%	44 1%	65 1%	223 4%	132 3%	1338 26%	0 0%	83 2%	0 0%	1769 34%	5193 100%
Cliff	363%	98 7%	0 0%	0 0%	90 6%	0 0%	1124 81%	0 0%	0 0%	0 0%	49 4%	1396 100%
Deer	0 0%	116 6%	0 0%	170 9%	0 0%	5 0%	1115 56%	0 0%	323 16%	162 8%	84 4%	1975 100%
L. Nesko-win	0 0%	1016 20%	0 0%	0 0%	190 4%	0 0%	3204 64%	0 0%	0 0%	69 1%	556 11%	5035 100%
L. Salmon River	596 12%	303 6%	0 0%	66 1%	516 10%	42 1%	766 15%	0 0%	748 15%	189 4%	1772 35%	4996 100%
M. Salmon River	0 0%	307 8%	90 2%	470 12%	190 5%	175 4%	1111 28%	134 3%	335 8%	230 6%	990 25%	4031 100%
Panther1	0 0%	449 30%	35 2%	72 5%	247 16%	4 0%	415 28%	0. 0%	0 0%	248 16%	38 3%	1507 100%
Salmon	24 1%	59 2%	0 0%	239 8%	387 12%	178 6%	1358 44%	0 0%	438 14%	55 2%	368 12%	3106 100%
Slickrock2	0 0%	150 3%	111 2%	27 0%	1520 26%	278 5%	2391 42%	623 11%	168 3%	0 0%	477 8%	5745 100%
Treat/Alder Brook	0 0%	1007 20%	123 2%	111 2%	887 17%	576 11%	841 17%	582 11%	496 10%	0 0%	466 9%	5090 100%
Trout1	4 0%	455 13%	283 8%	39 1%	475 14%	310 9%	566 16%	399 11%	734 21%	117 3%	130 4%	3512 100%
U.	0	936	0	0	127	216	3062	0	0	94	152	4587

	Grass/ forb	Very Early	Early Pole	Conf. mix Pole	Young Conifer	Young Conf. mix	Mature Coni-fer	Mature Conf. mix	Decid-uous Mix	Pure Hard-wood	Un-typed	Total
Neskowin	0%	20%	0%	0%	3%	5%	67%	0%	0%	2%	3%	100%

	Grass/ forb	Very Early	Early Pole	Conf. mix Pole	Young Conifer	Youn g Conf. mix	Mature Coni- fer	Mature Conf. mix	Decid- uous Mix	Pure Hard- woo d	Un- typed	Total
U. Salmon River	74 1%	5758 46%	1066 8%	231 2%	595 5%	99 1%	2827 22%	0 0%	17 0%	0 0%	1932 15%	12598 100%
Widow	0 0%	790 40%	1 0%	33 2%	148 7%	172 9%	376 19%	0 0%	0 0%	148 7%	330 17%	1997 100%
Total	**973** **2%**	**13999** **22%**	**17529** **3%**	**15239** **2%**	**5842** **9%**	**2248** **3%**	**21939** **34%**	**1871** **3%**	**3380** **5%**	**1342** **2%**	**9467** **15%**	**64337** **100%**

Note: Subwatersheds with greater than 50 percent of their land base under federal management are highlighted in grey.

Table 3-14. Seral Classes on Federal Lands and Non-federal Lands (Shaded) Based upon the Vege Gis Data Layer (Acres)

Subwatersheds	Grass	Early	Conpole	Conmix pole	Hwmx pole	Yngcon	Yngcon mix	Hdwd	Hdwdmix	Matcon	Matmix	Late	Building	Road	Orchard	Water	Rock	Sand	Unknown	Total
Bear 2	0	28	7	8	0	6	2	16	85	3	2	0	0	0	0	0	0	0	1664	1823
	0	294	246	31	37	294	238	0	177	320	29	0	0	0	0	0	3	0	76	1745
Butte/Hawk	212	154	13	32	23	679	726	160	1835	122	254	2	97	50	0	24	8	262	87	4740
	0	21	0	54	0	39	62	0	66	61	114	33	0	0	0	0	0	0	2	453
Cliff	5	0	0	0	0	0	31	0	0	4	0	0	0	0	0	0	2	0	10	50
	15	0	12	0	6	4	432	0	0	537	0	253	0	0	0	0	8	0	80	1346
Deer	15	175	5	0	0	0	34	90	144	0	3	0	0	0	0	0	0	0	0	466
	1	14	1	30	0	8	76	198	229	731	163	57	0	0	0	0	0	0	0	1509
L. Neskowin	56	130	141	41	34	59	243	355	315	17	108	2	28	22	0	0	0	38	23	1612
	0	3	60	4	3	145	615	135	233	1744	126	296	0	16	0	0	0	0	42	3423
L. Salmon River	272	35	62	0	0	61	88	206	832	102	182	0	38	33	25	252	18	8	89	2303
	309	0	6	8	0	83	38	569	791	203	119	0	1	19	0	484	17	0	48	2693
M. Salmon River	89	140	15	3	10	9	106	347	757	12	45	0	0	27	0	35	0	0	1173	2767
	17	217	0	92	1	149	227	48	108	279	75	0	0	0	0	2	0	0	47	1263
Panther 1	0	5	1	0	26	0	0	0	124	0	0	0	0	0	0	0	0	0	555	711
	0	154	133	61	1	0	112	7	155	36	98	0	0	0	0	0	0	0	40	796
Salmon	68	177	0	0	0	0	41	151	165	8	4	0	0	16	0	2	0	0	0	632
	88	8	3	0	0	42	204	465	401	902	168	92	0	23	0	29	0	0	50	2474
Slickrock2	0	41	12	4	0	11	0	4	13	7	0	0	0	0	0	0	0	0	4283	4375
	0	301	402	77	0	318	0	7	62	149	0	0	0	0	0	0	0	0	53	1369
Treat/Alder Brook	0	17	7	0	1	3	6	1	5	0	0	0	0	0	0	0	0	0	4604	4644
	0	187	108	0	7	50	17	11	35	3	0	0	0	0	0	0	0	0	27	446
Trout1	0	48	60	0	3	17	39	1	41	10	33	0	0	0	0	0	0	0	1530	1783
	0	165	128	0	127	323	68	54	180	460	171	0	0	0	0	0	0	0	54	1730
U. Neskowin	22	16	73	4	5	35	619	41	468	22	4	0	0	0	0	0	0	0	24	1331
	0	3	236	180	37	408	796	62	180	994	145	186	0	0	0	0	0	0	29	3256
U. Salmon River	0	1	4	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	12460	12468
	0	5	33	22	0	18	0	22	0	16	0	0	0	0	0	0	0	0	14	130
Widow	0	4	0	0	0	3	1	0	1	0	0	0	0	0	0	0	0	0	1476	1486
	0	16	54	24	43	20	40	22	99	21	145	0	0	0	0	0	0	0	27	511
Total Acres	**1,168**	**2,359**	**1,824**	**676**	**362**	**2,783**	**4,861**	**2,973**	**7,502**	**6,762**	**1,991**	**921**	**165**	**206**	**25**	**828**	**55**	**309**	**28,567**	**64,337**

TABLE 3-15. SERAL CLASSES BASED UPON THE VEGE GIS DATA LAYER (PERCENT)

Subwatershed	Grass	Early	Conpole	Conmixpole	Hwmxpole	Yngcon	Yngconmi	Hdwd	Hdwdmix	Matcon	Matmix	Late	Building	Road	Orchard	Water	Rock	Sand	Unknown	Total
Bear 2	0%	9%	7%	1% 8	1%	8%	7%	0%	7%	9%	1%	0%	0%	0%	0%	0%	0%	0%	49%	100%
Butte/Hawk	4%	3%	0%	2%	0%	14%	15%	3%	37%	4%	7%	1%	2%	1%	0%	0%	0%	5%	2%	100%
Cliff	1%	0%	1%	0%	0%	0%	33%	0%	0%	39%	0%	18%	0%	0%	0%	0%	1%	0%	6%	100%
Deer	1%	10%	0%	2%	0%	0%	6%	15%	19%	37%	8%	3%	0%	0%	0%	0%	0%	0%	0%	100%
L. Neskowin	1%	3%	4%	1%	1%	4%	17%	10%	11%	35%	5%	6%	1%	1%	0%	0%	0%	1%	1%	100%
L. Salmon River	12%	1%	1%	0%	0%	3%	3%	16%	32%	6%	6%	0%	1%	1%	1%	15%	1%	0%	3%	100%
M. Salmon River	3%	9%	0%	2%	0%	4%	8%	10%	21%	7%	3%	0%	0%	1%	0%	1%	0%	0%	30%	100%
Panther1	0%	11%	9%	4%	2%	0%	7%	0%	18%	2%	7%	0%	0%	0%	0%	0%	0%	0%	39%	100%
Salmon	5%	6%	0%	0%	0%	1%	8%	20%	18%	29%	6%	3%	0%	1%	0%	1%	0%	0%	2%	100%
Slickrock2	0%	6%	7%	1%	0%	6%	0%	0%	1%	3%	0%	0%	0%	0%	0%	0%	0%	0%	75%	100%
Treat/Alder Brook	0%	4%	2%	0%	0%	1%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	91%	100%
Trout1	0%	6%	5%	0%	4%	10%	3%	2%	6%	13%	6%	0%	0%	0%	0%	0%	0%	0%	45%	100%
U. Neskowin	0%	0%	7%	4%	1%	10%	31%	2%	14%	22%	3%	4%	0%	0%	0%	0%	0%	0%	1%	100%
U. Salmon River	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	99%	100%
Widow	0%	1%	3%	1%	2%	1%	2%	1%	5%	1%	7%	0%	0%	0%	0%	0%	0%	0%	75%	100%
Total Acres	**1,168**	**2,359**	**1,824**	**676**	**362**	**2,783**	**4,861**	**2,973**	**7,502**	**6,762**	**1,991**	**921**	**165**	**206**	**25**	**828**	**55**	**309**	**28,567**	**64,337**

Subwatersheds with greater than 50 percent of their land base under federal management are highlighted in grey.

APPENDIX B

ROADS DATABASE

Roads Database

A database was created to summarize objective data on federal (Forest Service and Bureau of Land Management) lands in the Salmon River and Neskowin Creek watersheds. This informa-tion is intended to guide management decisions in which the risk of failure, ATM status, and access issues must be considered. Only roads on federal lands are included in this database. In-formation included in the database was gathered from aerial photographs dated 1972, 1993, and 1996; data available in the Siuslaw N.F. GIS database; local knowledge; and various reports cited in the References section of this report. Undersized culvert information was developed using GIS data and a spreadsheet provided by the Forest. The following is an explanation of the head-ings in the database table.

Map Code: A unique code number assigned to a road segment for the purposes of compiling data for the database. Road segment codes are keyed to their respective road segments in the GIS. Road segments were selected based on the subwatershed in which they occur, and topo-graphic position, i.e., valley bottom, mid-slope, or ridgetop.

Subwatershed: The subwatershed in which the road is located.

2nd Subwatershed: The next higher order subwatershed in which the road segment is located.

Road Number: The U. S. Forest Service or BLM road number, as reported in the GIS. Roads and spurs without road numbers are cited by section number.

Length: The length, in miles, of the road segment.

Topographic Position: The slope position of the road. R = ridge top, M = mid-slope, V = valley bottom.

Topographic (Position) Score: A non-dimensional weighting score, based on the road seg-ment's position on a slope, used to estimate the total risk of slides on the road segment. R = 0, V = 0, M = 1.

 # Stream Crossings: Number of stream crossings, as shown in the GIS layer, excluding cul-verted crossings.
Past Failures: Information based on aerial photo survey of landslides, earthflows, and debris flows. Y = Failure, N = None.

Failure Score: Road segments that have failed in the past, Y=1; segments with no identified failures, N=0.

Debris Slide Risk: Information based on a model that uses the digitial elevation model (DEM) to ientify areas that are susceptable to debris slides. The model considers slope steepness, slope shape (concave, convex, or planar), and the relative stability of underlying geologic formations. L = low risk, M = moderate risk, H = high risk.

Slide Score: A non-dimensional risk score that characterizes the risk of debris flows. Low risk, L = 0; moderate risk, M = 1; High risk, H = 2.

Photo Year: The year of the aerial photograph in which a slide on a road segment appears.

Construction Method: The type of road construction most likely used to build a given road segment. Roads built prior to 1972 were assumed to be built using the sidecast method. Roads built after 1972 are assumed to be built by end-hauling or other method. S = sidecast, NS = not sidecast.

Method Score: Sidecast roads that are inherently less stable than roads built using other meth-ods, S = 1; non-sidecast roads, NS = 0.

Total Risk Score: A non-dimensional number that ranks the risk of debris slides on a given road segment. The score is the total of the risk scores for slope position, past failures, slide score, and construction method.

Undersize Culverts: The number of culverts on a road segment that are too small for flows from a 100 year rainfall event.

Non-NF Access: Specifies whether road provides access to non-federal lands. Y = Yes, pro-vides access to private or other non-federal lands, N = No, does not provide access to lands other than federally owned.

ATM Status: The Access and Travel Management (ATM) maintenance designation of the road segment.

> Primary roads are maintained at a level that will encourage use by low-clearance vehicles such as passenger cars.
>
> Secondary roads are maintained at a level that will allow use by high clearance vehicles.

Blank entries indicate roads that are maintained at a minimum level, and are candidates for closure and/or obliteration.

Land Allocation: The land allocation the road crosses. All federal lands in the study area are in the Adaptive Management Area (AMA). LSR = Late Successional Reserve, M = Murrelet

Ownership: Specifies whether road segment is on National Forest or BLM land.

Map Code	Subwatershed	2nd Subwatershed	Road Number	Length (Miles)	Topo Position	Topo Score	# Stream Crossings	Past Failures	Failure Score	Debris Slide Risk	Slide Score	Photo Year	Construction Method	Methd Score	Total Risk Score	# Undersize Culverts	ATM Status	I Alloc
1	Butte/Hawk	Butte	1031	0.31	RM	0.5	0	N	0	L	0		S	1	1.5	0		
2	Butte/Hawk	Hawk	1268-112	0.35	M	1	0	N	0	M	1		S	1	3	0	Secondary	
3	Lower Neskowin	Prospect	1268-112	0.76	M	1	0	N	0	M	1		S	1	3	0		
4	Lower B34Neskowin	Jim	1268	2.34	M	1	1	Y	1	M	1	1993	S	1	4	0		
5	Upper Neskowin	Lewis	1280	1.22	RM	0.5	0	N	0	M	1		S	1	2.5	0		
6	Upper Neskowin	Lewis	None	0.2	R	0	0	N	0	M	1		S	1	2	0		
7	Upper Neskowin	Lewis	1280-113	0.48	M	1	1	N	0	L	0		NS	0	1	0		
8	Upper Neskowin	Lewis	1280-114	0.18	RM	0.5	0	N	0	L	0		S	1	1.5	0		
9	Upper Neskowin	Lewis	None	0.08	RM	0.5	0	N	0	M	1		S	1	2.5	0		
10	Upper Neskowin	Lewis	1280-111	0.23	RM	0.5	0	N	0	M	1		S	1	2.5	0		
11	Upper Neskowin	Lewis	1280-119	0.19	R	0	0	N	0	M	1		S	1	2	0		
12	Lower Neskowin	Jim	None	0.17	V	0	1	Y	1	H	2	1972	S	1	4	0		
13	Lower Neskowin	Section 1	None	0.41	V	0	0	N	0	L	0		S	1	1	0		
14	Lower Neskowin	Section 1	None	0.75	M	1	3	N	0	L	0		S	1	2	0		
15	Lower Neskowin	Section 6	None	0.57	V	0	1	N	0	L	0		S	1	1	0		
16	Lower Neskowin	Section 6	None	0.17	M	1	0	N	0	L	0		S	1	2	0		
17	Lower Neskowin	Section 6	None	0.3	V	0	0	N	0	L	0		S	1	1	0		
18	Lower Neskowin	Section 12	1861-123	0.39	RM	0.5	0	Y	1	L	0		S	1	2.5	0		
19	Lower Neskowin	Section 8	None	0.2	M	1	2	N	0	H	2		NS	0	3	0		
20	Lower Neskowin	Section 8	132	0.82	M	1	1	N	0	M	1		S	1	3	0		
21	Upper Neskowin	N	132	1.3	M	1	1	N	0	M	1	1996	S	1	3	1		
22	Upper Neskowin	Lewis/Sloan	1280	0.175	M	1	5	N	0	M	1		S	1	3	0	Secondary	
23	Upper Neskowin	Lewis/Sloan	1280	0.29	V	0	0	N	0	M	1		S	1	2	0	Primary	
24	Upper Neskowin	Sloan	12	0.51	V	0	4	N	0	H	2		S	1	3	0	Primary	
25	Upper Neskowin	Sloan	12	0.36	M	1	0	N	0	M	1		S	1	3	0	Primary	
26	Upper Neskowin	Sloan	None	1	RM	0.5	0	N	0	M	1		S	1	2.5	0		
27	Upper Neskowin	Sloan	N	0.1	V	0	0	N	0	M	1		S	1	2	0		
28	Upper Neskowin	No Name	12	0.25	V	0	0	N	0	M	1		NS	0	1	0	Primary	

29	Upper Neskowin	Upper Neskowin	12	0.86	RM	0.5	4	N	0	M	1		S	1	2.5	1	Primary	
30	Upper Neskowin	Upper Neskowin	1638	0.83	M	1	1	N	0	L	0		S	1	2	0		
31	Upper Neskowin	Upper Neskowin	Spur	0.23	M	1	0	N	0	L	0		S	1	2	0		
32	Upper Neskowin	Upper Neskowin	12	1.61	M	1	1	N	0	L	0		S	1	2	1	Primary	
33	Upper Neskowin	Upper Neskowin	Spurs	0.42	R	0	0	N	0	H	2		S	1	3	0		
34	Upper Neskowin	Upper Neskowin	12-127	0.5	M	1	0	N	0	M	1		S	1	3	0		
35	Upper Neskowin	Upper Neskowin	12-128	0.47	R	0	0	N	0	M	1		S	1	2	0		
36	Upper Neskowin	Upper Neskowin	12-128	0.14	M	1	0	N	0	M	1		S	1	3	0		
37	Upper Neskowin	Upper Neskowin	12-128	0.54	M	1	1	N	0	M	1		S	1	3	0		
38	Upper Neskowin	Upper Neskowin	12	0.49	V	0	0	N	0	M	1		S	1	2	0		
39	Upper Neskowin	Upper Neskowin	12	0.58	V	0	1	N	0	M	1		S	1	2	2		M,
40	Upper Neskowin	Upper Neskowin	12-130	0.39	V	0	1	N	0	M	1		S	1	2	0		
41	Upper Neskowin	Upper Neskowin	12-130	0.29	R	0	0	N	0	M	1		S	1	2	0		
42	Upper Neskowin	Upper Neskowin	Section 9	0.32	RM	0.5	1	N	0	M	1		S	1	2.5	0		
43	Upper Neskowin	Upper Neskowin	Section 9	0.34	R	0	0	N	0	H	2		S	1	3	0		
44	Upper Neskowin	Kingston	12-132	0.99	M	1	0	N	0	M	1		S	1	3	1		
45	Upper Neskowin	Upper Neskowin	Section 16	0.44	M	1	0	N	0	M	1		S	1	3	0		M
46	Upper Neskowin	Kingston	12	1.03	M	1	0	N	0	M	1		S	1	3	1	Primary	M
47	Upper Neskowin	Kingston	Section 15	1.1	M	1	0	N	0	M	1		S	1	3	5		
48	Upper Neskowin	Kingston	1861-118	0.5	M	1	0	N	0	M	1		S	1	3	0		
49	Upper Neskowin	Neskowin	1861-117	0.56	M	1	0	N	0	M	1		S	1	3	1		
50	Upper Neskowin	Upper Neskowin	1861-117	0.38	R	0	0	N	0	M	1		S	1	2	0		
51	Upper Neskowin	Upper Neskowin	1861-117	0.19	V	0	0	N	0	H	2		S	1	3	0		
52	Upper Neskowin	Upper Neskowin	1861-115	0.91	RM	0.5	0	N	0	M	1		S	1	2.5	0		
53	Cliff	Cliff	1861-122	0.98	M	1	1	N	0	L	0		S	1	2	0	Secondary	
54	Cliff	Cliff	1861-122	0.14	R	0	0	N	0	M	1		S	1	2	0	Secondary	
55	Cliff	Cliff	1861-122	0.5	M	1	0	N	0	L	0		NS	0	1	0	Secondary	
56	Cliff	Cliff	1861	0.79	R	0	0	N	0	L	0		S	1	1	0	Primary	
57	Cliff	Cliff	1861	1.49	RM	0.5	0	N	0	L	0		S	1	1.5	0	Primary	
58	Cliff	Cliff	1861-125	0.23	M	1	0	N	0	L	0		S	1	2	0	Primary	
59	Lower Salmon	Crowley	1861	0.65	RM	0.5	0	Y	1	M	1		S	1	3.5	0	Primary	
60	Lower Neskowin	Lower Neskowin	1861-121	0.34	M	1	0	N	0	L	0	1993	S	1	2	0		

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61	Lower Salmon	Crowley/Teal	Section 14	0.58	RM	0.5	0	N	0	L	0	S	1	1.5	0		
62	Lower Salmon	Crowley	Section 13	0.5	M	1	1	N	0	L	0	S	1	2	0		
63	Lower Salmon	Crowley	Section 13	0.32	V	0	1	N	0	L	0	S	1	1	0		
64	Lower Salmon	Crowley	Section 13	0.6	M	1	0	N	0	L	0	S	1	2	0		
65	Lower Salmon	Crowley	Section 13	0.3	M	1	0	N	0	L	0	S	1	2	0		
66	Lower Salmon	Crowley	Section 13	0.32	V	0	0	N	0	L	0	S	1	1	0		
67	Salmon Creek	Calkins	1861	1.21	RM	0.5	0	Y	1	M	1	S	1	3.5	0	Primary	
68	Salmon Creek	Salmon	1861	0.52	M	1	0	N	0	M	1	S	1	3	0		
69	Lower Salmon	Lower Salmon	Section 18	0.79	V	0	2	N	0	M	1	S	1	2	0	Primary	
70	Lower Salmon	Lower Salmon	Section 18	0.14	M	1	0	N	0	M	1	S	1	3	0		
71	Lower Salmon	Lower Salmon	Section 18	0.35	M	1	1	N	0	M	1	S	1	3	0		
72	Lower Salmon	Lower Salmon	Section 18	1.04	M	1	1	N	0	M	1	S	1	3	0		
73	Salmon Creek	Salmon	1861	0.52	M	1	0	N	0	H	2	S	1	4	0		
74	Salmon Creek	Salmon	1861	1.12	R	0	0	N	0	M	1	S	1	2	0		
75	Salmon Creek	Salmon	1861-119	0.2	M	1	0	N	0	M	1	S	1	3	0		
76	Salmon Creek	Salmon	Section 17	0.66	M	1	3	N	0	H	2	S	1	4	0		
77	Salmon Creek	Salmon	1861-120	1.07	M	1	0	N	0	M	1	S	1	3	0		
78	Salmon Creek	Salmon	1861-120	0.17	R	0	0	N	0	M	1	S	1	2	0		
79	Salmon Creek	Salmon	1861-120	0.65	M	1	0	N	0	M	1	S	1	3	1		
80	Salmon Creek	Salmon	1861	0.44	M	1	0	N	0	L	0	S	1	2	0		
81	Salmon Creek	Salmon	1861-103	0.63	V	0	0	N	0	H	2	S	1	3	0		
82	Deer	Deer	1861	0.83	R	0	0	N	0	L	0	S	1	1	0	Secondary	
83	Deer	Toketa	1861	0.87	RM	0.5	0	N	0	M	1	S	1	2.5	0	Secondary	
84	Deer	Deer	12	1.63	M	1	0	N	0	M	1	S	1	3	3	Primary	M
85	Deer	Deer	12	0.71	R	0	0	N	0	M	1	S	1	2	0		M
86	Deer	Deer	12	1.26	V	0	0	N	0	H	2	S	1	3	2	Primary	
87	Deer	Deer	12-136	0.23	M	1	0	Y	1	H	2	S	1	5	0		
88	Lower Salmon	Lower Salmon	Section 25	0.31	V	0	0	N	0	H	2	S	1	3	0		
89	Lower Salmon	Lower Salmon	Section 25	0.38	V	0	2	N	0	M	1	S	1	2	0		
90	Deer	Toketa	1888	1.2	RM	0.5	0	N	0	M	1	S	1	2.5	0		M
91	Deer	Toketa	1888-110	0.34	R	0	0	N	0	M	1	NS	0	1	0		M
92	Panther1	N. Fork Panther	1888-111	1.23	M	1	0	N	0	M	1	S	1	3	0		
93	Deer	Gardiner	1888	0.55	RM	0.5	0	N	0	H	2	S	1	3.5	0		

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94	Deer	Gardiner	1888-117	0.5	R	0	0	N	0	M	1		NS	0	1	0		
95	Deer	Section 28	1888-115	0.29	RM	0.5	0	N	0	M	1		NS	0	1.5	0		
96	Deer	Section 28	1888	1	RM	0.5	0	N	0	M	1		S	1	2.5	0		
97	Deer	Curl	1861-112	0.88	R	0	0	N	0	M	1		S	1	2	0		
98	Widow	W. Fork Salmon	1861-115	0.64	M	1	0	N	0	M	1		S	1	3	0		M
99	Widow	W. Fork Salmon	1861-116	0.2	M	1	0	N	0	M	1		S	1	3	0		
100	Widow	W. Fork Salmon	1861-116	0.41	M	1	0	N	0	H	2		S	1	4	0		M
101	Widow	W. Fork Salmon	1861-114	0.44	RM	0.5	0	N	0	M	1		S	1	2.5	0		
102	Panther1	N. Fork Panther	1861-113	0.44	M	1	0	N	0	L	0		S	1	2	0	Secondary	
103	Widow	W. Fork Salmon	1861-114	0.21	M	1	0	N	0	H	2		S	1	4	0		
104	Widow	W. Fork Salmon	1861-114	0.52	R	0	0	Y	1	M	1	1996	S	1	3	0		M
105	Panther1	N. Fork Panther	1861	1.06	RM	0.5	0	N	0	M	1		S	1	2.5	0	Secondary	
106	Panther1	N. Fork Panther	1861-112	0.77	R	0	0	N	0	L	0		NS	0	0	0		
107	Panther1	N. Fork Panther	1861-111	0.36	R	0	0	N	0	M	1		NS	0	1	0		
108	Panther1	Panther1	1861	0.42	M	0	0	Y	1	M	1		S	1	3	0	Secondary	
109	Panther1	Panther1	1861	0.08	R	1	0	N	0	M	1		S	1	3	0		
110	Widow	Widow	1863-111	1.13	RM	0.5	0	N	0	L	0		NS	0	0.5	0		
111	Widow	Widow	1863-112	0.05	R	0	0	N	0	L	0		S	1	1	0		
112	Panther1	Panther1	1861	0.31	RM	0.5	0	N	0	L	0		NS	0	0.5	0		
113	Middle Salmon	Willis	Section 5	0.14	M	1	0	N	0	M	1		S	1	3	0		
114	Middle Salmon	Willis	129	0.48	M	1	0	N	0	L	0		NS	0	1	0		
115	Middle Salmon	Willis	129	0.43	RM	0.5	1	N	0	L	0		S	1	1.5	0		M
116	Middle Salmon	Willis	1729	0.28	RM	0.5	0	N	0	M	1		S	1	2.5	0		
117	Middle Salmon	Willis	1729	0.31	RM	0.5	0	N	0	L	0	1972	S	1	1.5	0		
118	Middle Salmon	Willis	129-112	0.91	R	0	0	N	0	L	0		S	1	1	0		
119	Middle Salmon	Willis	129	1.17	M	1	0	N	0	M	1	1996	S	1	3	0		
120	Bear2	Morton	129-Spur	0.33	M	1	0	N	0	L	0		NS	0	1	0		M
121	Bear2	Morton	129-Spur	0.25	M	1	0	N	0	L	0		S	1	2	0		M
122	Bear2	Bear2	129-111	0.22	R	0	0	N	0	L	0		NS	0	0	0		
123	Bear2	Morton	Section 4	1.25	M	1	0	N	0	M	1		S	1	3	1		M
124	Bear2	Morton	1726	0.92	R	0	0	N	0	M	1		S	1	2	0		M
125	Bear2	Morton	1726	0.34	M	1	0	Y	1	M	1		S	1	4	0		

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126	Bear2	Bear2	1726	1.03	M	1	2	N	0	M	1		S	1	3	0	
127	Bear2	Southmon	1780	1.28	M	1	4	Y	1	M	1	1993, 1996	S	1	4	0	
128	Bear2	Southmon	1726-112	1.38	R	0	0	N	0	M	1		S	1	2	0	
129	Bear2	Gallow/Bear	1781	1.29	RM	0.5	0	Y	1	L	0	1996	S	1	2.5	0	M
130	Bear2	Gallow/Bear	1781-Spur	0.36	M	1	0	N	0	M	1		S	1	3	0	
131	Bear2	Tarry	1781-115	0.32	M	1	0	N	0	H	2		NS	0	3	0	
132	Bear2	Gallow	1781-116	0.41	RM	0.5	0	N	0	L	0		S	1	1.5	0	
133	Bear2	Bear2	1781	0.62	M	1	1	N	0	M	1		S	1	3	0	
134	Bear2	McMullen	1781-111	0.49	R	0	0	N	0	M	1		NS	0	1	0	
135	Bear2	McMullen	1781-111	0.89	RM	0.5	0	Y	1	M	1	1996	S	1	3.5	0	
136	Bear2	Bear2	121	1.08	R	0	0	N	0	M	1		NS	0	1	0	
137	Bear2	McMullen	121	0.84	RM	0.5	0	N	0	M	1		S	1	2.5	0	
138	Trout	Trout	121-125	0.22	M	1	0	N	0	M	1		S	1	3	0	
139	Bear2	McMullen	121-111	0.62	RM	0.5	0	N	0	M	1		S	1	2.5	0	
140	Bear2	McMullen	121	0.28	R	0	0	N	0	M	1		S	1	2	0	
141	Trout	Trout	121-120	0.11	M	1	0	N	0	M	1		S	1	3	0	
142	Bear2	McMullen	111+Spurs	1.52	M	1	0	Y	1	H	2	1996	S	1	5	5	
143	Bear2	McMullen	112	0.31	M	1	0	N	0	M	1		NS	0	2	0	
144	Bear2	McMullen	117	0.12	M	1	0	N	0	M	1		NS	0	2	0	
145	Bear2	McMullen	118-Spur	0.36	M	1	0	N	0	M	1		NS	0	2	0	
146	Bear2	McMullen	118	0.94	M	1	0	N	0	L	0		S	1	2	0	
147	Bear2	McMullen	114	0.42	R	0	0	N	0	L	0		S	1	1	0	
149	Bear2	McMullen	118-Spur	0.35	M	1	1	N	0	L	0		S	1	2	0	
150	Trout	Trout	Section 12	0.17	M	1	0	N	0	L	0		S	1	2	0	
151	Trout	Trout	Section 18	0.38	RM	0.5	0	N	0	L	0		NS	0	0.5	0	
152	Trout	Trout	118	1.78	M	1	0	Y	1	M	1		S	1	4	0	
153	Trout	Trout	118-129/128	0.29	M	1	0	N	0	H	2		NS	0	3	0	
154	Trout	Trout	118-130	0.52	M	1	0	N	0	M	1		NS	0	2	0	
155	Trout	Trout	118-131	0.3	M	1	0	N	0	H	2		NS	0	3	0	
156	Slickrock2	Slickrock2	1802	0.3	M	1	0	N	0	M	1		S	1	3	0	
157	Treat/Alderbrook	Treat	Section 32	0.35	RM	0.5	0	N	0	L	0		NS	0	0.5	0	
158	Treat/Alderbrook	Deer	Section 33	0.43	M	1	0	Y	1	M	1	1996	S	1	4	0	

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159	Treat/Alderbrook	Deer	Section 34	0.15	RM	0.5	0	N	0	L	0	1996	S	1	1.5	0
160	Upper Salmon	Lost Prairie	Section 25	0.28	V	0	0	N	0	M	1	1996	S	1	2	0
161	Treat/Alderbrook	Deer	Section 3	0.19	M	1	0	Y	1	M	1		NS	0	3	0
162	Slickrock2	Slickrock2	Section 4	0.24	M	1	0	N	0	M	1		S	1	3	0
163	Slickrock2	Slickrock2	Section 4	0.15	M	1	0	N	0	M	1		S	1	3	0
164	Slickrock2	Slickrock2	Section 9	0.18	V	0	0	N	0	M	1		S	1	2	0
165	Slickrock2	Slickrock2	Section 9	0.25	M	1	0	N	0	M	1		S	1	3	0
166	Slickrock2	Slickrock2	Section 9	0.21	M	1	0	N	0	M	1		NS	0	2	0
167	Treat/Alderbrook	Deer	Section 33	0.16	RM	0.5	0	N	0	M	1		NS	0	1.5	0
168	Slickrock2	Slickrock2	Section 9	0.92	RM	0.5	2	N	0	M	1		S	1	2.5	0
169	Slickrock2	Slickrock2	Section 8	1.06	RM	0.5	0	N	0	M	1		S	1	2.5	0
170	Slickrock2	Slickrock2	Rocky Point	0.22	RM	0.5	0	N	0	H	2		S	1	3.5	0
171	Slickrock2	Slickrock2	Section 10	0.26	M	1	0	Y	1	M	1	1996	S	1	4	0
172	Slickrock2	Slickrock2	Section 16	0.95	RM	0.5	2	N	0	M	1		S	1	2.5	0
173	Slickrock2	Slickrock2	Section 16	0.55	R	0	0	N	0	M	1		S	1	2	0
174	Slickrock2	Slickrock2	Section 5	0.28	M	1	0	N	0	M	1		S	1	3	0
175	Salmon Creek	Salmon	Forest Ctr	0.25	V	0	2	N	0	M	0		S	1	1	0

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