Lower Alsea River Watershed Analysis

1999

Marys Peak Resource Area
Bureau of Land Management
1717 Fabry Road
Salem, OR 97306
503-375-5646

Siuslaw National Forest
4077 Research Way
P.O. Box 1148
Corvallis, OR 97339
541-750-7234

U.S. Fish & Wildlife Service
2600 S.E. 98th Ave.
Suite 100
Portland, OR 97266
503-231-6179

Team Members

Belle Verbics	**Team Lead**
Karen Bennett	**Hydrologist**
Diane Rainsford	**GIS Analyst**
Scott Hopkins	**Wildlife Biologist**
Courtney Cloyd	**Geologist**
Jack Sleeper	**Fisheries Biologist**
Carrie Phillips	**Fish&Wildlife Biologist**

Consultants

Jane Kertis	**Ecologist**
Ken McCall	**Cultural/Recreation**
Dick Bergen	**Road Engineer**
Patrick Hawe	**Hydrologist**
Diane Morris	**Silviculturist**
Ed Obermeyer	**Silviculturist**
Jack Delaini	**Editor**

John P. Bacho Date: 9-29-99
John Bacho
Marys Peak Resource Area Manager

Date: 9/27/99
Doris Tai
Waldport District Ranger

The analysis generally follows the federal guide for watershed analysis (Version 2.2, August 95) although some modifications were made such as combining chapters to reduce redundancies. This is a document which is still evolving and will be updated as new information becomes available. The data in this document were the best available; in some cases there were little relevant data available. Management opportunities for this analysis area must be considered in light of the checkerboard land ownership pattern of BLM-administered lands in the eastern portion of the watershed. Cooperative programs with adjacent ownerships are necessary to achieve optimum results in restoration opportunities for this analysis area. No warranty is made as to the accuracy, reliability or completeness of the data or maps contained herein. This document was done in cooperation with the Bureau of Land Management, U.S. Forest Service, and U.S. Fish & Wildlife Service. A first production of this document was completed in August 1999.

Table of Contents

EXECUTIVE SUMMARY

Characterization: The Analysis Area

The Lower Alsea River watershed, located in the Alsea River Basin, encompasses about 98,470 land acres of the western Oregon Coast Range mountains along the lower Alsea River in Benton and Lincoln counties (Map 1: "Alsea Basin and Lower Alsea Analysis Area"). The watershed, with State Highway 34 running through it, stretches from Waldport on the coast to the inland town of Alsea. About 14 per cent of the watershed (13,786 acres) is managed by the Bureau of Land Management (BLM) management, about 43 per cent (42,342 acres) is managed by the United States Forest Service (USFS, Siuslaw National Forest), and the remaining land is in private ownership (Map 2: "Ownerships"). The communities of Tidewater and Bayview are located within the watershed boundaries.

The uplands are primarily forested areas in federal or private industrial forest ownership. The lowlands are mainly agricultural lands — orchards and pastures — and residential homes along the Alsea River. The watershed also encompasses the Alsea Bay and its estuary component.

The *Lower Alsea River Watershed Analysis* contains information which characterizes the processes and trends for resources of concern, and provides a context relating the function of this lower portion of the watershed to the Alsea River Basin as a whole. Critical problem areas both inside and outside federal lands are highlighted, though the focus is on the uplands, with limited projection on the estuary, lowlands, private lands, and state facilities. By analyzing limiting factors and understanding likely rates of recovery, the analysis helps to strategize and prioritize activities both spatially and by project type. This first iteration provides useful information about resource conditions for USFS, BLM, and other agency managers as well as watershed councils and private individuals.

Land Uses

BLM and U.S. Forest Service

The *Salem District Resource Management Plan* (RMP; USDI Bureau of Land Management 1995) allocates BLM-administered land to specific purposes and establishes management actions and/or direction for each allocation. The RMP incorporates all of the relevant decisions made in the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (ROD; USDA Forest Service and USDI Bureau of Land Management 1994b). The ROD also provides land use allocations for the Siuslaw National Forest (USFS). The land allocations and management actions and direction in the ROD and RMP provide the basic management guidance for this watershed analysis (Map 3: “Northwest Forest Plan Allocations”).

- **Late-Successional Reserves (LSR)**

  This land use allocation, in combination with some others, will maintain a functional, interactive late-successional and old-growth forest ecosystem. LSRs are designed to serve as habitat for late-successional and old-growth related species, including the northern spotted owl.

- **Riparian Reserves (RR)**

  Riparian Reserves are areas along all streams, wetlands, ponds, lakes, and unstable or potentially unstable areas where the conservation of aquatic and riparian-dependent terrestrial resources receive primary emphasis. The main purpose of the reserves is to protect the health of the aquatic system and its dependent species. The reserves also provide incidental benefits to upland species.

- **Matrix**

  These are federal lands outside of other land use allocations. Most timber harvest will occur on matrix lands, with provisions to ensure some habitat retention for ecological functions.

Climate and Geology

- The highest point in the analysis area is Grass Mountain, with an elevation of approximately 1,100 feet. The lowest elevation is the Alsea Bay, at sea level.
- Rainfall varies from about 60 - 80 inches on the coast to about 70 - 110 inches at higher elevations in the watershed.
- About 46% of the precipitation occurs during the months of November through January.
- Temperature ranges at the coast and inland are similar during the winter months, but average summer temperatures are higher farther inland.
- The majority of the area is underlain by sandstone and siltstone of the Tyee formation. In the western portion of the watershed, the underlying geology changes to include Yachats basalts south of the Alsea River (Map 4: “Lithology”).
- The watershed generally has a low landslide susceptibility rating (Map 5: “Landslide Risk”).

Forest Fragmentation

- The watershed was subject to large scale, infrequent fire in approximately 1850. (Map 6: "Fire History").

- Historically, the Lower Alsea landscape pattern consisted of large patches of single seral stages over most of the area (Map 7: "Historic Vegetation" [see also "Potential Veg."]).

- Currently, mid-seral stands occupy the highest percentage (32%) of the landscape. Landscape patterns are fragmented across the watershed (Map 8: "Lower Alsea Analysis Area Current Vegetation") and the Alsea Basin as a whole (Map 9: "Alsea Basin Current Vegetation").

- Major tree species include Douglas-fir and western hemlock, with Sitka spruce along the coast, and noble fir at higher elevations.

- Approximately 11.4% of the watershed provides interior forest habitat.

- Three federally listed wildlife species (bald eagle, northern spotted owl, and marbled murrelet) are known to occupy the watershed. Other Special Status and Special Attention species are present or suspected based on the presence of suitable habitat.

- No federally listed plants are presently known in the watershed. Special Attention plant species known to occur include thirteen fungi and three lichens.

Aquatic Habitat

Hydrology

- The Lower Alsea watershed covers the lower mainstem of the Alsea River and twenty subwatersheds (Map 10: "Subwatersheds").

- The Alsea River is listed in the Department of Environmental Quality's 1998 303(d) report (Oregon Department of Environmental Quality 1998) as water quality limited for temperature from the mouth to the confluence of the North and South Forks as well as to the headwaters of the North Fork. Fall Creek is also listed as water quality limited for temperature from the mouth to the headwaters.

- There are over 250 water users within the boundaries of the Lower Alsea, and several municipal water rights are held by the City of Waldport.

- More water is allocated than is available during the months of August, September and

October.

- C Beneficial uses include irrigation, livestock watering, drinking water, domestic use (ground-water and surface), fisheries and aquatic life, and recreation.

- The biggest change in the mainstem channel function is disconnection with the flood plain.

- The estuary has experienced numerous alterations that have affected the amount and distribution of habitat as well as the functions of those habitats.

Riparian

- Large conifers in riparian areas are more abundant in the western portion of the watershed than in the eastern portion (Map 11: "Riparian Canopy Species"). The high proportion of meadows, residential lawns, and hardwoods point to a lack of large wood recruitment for streams in the next several decades.

- Canopy closure varies across the watershed. Lack of tall conifers reduces stream shade, particularly along depositional reaches (Map 12: "Riparian Canopy Cover").

Fish

- C Salmonid stocks present in the Lower Alsea are fall and spring Chinook, chum, and coho salmon, winter steelhead, and resident and searun cutthroat. Coho salmon are listed as a threatened species under the Endangered Species Act.

- C Pools are moderately abundant, but deep pools are uncommon.

- Most streams have a low amount of large wood.

Human Uses

Transportation

- C For the watershed as a whole, the existing road density is approximately 4.2 miles of road per square mile of land.
- The highest percentage of roads are located on mid-slope positions.

Recreation

- There are five day-use and campground areas, and five public boat launches along the Lower Alsea. There are no developed hiking trails.

- Hunting and fishing are key recreation activities.

FINDINGS AND RECOMMENDATIONS: SUMMARY

The full Lower Alsea Watershed Analysis identifies issues and key questions, evaluates reference and current conditions, and addresses findings and recommendations (which meet management objectives outlined in the agencies' resource plans) and/or opportunities (these "opportunities for cooperative efforts" are areas where public agencies and private landowners may work together to achieve shared goals). The table which follows summarizes those issues, recommendations and opportunities.

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (p. 86)			

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.)			

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.) **Aquatic Habitat: Hydrology (p. 87)**			

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.)	habitat by wildlife. The watershed		
Aquatic Habitat: Hydrology (p. 87)	1) Corridors of late-seral habitat are evident when viewed from the landscape perspective.		

Issue	Findings	Recommendations	Oppo
Aquatic Habitat: Forest Fragmentation (cont.)	habitat by wildlife. The watershed		
Aquatic Habitat: Hydrology (p. 87)	2) Road density affects use of		

Issue	Findings	Recommendations	Oppo
Aquatic Habitat:	habitat by wildlife. The watershed averages 4.2 miles of road per square mile.		
	1) Water quantity is over-allocated 2) High temperatures limit water quality in many streams and are too high for optimum salmonid production.		

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.)	habitat by wildlife. The watershed averages 4.2 miles of road per square mile.	create new and enlarge exist- • Promote late-seral development within identified connectivity corridors as displayed on Map 29. C North of the Alsea R. are Contiguous Large Mature Cells as identified in the LSRA. These cells are high priority for treat-ment if needed. Key recom-mendations: limit entries; treat an entire block at once; and close roads as soon as possible to allow recovery to proceed unhindered. C South of the Alsea R. are Mixed Seral Cells as identified in the LSRA. These are high priority for treatment if needed. Key recommendations: grow out from adjacent late-successional habitat; and	
Aquatic Habitat: Hydrology (p. 87)	1) Water quantity is over-allocated 2) High temperatures limit water quality in many streams and are too high for optimum salmonid production. 2) Road density affects use of		

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.)	habitat by wildlife. The watershed averages 4.2 miles of road per square mile.	create new and enlarge existing small patches.	
Aquatic Habitat: Hydrology (p. 87)	1) Water quantity is over-allocated 2) High temperatures limit water quality in many streams and are too high for optimum salmonid production.	• Treatment priority is moderate for the Early Seral Connectivity Cells. Key recommendations: same as those for the Mixed Seral Cells. • Treatment priority for Early Seral Corridor and Early Seral Buffer Cells is moderate-low. Key recommendations: use low risk silvicultural treatments around existing threatened and endangered species; focus on treating unsuitable habitat for restoration. • Implement early silvicultural treatments across the landscape based on criteria in Appendix 8. • Implement road management	

Issue	Findings	Recommendations	Oppo
Aquatic Habitat:		systems to reduce or eliminate miles of open road.	
		(None identified) • Manage riparian zones using a variety of methods, including planting conifers, to provide more shade and reduce water temperatures. • Provide in-stream large wood structure to reconnect flood-plains.	

Issue	Findings	Recommendations	Oppo
Aquatic Habitat: **Estuary (p. 91)**			

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.) / **Aquatic Habitat (p. 81)**	habitat by wildlife. The watershed averages 4.2 miles of road per square mile.	create new and enlarge existing small patches. / systems to reduce or eliminate miles of open road.	Forks Alsea (None identifie
Aquatic Habitat: Hydrology (p. 87)	1) Water quantity is over-allocated 2) High temperatures limit water quality in many streams and are too high for optimum salmonid production. 2) Road density affects use of	(None identified) C Treatment priority is moderate for the Early Seral Connectivity Cells. Key recommendations: same as those for the Mixed Seral Cells. C Treatment priority for Early Seral Corridor and Early Seral Buffer Cells is moderate-low. Key recommendations: use low risk silvicultural treatments around existing stands; create and enlarge openings; focus on conifers, to provide habitat for restoration. • Manage riparian zones using a variety of methods, including planting conifers, to provide shade and reduce water temperatures. C Implement early silvicultural treatments across the landscape based on criteria in Appendix 8. • Provide stream large wood structure to reconnect floodplains. • Implement road management	

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.)	habitat by wildlife. The watershed averages 4.2 miles of road per square mile.	systems to reduce or eliminate miles of open road.	Forks Alsea
Aquatic Habitat: Hydrology (p. 87)	1) Water quantity is over-allocated	(None identified)	
	2) High temperatures limit water quality in many streams and are too high for optimum salmonid production.	• Manage riparian zones using a variety of methods, including planting conifers, to provide more shade and reduce water temperatures. • Provide in-stream large wood structure to reconnect floodplains.	(None identifie

Issue	Findings	Recommendations	Oppo
Aquatic Habitat: **Estuary (p. 91)**			Forks Alsea
			• Determine i are not bein be sold or l • Improve eff bution of wa • Acquire in- rights for tri • Focus on A ity Areas ar meadows th wide native on each side channel and • Establish co wide chann shade, esp. mainstem, N

List of Tables

List of Tables (cont.)

List of Figures

List of Maps

List of Maps (cont.)

Chapter 1 - Characterization

The Analysis Area

The Lower Alsea River watershed, located in the Alsea River Basin, encompasses about 98,470 land acres of the western Oregon Coast Range mountains along the lower Alsea River in Benton and Lincoln counties (Map 1: "Alsea Basin and Lower Alsea Analysis Area"). The watershed, with State Highway 34 running through it, stretches from Waldport on the coast to the inland town of Alsea. About 14 per cent of the watershed (13,786 acres) is managed by the Bureau of Land Management (BLM) management, about 43 per cent (42,342 acres) is under United States Forest Service (USFS, Siuslaw National Forest) management, and the remaining land is in private ownership (Map 2: "Ownerships"). The communities of Tidewater and Bayview are located within the watershed boundaries.

The uplands are primarily forested areas in federal or private industrial forest ownership. The lowlands are mainly agricultural lands — orchards and pastures — and residential homes along the Alsea River. The watershed also encompasses the Alsea Bay and its estuary component.

This *Lower Alsea River Watershed Analysis* contains information which characterizes the processes and trends for resources of concern, and provides a context relating the function of this lower portion of the watershed to the Alsea Basin as a whole. Critical problem areas both inside and outside federal lands are highlighted, though the focus is on the uplands, with limited projection on the estuary, lowlands, private lands, and state facilities. By analyzing limiting factors and understanding likely rates of recovery, the analysis helps to strategize and prioritize activities both spatially and by project type. This first iteration provides useful information about resource conditions for USFS, BLM, and other agency managers as well as watershed councils and private individuals.

Land Uses

BLM and U.S. Forest Service

The *Salem District Resource Management Plan* (RMP; USDI Bureau of Land Management 1995) allocates BLM-administered land to specific purposes and establishes management actions and/or direction for each allocation. The RMP incorporates all of the relevant decisions made in the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl* (ROD; USDA Forest Service and USDI Bureau of Land Management 1994b). The ROD also provides land use allocations for the Siuslaw National Forest (USFS). The land allocations and management actions and direction in the ROD and RMP provide the basic management guidance for this watershed analysis (Map 3: "Northwest Forest Plan Allocations").

- **Late-Successional Reserves (LSR)**

  This land use allocation, in combination with some others, will maintain a functional, interactive late-successional and old-growth forest ecosystem. LSRs are designed to serve as habitat for late-successional and old-growth related species, including the northern spotted owl.

- **Riparian Reserves (RR)**

  Riparian Reserves are areas along all streams, wetlands, ponds, lakes, and unstable or potentially unstable areas where the conservation of aquatic and riparian-dependent terrestrial resources receive primary emphasis. The main purpose of the reserves is to protect the health of the aquatic system and its dependent species. The reserves also provide incidental benefits to upland species.

- **Matrix**

  These are federal lands outside of other land use allocations. Most timber harvest will occur on matrix lands, with provisions to ensure some habitat retention for ecological functions.

TABLE 1-1: LAND USE ALLOCATION AND OWNERSHIP

Land Use Allocation	BLM	USFS	Private Industrial Forest	Other Private	State	Estuary
LSR (%)	91	77.5	NA	NA	NA	NA
RR in Matrix (%)	8	20	NA	NA	NA	NA
Matrix Outside RR (%)	1	2.5	NA	NA	NA	NA
Total Acres	12,975	41,590	21,511	20,005	239	2,150
Per Cent Ownership	14	43	21	19	0.25	2

Climate and Geology

C The highest point in the analysis area is Grass Mountain, with an elevation of approximately 1,100 feet. The lowest elevation is the Alsea Bay, at sea level.

C Rainfall varies from about 60 - 80 inches on the coast to about 70 - 110 inches at higher elevations in the watershed.

C About 46% of the precipitation occurs during the months of November through January.

C Temperature ranges at the coast and inland are similar during the winter months, but average summer temperatures are higher farther inland.

C The majority of the area is underlain by sandstone and siltstone of the Tyee formation. In the western portion of the watershed, the underlying geology changes to include Yachats basalts south of the Alsea River (Map 4: "Lithology").

C The watershed generally has a low landslide susceptibility rating (Map 5: "Landslide Risk").

Forest Fragmentation

C The watershed was subject to large scale, infrequent fire in approximately 1850. (Map 6: "Fire History").

C Historically, the Lower Alsea landscape pattern consisted of large patches of single seral stages over most of the area (Map 7: "Historic Vegetation" [see also "Potential Vegetation"]).

- Currently, mid-seral stands occupy the highest percentage (32%) of the landscape. Landscape patterns are fragmented across the watershed (Map 8: "Lower Alsea Analysis Area Current Vegetation") and the Alsea Basin as a whole (Map 9: "Alsea Basin Current Vegetation").

C Major tree species include Douglas-fir and western hemlock, with Sitka spruce along the coast, and noble fir at higher elevations.

- Approximately 11.4% of the watershed provides interior forest habitat.

- Three federally listed wildlife species (bald eagle, northern spotted owl, and marbled murrelet) are known to occupy the watershed. Other Special Status and Special Attention species are present or suspected based on the presence of suitable habitat.

C No federally listed plants are presently known in the watershed. Special Attention plant species known to occur include thirteen fungi and three lichens.

Aquatic Habitat

Hydrology

- The Lower Alsea watershed covers the lower mainstem of the Alsea River and twenty sub-watersheds (Map 10: "Subwatersheds").

- The Alsea River is listed in the Department of Environmental Quality's 1998 303(d) report (Oregon Department of Environmental Quality 1998) as water quality limited for temperature from the mouth to the confluence of the North and South Forks as well as to the headwaters of the North Fork. Fall Creek is also listed as water quality limited for temperature from the mouth to the headwaters.

- There are over 250 water users within the boundaries of the Lower Alsea, and several municipal water rights are held by the City of Waldport.

- More water is allocated than is available during the months of August, September and October.

- Beneficial uses include irrigation, livestock watering, drinking water, domestic use (groundwater and surface), fisheries and aquatic life, and recreation.

- The biggest change in the mainstem channel function is disconnection with the flood plain.

- The estuary has experienced numerous alterations that have affected the amount and distribution of habitat as well as the functions of those habitats.

Riparian

- Large conifers in riparian areas are more abundant in the western portion of the watershed than in the eastern portion (Map 11: "Riparian Canopy Species"). The high proportion of meadows, residential lawns, and hardwoods point to a lack of large wood recruitment for streams in the next several decades.

- Canopy closure varies across the watershed. Lack of tall conifers reduces stream shade, particularly along depositional reaches (Map 12: "Riparian Canopy Cover").

Fish

- Salmonid stocks present in the Lower Alsea are fall and spring Chinook, chum, and coho salmon, winter steelhead, and resident and searun cutthroat. Coho salmon are listed as a threatened species under the Endangered Species Act.

- Pools are moderately abundant, but deep pools are uncommon.

- Most streams have a low amount of large wood.

Human Uses

Transportation

- For the watershed as a whole, the existing road density is approximately 4.2 miles of road per square mile of land.

- The highest percentage of roads are located on mid-slope positions.

Recreation

- There are five day-use and campground areas, and five public boat launches along the Lower Alsea. There are no developed hiking trails.

- Hunting and fishing are key recreation activities.

Visual Resource Management (VRM [BLM lands only])

- VRM class designations (Map 13: "Visual Resources Management Classes")

Class	Acreage	Management Objective
VRM class I	649 acres	Preserve the existing character of landscapes
VRM class II	1,133 acres	Retain the existing character of landscapes
VRM class III	448 acres	Partially retain the existing character of landscapes
VRM class IV	10,671 acres	Allow major modifications of existing character of landscapes

Chapter 2 - Issues and Key Questions

Introduction

This chapter identifies the specific issues that are relevant to the Lower Alsea River watershed. These issues were used to develop key questions which focused the analysis on particular types and locations of cause-and-effect relationships, and discerned conditions as they relate to values, uses and key ecosystem components and processes of the watershed.

A variety of sources provided insight into the values and uses which led to the issues for this watershed analysis. They include recent analysis documents such as the "Northwest Forest Plan" (NFP; USDA Forest Service and USDI Bureau of Land Management 1994a) on a regional level, the *Salem District Record of Decision and Resource Management Plan* (RMP; USDI Bureau of Land Management 1995) and the *Siuslaw National Forest Land and Resource Management Plan* (USDA Forest Service 1990) on a management area level, and the Oregon Department of Fish and Wildlife's *Alsea River Basin Fish Management Plan* (1997). Interactions with the Alsea Watershed Planning Team, landowners, other interested individuals and groups, and discussions with county, state and federal resource specialists also helped to identify issues and key questions.

Forest Fragmentation

Issues

Ecological succession coupled with human-caused and natural disturbances have created a mosaic of vegetation types which are quite different from vegetation patterns of the past. Although vegetation patterns are never static, the rate and intensity with which these patterns change can be greatly affected by management activities and human pressures. The issue of fragmentation across the forest landscape is important in the context of the Late-Successional Reserves system.

Key Questions

- What are the natural disturbance regimes, and how have they changed?

- What are the historic and current landscape patterns with regard to structural composition, patch shape and size, species composition, and successional pathways? What role does this watershed play currently (and in the future) with respect to the larger late-successional reserve system?

- What are the current amount and condition of special habitats within the watershed?
- What are the natural and human causes of change between historical and current species dis-

tribution and habitat quality for special status and special attention species, and species for which there are social goals?

- What are the current conditions and trends of special status/special attention plant species in the watershed?

- What and where are the opportunities to manage vegetation in order to maintain or enhance desired future conditions?

Aquatic Habitat

Issues

The Lower Alsea River is directly influenced by major tributaries that flow into the mainstem river. The apex of hydrological cumulative effects directly affecting aquatic species is the Alsea Bay and estuary. Modifications of hillslopes and riparian areas due to road construction and har-vest may have altered the timing, duration and quantity of stream flows in the Alsea River basin. Human pressures along the mainstem river and manipulations around the bay have influenced these ecosystems.

Key Questions

- What are the disturbance processes, and how do they affect aquatic habitat?

- What are the reference and current geomorphic characteristics of stream systems?

- What beneficial uses occur within the watershed? Which water quality parameters (e.g., pH, dissolved oxygen) are critical to these uses?

- What are the reference and current conditions of aquatic habitat relating to riparian areas and in-stream channel components?

- How does the aquatic habitat in the Lower Alsea watershed fit within the context of the entire Alsea Basin?

- What are the reference and current estuary conditions?

- What are the opportunities to maintain and restore aquatic habitat and processes?

- What are the opportunities to affect estuary conditions and functions?

Fish Populations

Issues

Anadromous fish (coho, Chinook, steelhead, cutthroat) use the Lower Alsea River and associated tributaries. Habitat for fish and other aquatic species has been degraded. Habitat problems include the lack of large woody debris, quality pools, complex system of side channels, and substrate diversity. Coho salmon were listed as a threatened species by the National Marine Fisheries Service.

Key Questions

- What are the reference and current relative abundance and distribution of resident and anadromous fish species in the watershed?
- What influence have hatchery fish had on wild fish populations and their genetic composition?
- What management opportunities are available to maintain or restore Alsea fish populations?

Human Uses

Issues

Land use and population pressures, such as housing and transportation development, commodity extraction, and recreation trends, have affected both terrestrial and aquatic resources. Social and economic parameters, along with biophysical elements, shape forest management activities within the legal framework of laws and statutes.

Key Questions

- What are the historical and current patterns of forest product extraction, transportation, and major recreation uses within the watershed?
- Does the current road system meet projected future needs for forest management activities, access, recreation, and forest product extraction?
- What are the opportunities to manage the road system to improve fish, wildlife and water quality?
- What are the opportunities to address recreation issues in the watershed?

Chapter 3: Reference and Current Conditions

This section describes reference and current conditions within the watershed related to the issues identified in Chapter 2. The purpose is to identify the dominant physical, biological and human components and processes that affect ecosystem functions or conditions. The description includes the current ranges, distributions, conditions and trends of various resources. This information base provides a better understanding about the capability of the ecosystems to achieve key management plan objectives.

FOREST FRAGMENTATION: Reference Conditions

Natural Disturbance Processes

Fire and wind are the dominant disturbance processes affecting vegetation pattern, composition and structure (see *Late-Successional Reserve Assessment: Oregon Coast Province - Southern Portion* [LSRA; USDA Forest Service 1997b], pp. 13 and 14, for general description). A majority of the watershed burned in the Yaquina Fire, circa 1849 (Map 6: "Fire History"). This fire burned approximately 800,000 acres between the Siuslaw and Siletz watersheds, while missing portions of the Mill, Skunk and Burch Creek subwatersheds. Stand replacement fire intensities occurred throughout much of the Yaquina Fire's boundaries, but undoubtedly unburned islands and patches of less severe burns occurred. A reburn in Bayview and a burn in the Burch and upper Risley subwatersheds happened between 1850 and 1890. A reburn in Burch and Salmonberry subwatersheds, and an initial burn in the Mill Creek subwatershed occurred between 1890 and 1920. (Teensma et al. 1991)

Disturbance Regime

Agee (1991) describes this area in general as having a low frequency (greater than 200 years), high severity regime. Impara (1998) found coastal and interior areas dominated by a single or two age classes, with fire intervals ranging from 200 to 300 years.

Vegetation

Landscape Pattern

Vegetation pattern is affected by disturbance processes and the distribution of plant species and successional pathways found across the landscape. Fire and wind are responsible for the resultant vegetation pattern at the landscape scale (see Table 3-1, "Disturbance and Vegetation Patterns"). Fire regime information and fire history indicate that the Lower Alsea landscape pattern consisted of large patches of single seral stages over most of the area. Within the Sitka spruce zone and upper reaches of the watershed, the patterns are more variable.

For several thousand years, the western hemlock/Douglas-fir forests of the Coast Range have been dynamically responding to both large-scale and localized disturbance events. The condition of the vegetation occupying the landscape at any one time could therefore be quite variable. The enormous acreages affected by major fire events in the Coast Range could far surpass the size of any single watershed. Considering this, it is easy to conclude that forest conditions within any watershed could naturally have ranged from completely burned over to completely covered in mature and old-growth forests (i.e., conifer dominated stands over 80 years old, collectively referred to as "late seral"). We know from reconstruction of historic forest inventory records (Teensma et al. 1991), forest vegetation potential (Franklin and Dyrness 1973), and fire return intervals (Agee 1993) that on average, mature and old-growth forests occupied 60% to 80% of the Coast Range landscape. Ripple (1994) estimated that 61% of the Coast Range was occupied by late seral forests prior to 1840. In contrast, perhaps 20% to 40% of the Coast Range was typically in early seral conditions, resulting from recent fires or localized disturbances.

A vegetation map of 1955, made from county-wide surveys (Map 7: "Historic Vegetation"), displays landscape patterns prior to major commercial logging. Mapping resolution and units are unknown for this coverage, and it does not completely cover the Lower Alsea area; therefore, descriptions and comparisons are general in nature. Key points about this pattern include:

- 60% of the watershed was classified as mature conifer (includes unclassified areas in calculations so percentage is a minimum);
- 75% of mature conifers were distributed in giant patches (>100,000 acres) that extended outside of the watershed boundary; this was most likely the result of the Yaquina Fire of 1849; and
- the remaining areas are a mix of large to small patches located in the eastern end of the watershed (see patch sizes descriptions in Table 3-1, "Disturbance and Vegetation Patterns").

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (p. 86)			

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.)			

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.) **Aquatic Habitat: Hydrology (p. 87)**			

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.)	habitat by wildlife. The watershed		
	1) Corridors of late-seral habitat are evident when viewed from the landscape perspective.		
Aquatic Habitat: Hydrology (p. 87)			

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.)	habitat by wildlife. The watershed		
Aquatic Habitat: Hydrology (p. 87)	2) Road density affects use of		

Issue	Findings	Recommendations	Oppo
Aquatic Habitat:	habitat by wildlife. The watershed averages 4.2 miles of road per square mile.		
	1) Water quantity is over-allocated 2) High temperatures limit water quality in many streams and are too high for optimum salmonid production.		

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.) / **Aquatic Habitat**	habitat by wildlife. The watershed averages 4.2 miles of road per square mile.	create new and enlarge exist- / systems to reduce or eliminate • Promote late-seral development within identified connectivity corridors as displayed on Map 29. C North of the Alsea R. are Contiguous Large Mature Cells as identified in the LSRA. These cells are high priority for treat-ment if needed. Key recom-mendations: limit entries; treat an entire block at once; and close roads as soon as possible to allow recovery to proceed unhindered. C South of the Alsea R. are Mixed Seral Cells as identified in the LSRA. These are high priority for treatment if needed. Key recommendations: grow out from adjacent late-successional habitat; and	
Aquatic Habitat: Hydrology (p. 87)	1) Water quantity is over-allocated 2) High temperatures limit water quality in many streams and are too high for optimum salmonid production. 2) Road density affects use of		

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.)	habitat by wildlife. The watershed averages 4.2 miles of road per square mile.	create new and enlarge existing small patches.	
Aquatic Habitat: Hydrology (p. 87)	1) Water quantity is over-allocated 2) High temperatures limit water quality in many streams and are too high for optimum salmonid production.	C Treatment priority is moderate for the Early Seral Connectivity Cells. Key recommendations: same as those for the Mixed Seral Cells. C Treatment priority for Early Seral Corridor and Early Seral Buffer Cells is moderate-low. Key recommendations: use low risk silvicultural treatments around existing threatened and endangered species; focus on treating unsuitable habitat for restoration. C Implement early silvicultural treatments across the landscape based on criteria in Appendix 8. • Implement road management	

Issue	Findings	Recommendations	Oppo
Aquatic Habitat:		systems to reduce or eliminate miles of open road.	
		(None identified) • Manage riparian zones using a variety of methods, including planting conifers, to provide more shade and reduce water temperatures. • Provide in-stream large wood structure to reconnect flood-plains.	

Issue	Findings	Recommendations	Oppo
Aquatic Habitat: **Estuary (p. 91)**			

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.)	habitat by wildlife. The watershed averages 4.2 miles of road per square mile.	systems to reduce or eliminate miles of open road. / create new and enlarge existing small patches.	Forks Alsea (None identifie
Aquatic Habitat: Hydrology (p. 87)	1) Water quantity is over-allocated 2) High temperatures limit water quality in many streams and are too high for optimum salmonid production. 2) Road density affects use of	(None identified) C Treatment priority is moderate for the Early Seral Connectivity Cells. Key recommendations: same as those for the Mixed Seral Cells. C Treatment priority for Early Seral Corridor and Early Seral Buffer Cells is moderate-low. Key recommendations: use low risk silvicultural treat- • Manage riparian zones using a variety of methods, including planting conifers, to provide more shade and reduce water temperatures. C Implement early silvicultural treatments across the land- • Provide instream large wood structures to reconnect floodplains. • Implement road management	

Issue	Findings	Recommendations	Oppo
Forest Fragmentation (cont.)	habitat by wildlife. The watershed averages 4.2 miles of road per square mile.	systems to reduce or eliminate miles of open road.	Forks Alsea
Aquatic Habitat: Hydrology (p. 87)	1) Water quantity is over-allocated	(None identified)	
	2) High temperatures limit water quality in many streams and are too high for optimum salmonid production.	• Manage riparian zones using a variety of methods, including planting conifers, to provide more shade and reduce water temperatures. • Provide in-stream large wood structure to reconnect floodplains.	(None identifie

Issue	Findings	Recommendations	Opp
Aquatic Habitat: Estuary (p. 91)			Forks Alsea
			• Determine i are not bein be sold or l • Improve eff bution of w • Acquire in- rights for tri • Focus on A ity Areas ar meadows th wide native on each sid channel and • Establish co wide chann shade, esp. mainstem, N

Species Composition

The local vegetation environment is captured in the types and distributions of plant series. Plant series were described by Hemstrom and Logan (1986) and modeled by McCain (in progress) for the Lower Alsea watershed as follows:

- Sitka spruce (wet coastal, most productive) - 17% of watershed
- Western hemlock (range of conditions, inland) - 80%
- Noble fir (high elevation) - 1%
- Other (unknown) - 2%

Plant association groups (PAGs) identify a finer scale of variability in the kinds of environments as well as potential plant communities across the watershed (Map 14: "Potential Natural Vegetation"). The vegetative environment is linked to site productivity, dominant species (conifer, hardwood), and successional pathways. PAGs can assist in predicting future vegetation composition, structure and pattern, as well as serve as guides to treatment prescriptions (see USDA Forest Service 1997b).

Table 3-2 ("Plant Series by Environment") presents the major plant series and per cent area occupied, by environment:

TABLE 3-2: PLANT SERIES BY ENVIRONMENT

	Environment (percentage of occupied area)		
Plant Series	**Wet**	**Moist**	**Dry**
Sitka spruce	13	3	1
Western hemlock	26	41	13

In summary:

- Sitka spruce types are distributed close to the coastal strip and extend inland along major drainage bottoms.
- Western hemlock wet types are often associated with lower slopes and in riparian areas. Moving eastward through the watershed, the wet types become more restricted to narrow bands along the channel bottoms; this is most evident in the northeastern portion of the watershed.
- Western hemlock moist and dry types display the opposite trend, becoming more dominant moving eastward through the watershed. Moist types are associated with mid-slope, well drained conditions. Dry types are associated with upper slope and ridgetop conditions.

Successional Pathways

The LSRA for the Oregon Coast Province, southern portion (USDA Forest Service 1997b, pp. 48-52), contains conceptual models for stand development for each environment and disturbance regime. Key points on dominant pathways include:

- Western hemlock wet environments: after disturbance, regeneration of conifers is sporadic due to high competition of salmonberry and red alder. Two dominant successional pathways are:

  - Pure red alder in wettest areas succeeding to western hemlock/western red cedar with no disturbance. Often these areas are located on flood plains where disturbance will keep them in pure alder condition indefinitely.
  - Scattered Douglas-fir mixed with red alder and big-leaf maple in early seral stages, succeeding to a low density of very large Douglas-fir with mixed amounts of western hemlock/western red cedar in the lower layers.

- Western hemlock moist environments: after disturbance, regeneration of conifers is common at various densities. Two dominant successional pathways are:

  - Pure Douglas-fir stands develop over time, with mixed amounts of shade-tolerant species present. These are relatively homogeneous stands.
  - Red alder and Douglas-fir initial stand develops over time into a multi-layered stand with western hemlock and western red cedar in the lower layers. A good example of this can be seen at Sudan and Mill creeks, where large Douglas-firs occupy the highest layer, many of these being remnants of the previous disturbance. Western hemlock and scattered western red cedar are co-dominants.

- Western hemlock dry environments: droughty conditions occur here. Fires may burn hotter, providing a good seedbed for Douglas-fir regeneration. There is a single successional pathway:

  - Pure Douglas-fir stands develop over time; these may be dense and homogeneous. Shade-tolerant species of various densities occur in the lower layers in late seral conditions.

- Sitka spruce types were not described in the LSRA (USDA Forest Service 1997b) but follow path-ways similar to the western hemlock types. Sitka spruce and western hemlock are more common in all environments in this zone.

See Appendix 1 ("Successional Pathways") for additional information.

Wildlife

Response to Disturbance Regimes

The vegetation that defines a watershed is also most responsible for defining the wildlife species that can be found in that watershed. Each vegetation community and its stand characteristics create distinct environmental conditions that fulfill the habitat requirements of certain wildlife species. Based on an understanding of the reference conditions for vegetation, assumptions can be made about the existence and prominence of various wildlife species and their populations.

Historical accounts of the earliest explorers and settlers shed some light on the more notable species. For instance, the journals of David Douglas reveal that grizzly bears, Columbian white-tailed deer, and California condors were occasionally encountered in the Willamette Valley and central Oregon Coast Range. These species have since become extinct or extirpated from this area. There is also evidence that the Alsea Valley supported stable herds of elk and deer which attracted Native Americans and early settlers. Species, historical presence, and population fluctuations must be inferred based on the spatial and temporal scales of vegetation patterns.

At the scale of the Coast Range Province, it is likely that when major disturbances occurred, such as the Yaquina Fire, the remaining patches of late seral vegetation would function as refugia for those species which are closely associated with such habitat. In contrast, species associated with early successional stages would have flourished for a time immediately following such a disturbance. With the fire-return interval of 200 to 300 years, the vegetation between the unburned patches would have ample time to recover, and those species associated with late-seral conditions would then be able to disperse out of the refugia and repopulate the recovered forest. The populations of wildlife species associated with late-seral forest and species associated with early-seral conditions would alternately have ebbed and flowed as the seral stages naturally shifted in response to succession and disturbance.

Even when late-seral forests dominated a watershed, it is likely that other seral stages would still be present at some level within the watershed or in adjacent watersheds. Therefore, a variety of wildlife species associated with other seral stages and special habitats would also likely be present in the watershed. At the province scale, the most prominent and longest lasting habitat available to wildlife species through time was likely late-seral forest, due to the long duration of this stage and the long fire-return interval. Thus, it is logical to expect that the Coast Range would support a stable and diverse assemblage of late-seral associated species.

Large-scale fire disturbance processes would affect the forests at variable intensities, leaving large amounts of down wood and standing snags across the landscape. The more frequent small-scale disturbances (localized blowdown, landslides, insect kills, and disease pockets) would leave canopy gaps within the recovering forest patches. These processes, along with individual site conditions (microclimate, elevation, slope aspect), would contribute to the development of several important structural features for wildlife, such as down wood, standing snags, and multiple canopy layers which include a highly diverse shrub and herbaceous layer in canopy gaps. The presence of these structural features is important to many animals by providing resting and nesting sites, protection from predators, food, and thermal protection. Down wood is also a critical component for many species of vascular plants, liverworts, mosses, fungi, and lichens which provide food for certain wildlife species.

While the diversity of wildlife species and their populations have likely fluctuated over the past several thousand years, there existed certain patterns which favored some species more than others. The response of wildlife species to these processes and resultant patterns would be quite variable. The larger vertebrates and most bird species are usually excellent dispersers, enabling them to repopulate distant forest patches following disturbances, or conversely, allowing them to use widely separated early-seral patches as natural succession moves the landscape toward late-seral conditions. For smaller vertebrates and some invertebrates (e.g., flightless insects and mollusks), adequate corridors of suitable habitat are necessary to allow for dispersal from one suitable patch to another.

As noted above, species adapted to late-seral forest conditions would have likely enjoyed the most often abundant and longest lasting of the available habitats. The populations of early-seral and edge-contrast (e.g., early-seral adjacent to late-seral habitat) species would have gone from "boom to bust" relatively quickly as early-seral habitats usually developed into subsequent seral stages within a few decades following a major disturbance. Species adapted to unique habitats, especially the higher elevation habitats, have likely been steadily declining through time due to natural successional processes. Some invertebrates in these areas have long since been separated from the populations of the Cascades and Rocky Mountains and have become relict populations, even evolving into distinct species from their now distant relatives.

Response to Landscape Patterns

The major issue concerning wildlife habitat at the regional scale is the depletion of mature and old-growth forests (i.e., conifer dominated stands $80 years old, collectively referred to as “late-seral”) that has occurred across the entire Coast Range Province. This concern has been the main focus of several scientific assessments and planning documents for this region (see Thomas et al. 1990, Johnson et al. 1991, Noss 1993, Thomas et al. 1993, USDI-BLM 1995 [Salem District RMP], USDA-FS and USDI-BLM 1994a [Northwest Forest Plan], and USDA Forest Service 1997b [LSR Assessment]). Forest management during the past century, and particularly within the last few decades, has been focused on harvesting older forests first in an attempt to attain a regulated forest with an equal distribution of all age classes within a rotation schedule of 80 years or less. This direction, along with ever changing approaches to size and spacing of harvest units, has had the effect of greatly depleting and fragmenting the late-seral habitat. Within this watershed, these activities have reduced the connectivity of late-seral habitat. The pertinent ecological and biological processes related to wildlife habitat within this watershed have also been discussed thoroughly at the regional scale in the above mentioned documents and have been outlined in the discussion of reference conditions.

Harvesting patterns, road building, and large fires of the mid-1800s have produced a mosaic of small patches of late-seral forest scattered across the watershed, mostly on federal lands. Where late-seral forest patches are surrounded by contrasting habitats (e.g., recent clearcuts, young stands), the edges of the older forest patch usually exhibit environmental conditions that are markedly different from the interior of the late-seral patch. In addition to creating differences in microclimate (e.g., humidity, temperature regime, light penetration) between the edge and the interior of a patch, edge habitats often have a greater diversity of competitor species and predators than the interior of a patch. It is reasonable to expect that as the distances between late-seral forest patches increases, and the propor-tion of edge to interior habitat increases, animals that are strongly associated with older forest habi-tats will be adversely affected.

There is no consensus on how far "edge effects" from open and young stands extend into a late-seral patch. Edge effects may be perceived very differently, depending on the species under consider-ation. In this analysis, an attempt was made to model edge effects on late-seral with the following constraints: 1) high contrast habitats were assumed to produce edge effects extending 400 feet into adjacent older stands; 2) moderate contrast habitats (e.g., mid-seral conifers and mature hardwoods) were modeled with a 200-foot edge effect; and 3) in some cases, very small moderate contrast patches were modeled to have no edge effect on late-seral habitat, especially when these patches were small (< 3 acres), narrow, and totally enclosed by late-seral.

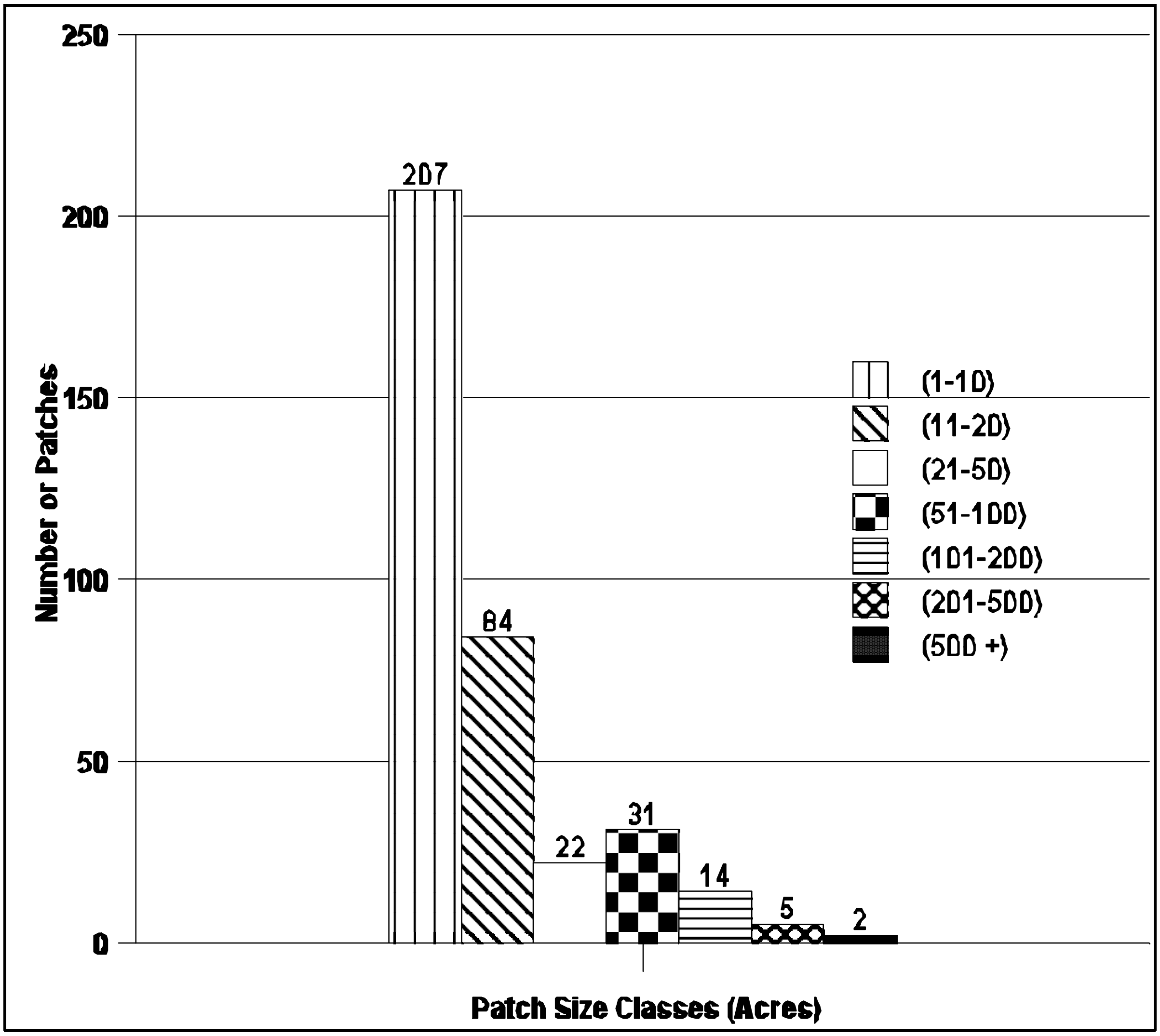


Figure 3-1: Current Condition of Interior Forest Patches

While 28,145 acres of late-seral habitat exists in the watershed (about 29.1% of the watershed), only 11,011 acres of this habitat (about 11.4% of the watershed) is considered to have interior forest conditions. This points to the moderately fragmented nature of late-seral forests in this watershed, which is further illustrated in Figure 3-1 ("Current Condition of Interior Forest Patches," above; see also Map 15: "Interior Forest").

Response to Species Composition: Special Habitats

Special habitats such as caves, cliffs, talus, exposed rock, dry meadows, and wetlands are important to wildlife. Indeed, the presence of some wildlife species is dependent upon the existence and extent of such habitats. Natural processes slowly reduce these habitats through time, moving them ecologically in the direction of the adjacent plant communities; yet other natural processes such as fire, disease, wind, and geomorphic events can produce and help maintain these habitats.

There has been no systematic inventory of special habitats (caves, cliffs, talus, exposed rock, dry meadows, and wetlands) within this watershed; caves, cliffs, and talus slopes are likely to be absent from it. However, meadow habitat (i.e., grassy balds, old homesteads) may be locally important, supporting a unique variety of wildlife species within a mostly forested environment. Within this watershed, there is likely to be a great variety of wetland habitats such as seeps, springs, ponds, marshes, and swampy areas adjacent to low gradient streams.

Stretches of low gradient streams often have beaver activity which creates ponds and wetlands that benefit a wide range of wildlife species (primarily amphibians, small mammals, and some invertebrates) as well as anadromous fish. Unfortunately, there were little data on the current status of beavers across the watershed; thus, it is unknown if beaver populations are occupying all of the available suitable habitat within this watershed. Anecdotal information by local communities indicates that beaver activity in this area has always been low. With little information on the abundance of special habitats in this watershed, this important component of biodiversity remains unknown.

Response to Successional Pathways: Structural Components

The structural features available within a given seral stage patch often determine whether certain wildlife species are able to utilize that habitat. The quality of wildlife habitat often depends on more than just the quantity of various seral stages. Natural ecological processes (e.g., fire, windstorms, disease) have tended to build structural features into forest stands; past management regimes have generally reduced these features, precluding the processes which naturally create them. Prioritizing harvest of oldest stands first, mortality salvage programs, snag hazard contracts, and thinning prescriptions that eliminate suppressed trees and minor species are all examples of a past management paradigm that greatly reduced structural diversity and species composition in Coast Range forests. While recent harvest technologies have reduced ground disturbance impacts, these same efficiencies, as well as market considerations, have tended to leave fewer snags and less coarse woody debris on harvest units.

The structural components of forest stands of most concern in this watershed are standing snags, coarse woody debris (down logs), sub-canopy layers, and tree species diversity. Some inventory work, albeit limited, and local knowledge of this area suggest that all of these structural features currently exist at very low levels in the young forest stands (15 to 40 years old) in the watershed. Some notable exceptions to this occur in the western third of the watershed and at the higher elevations around Grass Mountain, where conifer and mixed conifer hardwood stands show considerable species diversity and subcanopy development. Some recent development of structural diversity can also be seen in aerial photo sequences (1988, 1993, 1996) where several clusters of recently dead trees (from several trees to one-half acre patches) are scattered throughout the mature forest stands across the watershed. These small patches are likely caused by a combination of disease, insects, and moisture stress beginning in the late 1980s, and several years of below average rainfall. Also of note are a few scattered snag patches around the edges of past harvest units which have resulted from escaped prescribed burns.

FOREST FRAGMENTATION: Current Conditions

Vegetation

Landscape Patterns

Late-seral forest occupies 29% of the watershed, but there are no giant patches (patches within the watershed extending beyond watershed boundaries). Most of the late-seral is distributed in medium-sized patches approximately 100-1,000 acres in size (55% of the landscape), with patches of less than 100 acres occupying 19% of the landscape.

Multi-layered stands occupy 1% of the current landscape. Sixty-five per cent of the multi-layered acres occur in medium-sized patches of 100-1,000 acres; the other 35% are found in small patches of less than 100 acres.

TABLE 3-3: SERAL STAGE DISTRIBUTION

Seral Stage	Acres	Per Cent of Total
Grass/Forb	3,825	4
Early Seral	10,040	10
Sub-total Early Seral:	13,865	14
Conifer Pole	7,571	8
Mixed Pole	2,315	2
Old Plantations	18,970	19
Mid-Aged Conifer	2,059	2
Mid-Aged Conifer Mix	820	1
Sub-total Mid-Seral:	31,735	32
Mature Conifer	17,966	18
Mature Conifer Mix	9,865	10
Late, Multi-Layered	1,089	1
Sub-total Late Seral:	28,920	29
Pure Hardwood	6,404	6
Hardwood/Conifer	18,107	18
Grand* Totals:	**99,031**	**100**

* The "Acres" total includes the three sub-totals plus the "Pure Hardwood" and "Hardwood/Conifer" figures.
Note: See also Appendix 2 ("Seral Class Definitions").

Link to Late-Successional Reserve Assessment (1997b)

Landscape Zones and Landscape Cells are described in the LSRA (USDA Forest Service 1997b), pp. 29 - 33. The following points relate to the LSRA's descriptions:

- Approximately 60% of the watershed is in the Core Zone, providing current and future genetic sources for populations of late-successional species and communities.
- Approximately 35% of the watershed is in the Corridor Zone, providing key connectivity with the LSR network, and potential refugia for late-successional species and communities.
- Approximately 5% of the watershed is in the Buffer Zone, providing connectivity within the Late-Successional Reserve (LSR).
- About 25% of the watershed is in Contiguous Large Mature Cells containing over 40% of late-successional habitat currently. These cells are the foundation for recovery of late-successional species and habitat.
- About 25% of the watershed is in Mixed Seral Cells that are currently between 25 and 40% late-successional habitat.
- About 20% of the watershed is in Early Seral Connectivity Cells whose function is to link existing large contiguous mature patches.
- Early Seral Corridor and Early Seral Buffer Cells comprise the rest (about 30%) of the watershed and will function to maintain dispersal habitat.

Stand Conditions

Managed stands are shown on Map 16, "Managed Stands." Stand structure, composition, and coarse woody debris (CWD) strategies are all contained within the LSRA (USDA Forest Service 1997b) and should be adhered to. Stand treatments follow the successional pathways, and ranges of tree densities, and CWD were derived from models, literature, and current vegetation survey data. The LSRA (USDA Forest Service 1997b), lists treatment triggers and appropriate activities (Table 7, p. 42) that will be followed.

Species Composition

Dominant tree species composition and structure were determined using aerial photography interpretation. The distribution of dominant tree species is influenced by the biological environment and disturbance frequency and type. Some general observations include the following:

- Sitka spruce and western hemlock are common dominants in the western portion of the watershed within the Sitka spruce zone. Douglas-fir is common in younger managed stands.
- Douglas-fir became the dominant species over most of the remaining watershed area. The Yaquina Fire of 1849 may have provided seedbeds and seed sources favorable to the establishment of Douglas-fir.
- Western hemlock is scattered across the landscape. Again, the Yaquina Fire probably provided seed source, with variable fire severity patterns or remnant pockets left undisturbed by the fire.

Successional Pathways

Biological environments are responsible for species composition and structure. An overlay of the plant association groups (biological environment) with the current vegetation shows the following (see also Appendix 3, "Plant Association Group Overlay with Current Vegetation"):

- A higher percentage of stands (approximately 90% in Sitka spruce and 70% in western hemlock) in the wet environments in both zones had less than 60% conifer crown closure than did the moist (sword fern), which in turn had a higher percentage than did the dry (salal) environments.
- The percentage of canopy that is conifer showed similar trends. The wet types had the lowest percentage of canopy in conifer and the highest percentage in hardwoods, with over half of the stands in the spruce zone with more hardwood than conifer cover.

Forest Health

Swiss needle cast: The fungus (*Phaeocryptopus gaeumannii*) which causes this disease occurs throughout the range of Douglas-fir. Historically, the disease has not caused appreciable damage, and until recently, was thought to be unimportant. 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).

The disease has been most widespread in the coastal fog zone; most of the discoloration associated with Swiss needle cast has occurred within 15 miles of the coast. Trees with symptoms of the disease have increasingly been observed farther inland. Stand exams have shown infections in the Canal, Darkey, and Risley creek drainages (Map 17: "Swiss Needle Cast Infestation Severity").

Although Swiss needle cast rarely causes mortality, it does reduce tree growth. If sustained, Swiss needle cast infections may reduce opportunities to manipulate stands into desired structures and compositions. Because Swiss needle cast causes a reduction in foliage, it decreases crown closure in severely affected stands. Also, because it is an airborne disease, thinning may not be a viable treatment option in these stands.

Laminated Root Rot: The fungus (*Phellinus weirii*) which causes this disease exists in the watershed but is not a significant problem.

Sitka Spruce Tip Weevil: This insect (*Pissodes strobi*) is present and will continue to be present in the spruce zone. The weevil generally affects spruce trees under 50 feet tall and 8 to 30 years old. Planting spruce under the canopy or in known fog areas can sometimes lessen the damage.

Bark Beetles: These insects are often associated with root disease, blowdown events, and other large-scale disturbances that weaken trees. The creation of downed wood as part of the late-successional management strategy has raised concerns about increasing beetle-caused mortality (USDA

Forest Service 1997b, p. 23). Concentrations of down wood may allow beetle populations to expand beyond current endemic levels.

Bears: Damage has been noted in Risley, Upper Scott, and Fall creek drainages. Damage tends to occur in stands thinned in the past.

Special Status Species: Wildlife and Botany

Wildlife Species of Concern

Wildlife species of concern within this watershed include:

Special Status Species - sensitive species identified by Forest Service and BLM policies, including those listed under the Endangered Species Act
Special Attention Species - recognized in the Northwest Forest Plan as Survey and Manage [SM] and Protection Buffer [PB] species
Species of Local Interest - locally important species related to social, economic, or cultural issues

The *Atlas of Oregon Wildlife* (Csuti et al. 1997) and the *Oregon Wildlife Diversity Plan, 1993-1998* (ODFW 1993) include a complete list of (mostly) vertebrate wildlife species that are likely to occur in various habitats of the Oregon Coast Range. The publication *Rare, Threatened and Endangered Plants and Animals of Oregon* (ONHP 1998) has lists of plants and wildlife species (including fish and invertebrates) that are declining or at risk of decline. Appendices C, D, and E of the *Late-Succes-sional Reserve Assessment - Oregon Coast Province* (USDA Forest Service 1997b) has lists of species associated with older forests, extirpated species, and special status species (including plants). Addi-tionally, both the Forest Service and BLM maintain lists of special status and special attention species which are updated periodically as warranted by new information.

The management direction outlined in the Northwest Forest Plan is specifically intended to benefit a great diversity of wildlife species, especially those associated with older forests, such as the bald eagle, marbled murrelet, and the northern spotted owl. By addressing broad issues concerning wild-life habitat, it is believed that the overall diversity of wildlife species across the Coast Range and within this watershed will be maintained. Indeed, for all species of concern, it is assumed that their population size and distribution will be benefitted or limited by the amount and trend in their pre-ferred habitat.

Species discussed in this analysis met all of the following criteria: (1) their current geographic range includes all or part of the watershed (excluding extirpated species); (2) the watershed has the poten-tial to provide enough suitable nesting and/or foraging habitat to sustain viable populations or con-tribute to their recovery; and (3) they are known to occur, or else sufficient information exists on life history and preferred nesting and foraging habitats to suspect their presence. Therefore, this analysis excludes some species of concern within the Coast Range Province. Refer to agency lists or the documents described above for more information on species not listed here.

TABLE 3-4: SPECIAL STATUS SPECIES

Common Name (*Scientific name*)	Status	Trend	Notes
Bald eagle (*Haliaeetus leucocephalus*)	T/S/FL/3/D	S	Populations increasing in Oregon; species has been petitioned for de-listing.
Northern spotted owl (*Strix occidentalis caurina*)	T/S/FL/1/D	I	Should benefit from in-growth of habitat on federal lands; dispersal on private land is a concern.
Marbled murrelet (*Brachyramphus marmoratus*)	T/S/FL/2/D	U	Should benefit from in-growth of federal habitat, but conditions at sea will complicate recovery.
White-footed vole (*Arborimus albipes*)	S/S/BA/3/D	I	Should benefit from in-growth of habitat in riparian zones on federal lands; dispersal is a concern.
Northwestern pond turtle (*Clemmys marmorata*)	S/S/BA/2/S	U	Potential habitats (slow streams, large ponds and wetlands) are mainly on private lands.
Red-legged frog (*Rana aurora*)	S/S/BA/4/D	I	Habitat recovery expected; other factors besides habitat may be affecting species.
Alsea micro caddisfly (*Ochrotrichia alsea*)	S/S/BT/3/S	U	Aquatic invertebrate known from Alsea Basin, but little known of life history requirements.
Oregon giant earthworm (*Driloleirus macelfreshi*)	S/-/BS/1/S	I	Less ground disturbance on federal lands should benefit species.
Roth's blind ground beetle (*Pterostichus rothi*)	S/-/BS/1/D	S	Documented on Grass Mtn ACEC.; rare endemic in Coast Range; little known of life history.

Status (Fed/FS/BLM/ONHP/Presence): **Fed**= federal status (S=species of concern, T=threatened); **FS**=Forest Service status (S= sensitive); **BLM**=BLM status (FL=Federally Listed, BS=sensitive, BA=assessment, BT=tracking); **ONHP**=Oregon Natural Heritage Program (see ONHP 1998); **Presence**= presence in watershed (D= documented S=suspected)
Trend: Assuming implementation of NFP over next 5 decades (I=improve, S=stable, U=unknown)

Bald eagles have nested in at least four locations adjacent to the Alsea Bay estuary since the late 1970s. Both nesting and non-nesting eagles are likely to use the estuary and larger tributaries year-round while foraging for their prey, mostly fish. As of 1998, there was one active eagle nest on private land adjacent to the estuary. Bald eagles have also been regularly observed in Fall Creek near the fish hatchery during the breeding season. Limited nest searching and a few attempts to follow these eagles has failed to turn up a nesting pair in this upriver location. Suitable nesting habitat for these species includes late-seral forest stands and individual large trees, usually within a mile of the estuary and larger tributaries.

Northern spotted owls are known to nest in at least eight sites on federal lands within this watershed. There has been consistent monitoring of occupation and reproduction at these sites since 1990. These sites show relatively low reproduction, averaging about one young produced every fourth year. This watershed lies in a zone of transition from larger clusters of owl sites (having larger patches of habitat) to the south, and smaller dispersed clusters of owl sites (with greatly dispersed habitat patches) to the north. For this reason, maintaining suitable habitat for nesting owls and maintaining dispersal habitat (i.e., conifer dominant stands greater than 35 years old) across the watershed should benefit owls within this watershed and adjacent watersheds.

Critical habitat for the spotted owl was designated on federal lands in 1991. There are about 34,290 acres of critical habitat for this species within this watershed. The LSR land use allocation on federal lands covers more total area (44,130 acres) than critical habitat and includes the majority of the critical habitat. It is likely that in-growth of conifer forest stands within the LSR allocation will enhance the condition of critical habitat in the future.

Marbled murrelets are known to occupy several of the late-seral forest patches on federal land, especially those patches having remnant old-growth trees. Intensive surveys for these species were conducted on Forest Service and BLM lands from 1990 to 1993. About one-third of the federal lands in the watershed were surveyed for murrelets during this time period. Suitable habitat in several locations was found to be occupied, and it is likely that additional late-seral forest stands may be occupied by this species. More recent survey efforts (i.e., past five years) at occupied sites within this basin suggest a decreasing trend in murrelet detection rates which may indicate a declining breeding population. However, a clear relationship between survey detections and breeding population has not been established.

Eighty-one per cent of the federal land within this watershed (all of the LSR allocation, about 44,130 acres) was designated as critical habitat in 1996. Much of the suitable habitat (late-seral) lying within critical habitat units exists as small patches with adjacent high contrast edges (i.e., grass-forb, early seral, pole stands). These patches are vulnerable to windthrow and likely have higher predation rates due to avian predators. This vulnerability may be of greatest concern along edges adjacent to private lands where rotation ages on private forests tend to perpetuate high contrast edge conditions. Overall trends for this species are difficult to predict due to low population numbers and complicated conditions of the near-shore ocean environment (foraging habitat).

White-footed voles are known to occur adjacent to this watershed, along the South Fork Alsea River. This species has most often been found along small streams with dominant red alder stands and is usually associated with heavy cover, such as down logs with dense shrubs. This species is among the rarest mammals in the Pacific Northwest, having been collected from only a few sites. Connectivity of riparian hardwood stands and the conditions of coarse woody debris within riparian areas may currently be limiting factors for white-footed voles in this watershed. Forest management activities that affect conditions of late-successional forest, riparian forests, or coarse woody debris will have a high potential for impacting this small mammal.

The **northwestern pond turtle** is a rare species that prefers the habitat of marshes, lakes, ponds, and slow flowing rivers and creeks. It uses terrestrial habitats for nesting, overwintering, and dispersal. This species is sensitive to loss of habitat and human disturbance. Additionally, the recruitment of young turtles into the population may be limited by introduced predators such as the largemouth bass and bullfrog. Low gradient reaches of the mainstem Alsea, as well as the larger tributaries, may provide suitable habitat for this species.

The **red-legged frog** is known to occur within the watershed. This frog is more often found in larger streams and wetlands. Conditions of upland habitats are important for this species, as they move through the terrestrial ecosystem when dispersing. Regionally, the populations of this species are believed to be declining due to loss of riparian habitat and loss of key components from the terrestrial system (e.g., large late-seral patches, coarse woody debris). Within this watershed, extensive logging activity in the past few decades likely affected populations of this species by fragmenting them into smaller localized areas.

The **Alsea micro caddisfly** is an obscure aquatic invertebrate that is known to occur within the mainstem of the Alsea River. In reconsideration of this species' taxonomy, some experts believe it should be lumped with another, more widely distributed species.

Very little is known about invertebrates in the forested ecosystems of the Oregon Coast Range. The **Oregon giant earthworm** is likely to occur in stable older soils in this part of the Range. No agency surveys or locations of this species are known for this watershed. The **Roth's blind ground beetle** is known to occur at only four sites; three are immediately adjacent to this watershed. All of these sites are within late-seral forests, usually at higher elevations such as Grass Mountain.

<u>TABLE 3-5: SPECIAL ATTENTION SPECIES</u>

Common Name (*Scientific name*)	Status	Trend	Notes
American marten (*Martes americana*)	RR	U	Recent records from adjacent watersheds suggest presence; prefers large patches of late-seral forest
Red tree vole (*Arborimus longicaudus*)	SM-2	I	Late-seral forest associated species; prominent prey item for spotted owls
Roosting bats (four species)	RB	I	Associated with late-seral forests and riparian areas; protection of known roost sites required
Oregon megomphix snail (*Megomphix Hemphilli*)	SM-2	U	Rare snail; little known about life history and habitat needs; also BLM BS (sensitive) status
Blue-gray tail-dropper slug (*Prophysaon coeruleum*)	SM-2	U	Uncommon slug of moist conifer forests; little known about life history requirements
Papillose tail-dropper slug (*Prophysaon dubium*)	SM-2	U	Rare siugl of moist conifer forests; little known about life history requirements
Status: RR=Riparian Reserve Assessment species, SM-2= Survey & Manage Category 2, RB=roosting bat sites identified in NFP for protection. **Trend**: Assuming implementation of NFP over next 5 decades (I=improve, S=stable, U=unknown).			

The **American marten** is a medium-sized member of the weasel family that feeds mostly on squirrels and other small mammals. This species is more abundant in higher elevations of the Cascade Range, with only a few sightings within the Oregon Coast Range. Key habitat features for this species are large downed logs, large patches of late-seral forest, and forested riparian zones. Martens are known to preferentially select resting sites in large diameter trees near streams. In-growth of late-seral forest, managing for large coarse woody debris, and maintaining forested riparian corridors should benefit this species.

The **red tree vole** is a small, nocturnal mouse that feeds primarily on Douglas-fir needles. This species is almost entirely arboreal, spending most of its life in the forest canopy, moving from tree to tree through the canopy. The main predators on this species are probably spotted owls, other owl species, raccoons, martens, and fishers. Red tree voles have been captured in all forest seral stages, but appear to be most abundant in late-seral conifer forests. They have been known to cross small forest roads, forest gaps, and small streams when moving between nest sites, but in general this species is believed to have rather limited dispersal abilities across the landscape. For this reason, the major threat to this species is thought to be geographic isolation of populations. In-growth of conifer forest habitat within the LSR allocation is expected to benefit this species in the long-term.

Several **roosting bats**, including the **long-eared myotis**, **long-legged myotis**, **Yuma myotis**, **fringe-tailed bat**, and **silver-haired bat** are all likely to occur in late-seral forest within the watershed. Structural features of the older forest stands, including large snags, tree deformities, prominent flaking bark, and thick foliage, are known to provide suitable roosting sites for some of these species.

These bats may forage over a variety of forest stands. Riparian areas with adjacent late-seral habitat may be particularly important, since insect swarms associated with a nearby water source can provide good foraging habitat in close proximity to roosting sites. There are few known site locations and very little survey information for these species within this watershed. Considering the association of these species with late-seral forests, snags, and riparian areas, it is likely these species are very sensitive to forest management practices.

There is a reasonable likelihood that the three **mollusk species of concern** occur in this watershed. These species are most often found in moist forest conditions associated with down logs, riparian habitat, and remnant old-growth patches. The dispersal potential for these species can be severely affected by the high degree of fragmentation of late-seral forests. As of October 1, 1998, all ground disturbing activities (e.g., road building, timber harvest) implemented on Forest Service and BLM lands within this watershed must be surveyed for these species. As the agencies learn more about the abundance and distribution of these species, management options will likely gain more flexibility.

TABLE 3-6: SPECIES OF LOCAL INTEREST

Common name	Status	Trend	Notes
Roosevelt elk	game	up	Local displacement likely, long-term trend unknown
Black-tail deer	game	up	Local displacement likely, long-term trend unknown
Black bear	game	up	Local displacement likely, long-term trend unknown
Cougar	game	up	Likely to follow trends with deer and elk
Beaver	furbearer	unknown	Localized distribution, long-term trend unknown
Neotropical migratory birds	MBTA	mixed	Mature hardwood forests may be locally important

Status: game=regulated game species, furbearer=regulated furbearer, MTBA=protection afforded by Migratory Bird Treaty Act. **Trend**: Assuming implementation of NFP over next 5 decades (up=upward trend evident, mixed=trends complicated by upward and downward factors, U=unknown).

Roosevelt elk and **black-tailed deer** populations appear to be increasing within the watershed. Complaints about damage to agricultural crops and young plantations also appear to be on the rise for both of these species. Elk damage is locally a concern along the Highway 34 corridor. There is also concern that current management direction, which emphasizes older forest conditions on federal lands, will further reduce available forage for deer and elk, thereby increasing damage complaints on private lands in this watershed.

Excluding the open agricultural areas of the Highway 34 corridor, about 10% (10,150 acres) of the watershed is currently in potential forage habitat for deer and elk (i.e., recent clearcuts, grass/forb, shrub/sapling stage). This level of forage habitat is below the 20% recommended by ODFW (1990). Thermal cover comprises 68% of the watershed and is defined as those forest stands greater than 50 years old and less than 130 years old. Optimal thermal cover, which is defined as $130 years old, is extremely scarce (only 1%) in this watershed and lies almost entirely on Forest Service and BLM lands. The quality of elk habitat is also influenced by its exposure to human disturbance. Elk that use habitats within areas of high road density are more vulnerable to harassment and poaching. As new harvest units are created (mostly on private lands) and older harvest units mature, deer and elk distribution is expected to shift across the watershed.

Black bears and **cougars** are game species known to occur within this watershed. Damage complaints concerning bears have markedly decreased in the past few years in both Benton and Lincoln Counties. Since Ballot Measure 18 was passed by Oregon voters in 1994 restricting certain hunting practices for both bear and cougar, there has been a concern that hunting pressure will not be adequate to prevent damage complaints from trending upward. These concerns are being addressed by state regulations that will adjust hunting fees and the length of hunting seasons for these species.

Neotropical migratory birds are most often thought of as small songbirds that breed in North America and spend the winter in Central and South America. Many of these species are believed to have declined due to changes in forest habitats that have occurred on both their breeding and wintering grounds. While these bird species occupy a diverse array of breeding habitats, several of these species are closely associated with riparian hardwood and mixed conifer/hardwood forests. Thoughtful management of hardwood forest stands may be an important element in conserving avian diversity within this watershed.

Plant Species of Concern

Within this watershed, plant species of concern are defined as follows: listed, proposed and candidate species being reviewed under the Endangered Species Act; sensitive species identified by Forest Service and BLM policies; Survey and Manage species and Buffer Protection species identified in the Northwest Forest Plan; and uncommon and special interest plant species afforded protection under State of Oregon statutes. A review of various agency records and range maps showed that no federally listed species are presently known to occur within this watershed. The loose-flowered bluegrass (*Poa laxiflora*: FS-sensitive, BLM-tracking species) is known to occur at several sites on both Forest Service and BLM lands within the watershed. The Oregon Coast Range represents the center of distribution for this species and contains the majority of known sites. Threats to this species are now minimized on federal lands due to reduction in clearcutting of forests.

There are several lower, nonvascular plants (mosses and liverworts) and fungi (including lichens) that are designated Special Attention Species (SAS). These species are to be protected by survey and manage (S&M) or protection buffer (PB) guidelines identified in the Northwest Forest Plan (see Table C-3 in the ROD [USDA Forest Service and USDI Bureau of Land Management 1994b]). A complete understanding of their current distribution is unavailable for many of these species. Based on records from Oregon State University and BLM records, the following species are known to occur in the watershed: the fungi *Boletus piperatus, Cudonia monticola, Gastroboletus turbinatus, Gomphus clavatus, G. floccosus, Gymnomyces* sp. nov. # Trappe 47, *Leucogaster citrinus, L. microsporus, Martellia idahoensis, Phaeocollybia californica, P. fallax, P. kauffmannii,* and *Rhizopogon exiguus*, and the lichens *Lobaria oregona*, *L. pulmonaria*, and *Usnea longissima.*

The following factors have contributed to our limited knowledge about these species:

- Surveys and inventories have been limited predominantly to vascular plants.
- Sightings are few and widespread for some species, indicating large gaps in range information.
- Only the most rudimentary of ecological data are available for many species; therefore, habitat requirements are essentially unknown for most of these species.
- Sighting location information is often general, lacking specific information to permit adequate follow-up surveys.

This watershed contains a few plant species that are considered uncommon and of special interest. Some of these species are protected under the Oregon Wildflower Law (State of Oregon 1963), which makes it unlawful to export or sell or offer for sale or transport certain plant species. Some of the species likely to occur in this watershed include members of the following genera: *Calochortus*, *Calypso*, *Erythronium*, and *Rhododendron*.

Noxious Weeds

Certain invasive plant species, listed as Noxious Weeds by the Oregon Department of Agriculture (1995), are known to occur in the Lower Alsea watershed. They include Canada thistle (*Cirsium arvense*), bull thistle (*C. vulgare*), Scotch broom (*Cytisus scoparius*), St. Johnswort (*Hypericum perforatum*), and tansy ragwort (*Senecio jacobaea*).

Canada and bull thistles, St. Johnswort, and Scotch broom are well established and widespread throughout the Alsea River Basin as well as the entire Coast Range. Eradication is not practical using any proposed treatment methods; treatment emphasis is shifting toward the use of biological control agents. Populations of tansy ragwort have been partially contained as a result of biological control efforts. Populations of noxious weeds primarily occur in disturbed areas such as roads and landings.

Special Botanical Areas

Two sensitive botanical areas occur on federal lands within the Lower Alsea watershed: 1) Grass Mountain Research Natural Area (RNA) and Area of Critical Environmental Concern (ACEC); and 2) Alsea Bay Island parcel reviewed as a candidate for ACEC. The former site is located in Section 21, T. 13 S., R. 8 W., about five miles due northwest of Alsea. The latter site is in the upper estuary of Alsea Bay (opposite Eckman Slough) in Section 28 of T. 13 S., R. 11 W.

Grass Mountain: In the early days of settlement, ranchers drove their livestock to the top of Grass Mountain to graze. This practice subsequently died out, but was resumed during the years 1954 to 1974 when grazing permits were issued to a rancher. A State Forestry fire lookout tower was built on the top of Grass Mountain in the late 1930s; oblique photos taken from the lookout tower in 1934 by the U.S. Forest Service reveal that many of the nearby ridgetops were vegetated with grass. Over the years, Grass Mountain has been popular with hunters, hikers, sightseers, and picnickers; more recently, it has become popular for all-terrain vehicle use.

Grass Mountain is an excellent example of the grass bald communities typical of the Oregon Coast Range. About 20% of this ACEC is composed of eight grassy bald areas, while the remaining 80% is forested in mature noble fir and Douglas-fir stands (70 to 80 years old with some remnant old-growth trees). Two seral climax associations, the *Lomatium martindalei* and the *Elymus glaucus*, and two seral communities, *Carex rossii* and *Viola adunca*, are found on the balds. The forested areas cover all aspects at varying elevations and slopes, forming mesic habitats common in the Coast Range. The western hemlock/Douglas-fir/rhododendron/Oregon grape association is found on east-ern and southern slopes. The margins of the balds support a western hemlock/vine maple/salal asso-ciation which is currently dominated by noble fir. Noble fir also dominates the western hemlock/ salal/sword fern communities on north-facing slopes; it is near the southern limit of its distribution in the Coast Range. Vegetation management concerns include: 1) introduction of exotic plants and animals; 2) protection of the grass bald area from encroachment by adjacent forest; 3) disease or insect impacts on plant communities; and 4) human impacts on plant communities. A copy of the Grass Mountain ACEC plan is on file in the BLM's Salem District Office.

Alsea Bay Island Parcel: This 10 acre, BLM-administered parcel opposite Eckman Slough con-tains a salt marsh ecosystem which is habitat for *Stellaria humifusa*, a rare coastal marsh plant. In 1987, a BLM team of natural resource specialists reviewed and rejected this parcel for ACEC status. However, this team agreed that this parcel contains certain unique and sensitive resource values to warrant continued preservation. Legal ownership to the island has not been clearly identified (it may have been granted to the State). The parcel has received very little attention since the late 1980s, and no specific management concerns have been identified for this island parcel.

AQUATIC HABITAT: Reference Conditions

Several resource elements — climate, geology, soils, and hydrology — are linked to understanding aquatic habitat conditions.

Climate

The climate of the area is maritime, with distance from the ocean having a large effect on climatic features. Most precipitation falls from October to May. On the coast, 46% of the annual precipi-tation falls from November to January, whereas only 7% of the average annual precipitation falls in July, August and September. In summer, however, fog and drizzle along the immediate coastline cause a higher number of rainy days as compared to inland areas. Precipitation amounts increase from the beach, with 60-80 inches annually toward the crest of the Coast Range; 70-110 inches falls annually around Cannibal and Grass Mountains. Precipitation amounts decline farther inland toward the Alsea Valley. Snow is uncommon, but does occur throughout the watershed in some years. Typically, snowfall can be found November through March on the higher peaks, especially Grass Mountain, and less frequently on Cannibal Mountain.

The ocean has a dominating effect on temperature. Temperature ranges at the coast and inland are similar during the winter months, but average summer temperatures at Tidewater are 10 °F warmer than at the coast. Farther inland through the river valleys, summer temperature averages are even higher. Average annual temperatures along the coast are 44-57 °F, with an average maximum in September of 65 °F. Average annual temperatures inland at Tidewater are 43-64 °F, with an average maximum in August of 75 °F.

Winds are persistently from the north in summer and from the south, but less constant, in winter. In winter, the strongest gusts of wind are nearly always from the south to west quadrant; damaging winds are usually from large-scale winter storms. At exposed locations on the coast and on ridge-tops, wind speeds of 90-100 mph are nearly an annual occurrence.

Geology and Soils

A variety of geologic and soil resources occur within the watershed boundary (Table 3-7, "Geologic Influences on Physical Resource Components," p. 36). An understanding of the types of parent materials, climate and soils that have developed over time contributes to an understanding of physical charac-teristics such as erosion, stream geomorphology and stream flow.

Alluvial soils have formed adjacent to the mainstem of the Alsea River. There are wide bands of alluvial deposition above Missouri Bend, adjacent to Fall Creek, and around Grass Creek; these areas are mapped as the Alsea, Brenner, Knappa, Nehalem, and Nestucca soil series. These soils range from silt loams to silty clay loams, and except for Knappa soils, are subject to periodic wetness and some flooding. Some Nestucca soil variants which are excessively wet are considered hydric and classified as wetland soils. Brenner soils are found in depressions on flood plains and pond water during the rainy season, and are also hydric or wetland soils.

Toward the coast, west of and including Bain Slough, estuarine deposits result in the Clatsop soil, with an organic surface layer. This soil is normally above high tide but is subject to flooding during abnormally high tides. The soil has a high water table, and plant growth is affected by salt during the summer months. Soils along tributary streams were generally not mapped as separate units although a variety of different soils can be found along these streams.

Adjacent to the ocean, ancient marine terraces are found. Nelscott, Bandon and Lint soils cover these ancient terraces and are fine sandy loams and silt loams. Sitka spruce is the dominant forest species on these soils.

Farther inland the underlying geology changes to include the Yachats Basalt south of the Alsea River. These rocks give rise to the Formader and Hemcross soils of volcanic origin and have chemical properties with high phosphorus contents. The basalts are surrounded by tuffaceous siltstone units of the Alsea and Nestucca Formations, which continue north of the river (Map 4: "Lithology"). Soils derived from these base rocks are of the Skinner, Astoria and Fendall series and are cobbly clay loams over the harder basalts, and clays on the softer siltstones. Sitka spruce and western hemlock are the dominant species on these productive soils.

Various igneous intrusives and volcanics form Grass, Cannibal, and Digger mountains. These intrusives are more resistant to erosion than the softer Tyee sandstone around them. Soils of the Klistan and Mulkey series develop under the climatic conditions and parent material found in these areas. Productivity is low to moderate due to a reduced growing season caused by cold temperatures. Water holding capacity is reduced due to rock content and shallow soil depth . Other igneous intrusives in lower landscape positions give rise to Klickitat, Kilchis, and Harrington soil series.

The majority of the area is underlain by rhythmically bedded sandstone and siltstone of the Tyee formation. Bohannan, Slickrock and Preacher soils form on this bedrock. These are moderately deep to deep gravelly loam to clay loam soils which are highly productive and have a moderately high water holding capacity. Douglas-fir is the dominant species on these soils.

TABLE 3-7: GEOLOGIC INFLUENCES ON PHYSICAL RESOURCE COMPONENTS

Geology	Soils	Slopes	Streams
River and Estuary Deposits (3% of area)	Alsea, Brenner, Knappa, Nehalem, Nestucca: repeated reworking of sediments on active flood plains; fluvial erosion adjacent to streams	Planear to rolling 0-30%: 85% 30-60%:15%	Low gradient, unconfined, sinuous channels; wide range of particle sizes encountered
Marine Terrace (3% of area)	Nelscott, Bandon, Lint Series: fluvial erosion in channels is the dominant process	Low, gentle relief 0-30%: 89% 30-60%:11%	Low stream density; low gradients; mostly fine-grained sediments composed of silts and sands
Tuffaceous Siltstones of the Alsea and Nestucca Formations (5% of area)	Astoria, Fendall: deep seated mass movements are the predominate hillslope processes	Gentle to moderately steep, moderate-low relief 0-30%: 84% 30-60%:16%	Dendritic drainage; low stream density; silt and sand-sized sediments
Yachats Basalt (4% of area)	Skinner, Hembre: debris torrents and slides are primary hillslope erosion processes	Higher relief 0-30%: 70% 30-60%:30%	Trellis drainage pattern; steeper gradients; basalt cobbles and gravels
Mafic and Alkalic Intrusives (2% of area)	Klickitat, Mulkey: shallower, generally cold rocky soils	Higher relief 0-30%: 25% 30-60%:59% >60%:16%	Dendritic pattern; low stream density; basalt cobbles and gravels
Siletz River Volcanics (4% of area)	Klickitat, Kilchis, Harrington: moderately deep soils; debris torrents dominate	Higher relief 0-30%: 44% 30-60%:46% >60%: 10%	Dendritic drainage pattern; basalt gravels and cobbles
Tyee Formation (79% of area)	Bohannan, Slick-rock, Preacher: moderately deep to deep; debris torrents dominate	Higher relief 0-30%: 39% 30-60%:50% >60%: 11%	Dendritic drainage pattern; stream density moderate; low gradient streams far into drainages; incompetent sand-stone cobbles & gravels

Erosion Processes

Landforms in the Oregon Coast Range are the result of landslides and erosion (hillslope processes), and streamflow (fluvial processes) moving sediments from the slope to the valleys, and eventually to the ocean. The rate at which these processes shape the landscape is dependent on climate, particularly rainfall levels, and the physical properties of the soils and rocks in the area.

In the Lower Alsea watershed, very little surface erosion occurs due to the protective cover of organic material and the highly porous soils that are found there. Under natural conditions, surface erosion would only be expected as a result of flood events across flood plains and stream terraces and on exposed landslide scars.

Landslides are a natural landforming process. The rate at which landslides occur under natural conditions is, however, difficult to determine. It is assumed that landslides occur at some low level under forested conditions and at a higher rate in response to disturbances. Two general types of landslide activities — one deep seated, the other shallow — are known to occur in the area.

Deep seated mass movements, although rare, occur on the contact zone between the harder volcanic rock types and the less consolidated Tyee formation. These types of failures are known to occur on low-angle slopes in thick soils. The Scott Creek subwatershed has some active, large earthflow areas, and a large earthflow has been noted by locals in the area above Hellion Rapids.

Landslide scars and hollow depressions, often found in headwall areas, are evidence of historic landslide events. The frequency of sliding is variable, with few slides occurring during most years. In theory, significant natural landsliding across the watershed would have occurred during heavy precipitation events following severe wildfires. This pulse of wood and sediment would set up at tributary junctions or in low-gradient stream reaches and be routed through the system over time.

Shallow, rapid landslides usually initiate in unchanneled valleys with gradients steeper than 60%, with the majority occurring over 70% (Sessions, Balcom and Boston 1987). Using a susceptibility model developed by Shaw and Johnson (Appendix 4, "Shallow-rapid Landslide Susceptibility Model for Lower Alsea Watershed Analysis") for shallow-rapid landslides, the subwatersheds were rated for landslide susceptibility. The Bull Run, Cow, Lake, Skunk, Tidewater, and Upper Fall creeks' subwatersheds had the highest percentage of subwatersheds scoring in *both* moderate and high landslide susceptibility ratings; the Cow Creek drainage has the highest percentage of area in both categories. For the entire watershed, there are 2,241 acres (2.3%) rated as having high landslide susceptibility, and 10,734 acres (11.1%) rated moderate (Table 3-8, "Acreages and Per Cent Area in Each Landslide Susceptibility Rating Category," and Figure 3-2, "Percentage of subwatersheds in low, moderate, and high landslide susceptibility").

TABLE 3-8: ACREAGES AND PER CENT AREA IN EACH LANDSLIDE SUSCEPTIBILITY RATING CATEGORY

	Low		**Moderate**		**High**	
Subwatershed	***Acres***	***Pct. SWS***	***Acres***	***Pct. SWS***	***Acres***	***Pct. SWS***
Bayview	4808.7	99.1	37.7	0.8	2.0	0.1
Bullrun	3436.3	82.2	604.5	14.4	138.1	3.3
Burch	6615.6	92.5	462.0	6.5	72.4	1.0
Canal	7316.9	89.0	829.8	10.1	69.7	0.1
Cow	4518.1	76.8	1049.8	17.9	308.8	5.2
Darkey	1881.9	91.4	164.5	8.0	13.1	0.1
Digger	5342.9	86.3	698.6	11.3	147.9	2.4
Eckman	3999.6	98.6	57.1	1.4	0	0.0
Grass	2926.2	85.8	432.0	12.6	50.8	1.4
Lake	3648.1	80.4	671.8	14.8	218.4	4.8
Lint	2897.5	99.4	17.3	0.6	0	0.0
L. Fall	3772.9	81.4	733.3	15.8	131.4	2.8
Mill	3610.8	84.2	588.5	13.7	88.4	2.0
Risley	2805.2	87.4	347.4	10.8	58.4	1.8
Salmonberry	3077.1	93.1	191.6	5.8	36.6	1.1
Scott	6554.1	88.0	743.0	9.9	150.3	2.0
Skunk	2424.7	79.2	502.2	16.4	134.3	4.4
Sudan	2620.5	90.5	254.2	8.7	22.0	0.8
Tidewater	6097.0	82.1	1073.6	14.5	253.7	3.4
U. Fall	5656.6	77.7	1275.4	17.5	345.0	4.7
Totals:	84,010.7		10,734.3		2,241.3	

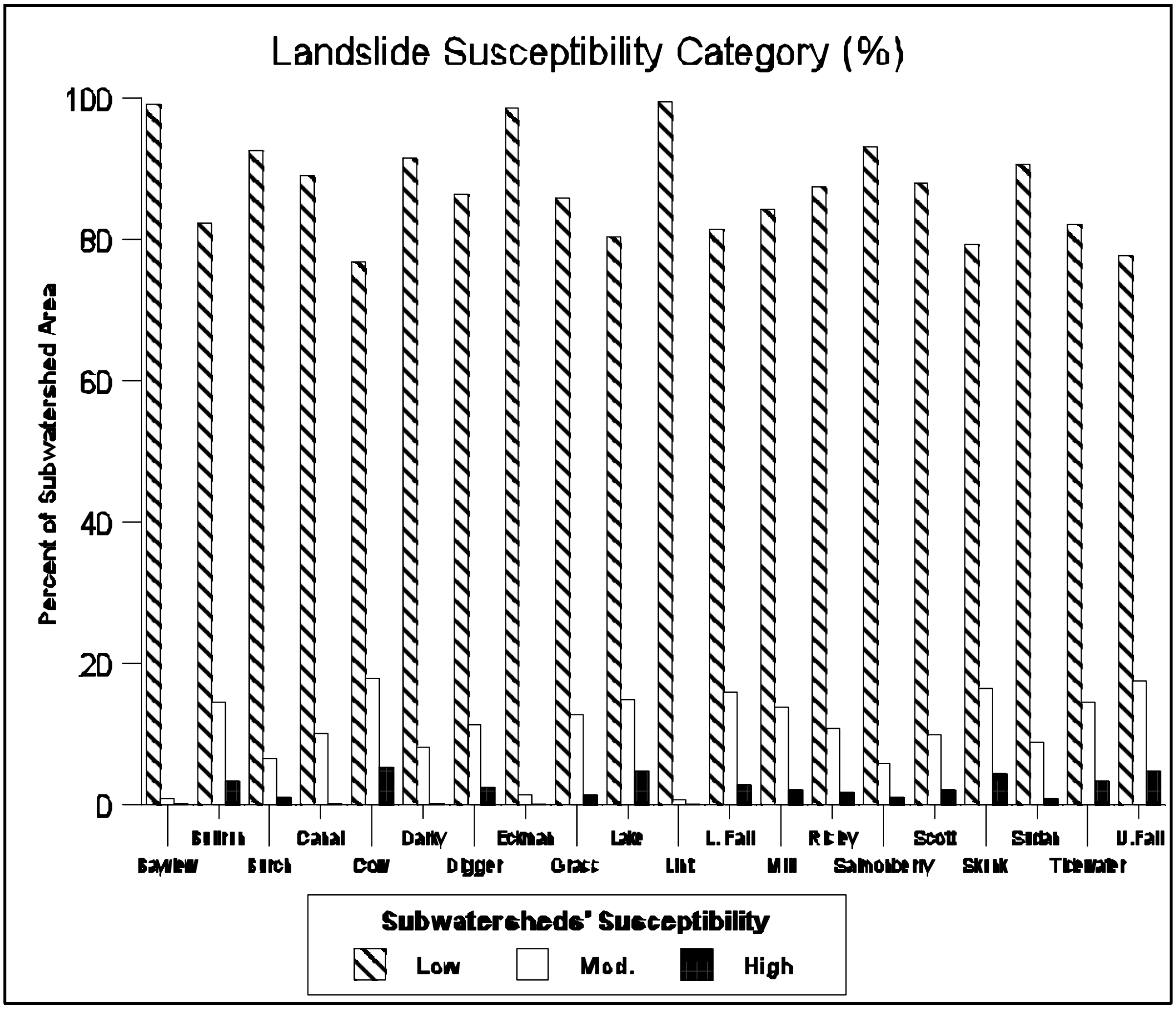


Figure 3-2: Percentage of subwatersheds in low, moderate, and high landslide susceptibility

Hydrology

The Lower Alsea Watershed (Hydologic Unit Code # 1710020504) is one of five watersheds that make up the Alsea Basin (fourth-field HUC # 17100205; see Map 18: "Alsea Basin Watersheds"). Watershed analyses have been completed by federal agencies on the other four watersheds within the Alsea Basin; the Upper Alsea includes the North Fork and South Fork watersheds (Map 10: "Sub-watersheds"). This Lower Alsea analysis area covers the lower mainstem of the Alsea and twenty subwatersheds. Eighteen subwatersheds drain directly into the Alsea River; the other two subwater-sheds drain into Fall Creek, which drains into the Alsea River (Map 10: "Subwatersheds").

Precipitation & Water Quantity

Oregon climatologists have recognized a cyclic nature to wet and dry periods. This cycle changes about every 20 years; the storms in the 1960s and early 1970s represented the last wet cycle, and the mid-1990s were the beginning of another 20 year wet cycle.

Stream flows follow precipitation patterns. At the beginning of the water cycle, usually early October, a portion of the rainwater is stored in the upland soils. As soils become saturated, more of the rainwater is returned to the stream channels through rapid groundwater transfer.

A record of discharge (stream flows) has been collected at the U.S. Geologic Survey (USGS) gauge near Tidewater (Figure 3-3, "Alsea River Near Tidewater, Oregon") since1939. Annual patterns show the highest flows occur November through January. The average annual discharge is 1,473 ft^3/sec, with a maximum discharge of 41,800 ft^3/sec. Minimum discharge within the measured period was 45 ft^3/sec on September 26 and 27, 1965.

About 4% of the analysis area is within the transient snow zone. Warm rains over snow-covered ground lead to rapid snowmelt and excessive runoff events. Higher stream flows and subsequent flooding of lowland areas can be expected.

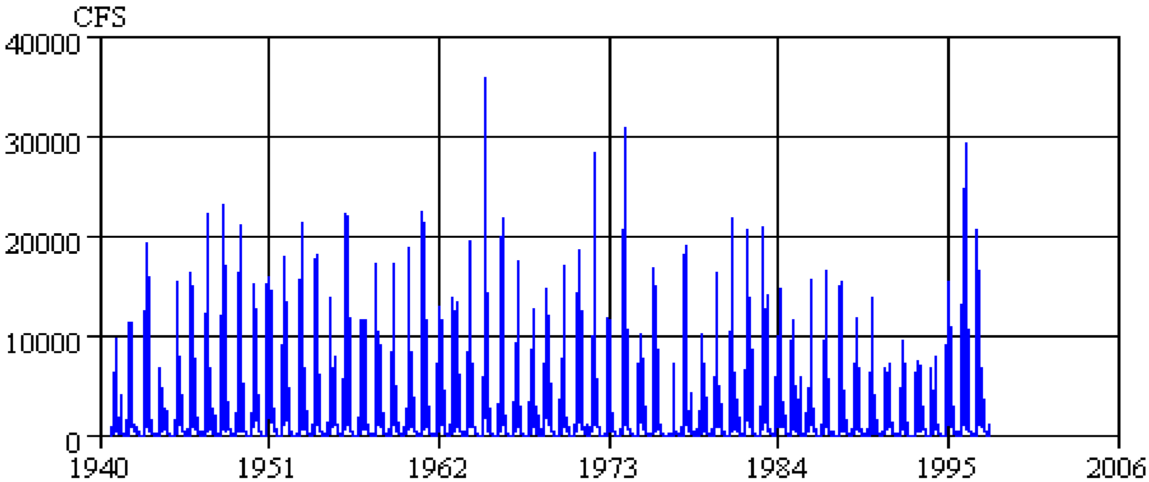


Figure 3-3: Alsea River Near Tidewater, Oregon (Station Number 14306500)

Floods

Periodic flooding occurs in the Alsea Basin. The largest measured flood event occurred on December 22, 1964, with a gauge height of 27.44 feet. However, a flood on or about February 3, 1890, reached a stage of 29.5 feet based on sediment line, but it was before the officially recorded data (USGS web site information). Flood thresholds are about 19,000 ft^3/sec or a stage of 18 feet. During the 57 years of record, flows have exceeded flood stage twenty-one times, with significant storm events in 1964, 1971, 1973, and 1996.

Water Quality

Water quality is expected to have been excellent the majority of the time, although it was undoubtedly influenced by natural disturbance events. Following wildfires and large storm events, landslides and loss of streamside vegetation would have led to increased sedimentation and warming of water temperatures. At some of these sites, extremely low dissolved oxygen levels may have resulted from excessive organic debris loading.

Stream Channel Classification

Geology and climate determine the number of particular types of streams in a given area. Identification of differences in channel function and resistance help to predict the potential availability and distribution of in-stream habitat components (see also Appendix 5, "Stream Channel Classification").

Stream function relates to how a channel will move sediment and wood. Stream gradient and valley confinement are the two stream function characteristics used to classify stream systems. Stream gradient determines stream energy, the dominant element influencing channel morphology (Map 19: "Stream Gradients"). Valley confinement controls aspects of potential stream response to storm events (Map 20: "Stream Confinement"). The combination of these two factors results in specific channel types which serve different ecological and hydrological functions and which vary in their ability to resist change.

Channel types are identified as either source, transport or depositional reaches (Montgomery et al. 1993; Map 21: "Stream Function"). Source reaches have gradients greater than 8% and are confined or moderately confined. These reaches respond quickly to storm events, are subject to periodic scour by debris flows, and provide cool water, sediment and wood to the rest of the stream system. Vege-tation on the stream-adjacent slopes strongly influences the channel resistance to disturbance events. There is little fish habitat due to the steep gradients and periodic flushing of wood and sediment.

Transport reaches have 4-8% gradients and are confined or moderately confined. Confined channel reaches have high energy during high stream flow, moving large pulses of wood and sediments downstream. Depending on the size of drainage area, debris and sediment can remain in the channels from tens to hundreds of years. In small drainages, in-stream and stream-adjacent large woody debris remains close to where it fell, eventually forming closely spaced jams. (Channel spanning log jams were probably quite common in most small tributaries to the Alsea River.) These streams are fairly resistant to changes in stream morphology. There are transitory accumulations of wood in log jams, with associated sediment back-up in the stream. High quality aquatic habitat is concentrated around these wood and sediment accumulations.

Deposition reaches have less than 4% gradients and are moderately confined or more commonly unconfined. Deposition reaches experience significant changes in stream morphology as sediment and wood supplies increase from upslope or upstream. These stream reaches historically had the best potential for providing quality aquatic habitat. During floods, the unconfined valley flood plains become long-term storage sites for sediments and wood. Gravels accumulated in these reaches provide excellent spawning habitat. Channels can shift laterally over time and therefore create sinuous stream channel patterns. During a flood event, calm water areas and numerous side channels are distributed throughout the flood plains, creating areas where small fish could take refuge.

Undercut banks, deep pools, large amounts of downed logs, and complex log jams are also components of this channel type. Reaches with large drainage areas (e.g., Fall Creek, Canal Creek and the mainstem of the Alsea River) can move a larger fraction of wood, resulting in larger, more widely spaced log jams. Large wood accumulations in the mainstem of the Alsea River were more often located on point bars, at tributary junctions, gradient breaks, and at meander bends. Due to the alluvial nature of depositions along these channel types, these channels are the most sensitive to changes in inputs of wood, sediment, and flows. Riparian vegetation along the valley floor contributes wood to the channel as individual pieces are undercut or blown down.

Tributaries within the Lower Alsea Analysis Area can be stratified into two distinct areas: streams that drain the south side of the Alsea mainstem have about twice as many low gradient (<4%) stream miles per watershed area when compared to streams (Scott, Fall and Mill) on the north side (Figure 3-4, "Low Gradient Stream Miles per Subwatershed Area"). Lint is even higher with about three and one-half times as many miles, although a large portion of Lint has tidal influence.

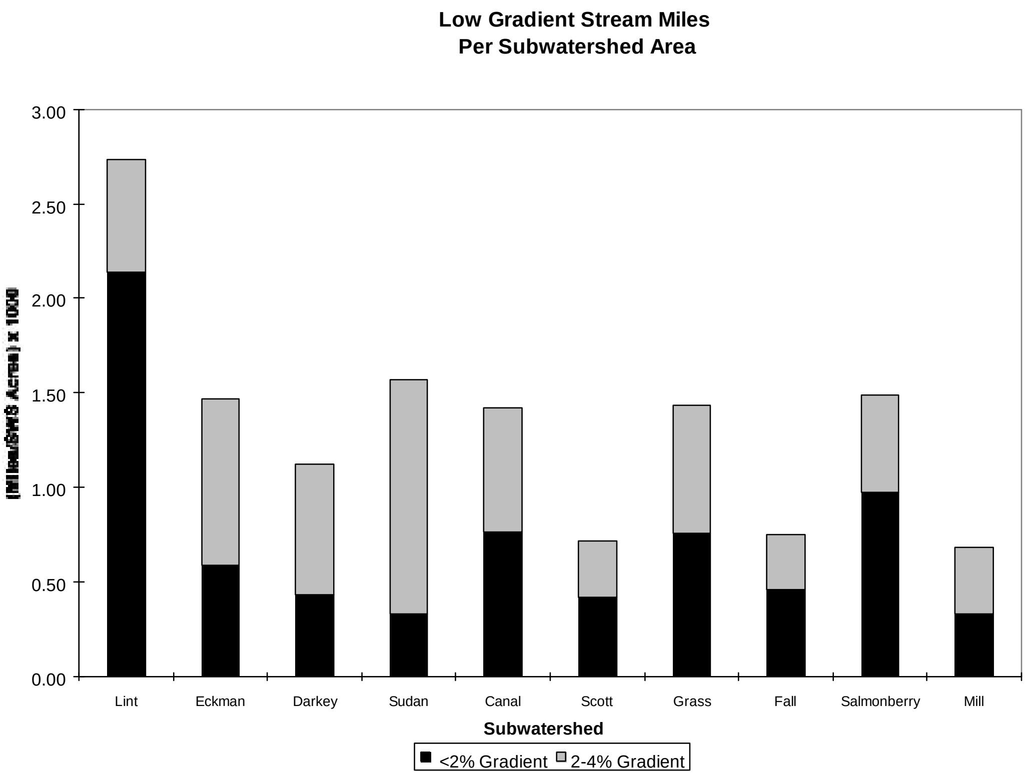


Figure 3-4: Low Gradient Stream Miles per Subwatershed Area

Channel Condition

The Alsea mainstem has three major geomorphic reaches. The lowest reach is influenced by ocean tides and extends from the mouth to about river mile 13. The channel substrate transitions from sand at the mouth to silt and clay upstream. This reach contains extensive tidal marshes in its lower portions that transition into levee bordered, wet sloughs, and higher terraces near its upper limit. The middle reach extends to about 1 mile downstream of Salmonberry Creek. Bedrock dominates the channel, although there are patches of large boulders at meander bends and gravel near tributary junctions. This reach is primarily moderately confined and entrenched. Terraces are high and do not flood in most years, but large, infrequent floods do extend onto many of the high terraces. The upper reach is the unconfined "Alsea Valley" that extends into the North and South Forks of the Alsea. Gravel is much more common in the channel, although bedrock is still observed. The channel remains entrenched within high terraces, but not as deep as the middle reach.

Riparian Vegetation

Riparian vegetation contains some of the most complex vegetative patterns on the landscape. Fire, debris torrents, channel shifts, flooding, bank erosion, and blowdown interact with flood plain and toe-slope surfaces to develop a complex mosaic of vegetation that contains all potential seral stages.

The processes that operate to form riparian vegetation patterns differ between small and large channels.

Following fire, many source streams are scoured to bedrock by debris torrents. These channels and adjacent hillslopes are then quickly colonized by alder or occasionally salmonberry. Conifers become established upslope of the channels, and over time, they begin to shade out the alder due to their height and the narrow valley bottoms. Eventually, many source channels are dominated by salmonberry, with conifers dominant on the toe-slope. Upslope conifers periodically fall into the channel, providing nurse logs and openings for other conifers to become established nearer the channel. In this way, conifers slowly encroach on these channels. Debris torrent tracks in mature forests are often colonized by conifers much faster than when fire has reset the upslope vegetation.

In transport and deposition reaches, channel shifts, flooding, bank erosion, and blowdown are the dominant disturbance mechanisms. Following fire, debris torrents and burned riparian areas deliver large amounts of wood and sediment to these channels. Large volumes of sediment are stored upstream of debris torrent deposits and wood accumulations. Eventually, streams cut through these deposits as wood breaks and floats downstream, leaving terraces upstream of the old deposits. Terraces are continually being formed and divided in channels with abundant wood.

The height of terraces, extent of soil development, and the availability of nurse logs strongly influence the riparian vegetation patterns found on flood plains of larger streams. On low terraces, red alder is the dominant tree species; on higher terraces, nurse log Sitka spruce (in the spruce zone), or western hemlock and western red cedar are dominant, with big-leaf maple more common in the inland portions of the analysis area. The oldest and largest trees, typically conifers, are found on the highest terraces; younger trees are found on the lower terraces and closer to the stream channel.

Sitka spruce (in the spruce zone), western hemlock, and western red cedar are the dominant conifer species on flood plains due to their adaptations to flood plain conditions. All three species are shade tolerant, and each can develop adventitious roots when buried by stream sediments or flood waters. Spruce and cedar are also tolerant of high water tables. Douglas-fir are present on the higher sites of the valley floors.

Riparian vegetation performs several important functions in aquatic ecosystems:

- provides the primary source of energy and nutrients for small streams
- maintains channel and flood plain stability during floods and channel shifts by holding on to sediment with its roots and trapping floating wood with its stems
- supplies the large wood that maintains a high degree of connection between the channel and its flood plain, forms a variety of surfaces on which riparian vegetation can develop, and forms high quality fish habitat
- shades streams and wetlands to keep water temperatures suitable for a wide variety of aquatic species. In general, riparian vegetation within 200 feet of stream channels directly affects shading and large wood inputs, whereas vegetation within 600 feet of stream channels affects microclimate components such as air temperature, wind speed, and relative humidity (FEMAT 1993)

Affect of LWD on Channel Structure

Large wood is a fundamental component of aquatic ecosystems and strongly influences their development and productivity. One of the most important functions of large wood is maintaining the connection between a channel and its flood plain (Maser et al. 1988). Large wood is delivered to stream channels by debris torrents, landslides and by falling from the adjacent riparian area.

When large wood enters a stream, sediment accumulates upstream, often creating a low-gradient, flat area. The size of the flat is related to the amount and size of the wood, valley gradient, and channel constraint. These low-gradient flats are most common just upstream of tributary junctions, where they have formed as a result of repeated debris torrent deposits. As these flats develop, the channel can shift positions on the flood plain, causing bank erosion and additional large wood recruitment. Channel shifts bring in large quantities of terrestrial biomass and nutrients for the aquatic ecosystem to process, and they are a major way in which side channels, high flow channels and wetlands are formed.

Large wood and the associated flats increase the streams' nutrient retention capacity by catching floating organics such as leaves, sticks, and salmon carcasses. As these substrates decompose, their nutrients become available to the aquatic ecosystem. Large wood on the upstream end of terraces can deflect flow around the terrace, allowing riparian vegetation to develop into later stages of succession. Large wood also functions as nurse logs and is often the major site of conifer establishment in riparian areas.

Large wood increases the frequency, depth, and types of pool habitats within streams. Large wood creates complex flow and cover patterns that provide habitat for many aquatic and terrestrial species. Log jams are areas of high fish production due to the large, deep, complex pools formed by the wood, and the abundant spawning gravels and side channels formed just upstream.

Although most log jams allow fish passage, some can create temporary fish passage barriers. Barriers may only persist for a few years before shifting and allowing passage. Barriers may have positive impacts on species upstream, such as cutthroat trout and salamanders, by temporarily releasing them from competition with other species. They may also help species segregate their use of the stream to utilize more fully the available habitat, thus minimizing competition and potentially increasing survival.

The abundance of large wood in streams is cyclic and strongly influenced by succession, fire, and geomorphology of the stream channel. Wood abundance in source reaches may increase for several fire cycles if the stream channel does not torrent. Debris torrents initiate in hollows or headwall areas adjacent to the main source channel. Radiocarbon dated wood at the contact between bedrock and the accumulated sediment and wood in hollows has been dated at 4,000-6,000 years before present in the Oregon Coast Range (Reneau and Deitrich 1990). This demonstrates the long time periods during which wood and sediment are accumulating in these areas, regardless of fire frequency. Benda and Cundy (1990) estimate that main source channels torrent with a frequency of around 700-1,500 years. When these channels torrent, most wood and sediment are removed from source reaches, thus restarting the long process of filling with sediment and wood. About half of all wood observed in transport and deposition reaches may originate from debris torrents in source reaches.

Large fires in mature forests leave portions of transport and deposition reaches filled with large wood from debris torrent deposits and with riparian snags killed by the fire. Wood abundance eventually decreases from decay and flotation of individual pieces, and then slowly increases as the developing forest begins to provide a new source of wood. Fire related wood inputs combine with pre-fire wood to maintain the function of large wood in fish bearing channels until additional wood is recruited from the developing forest (Long 1987). About 50 years following the fire, deciduous trees provide the majority of inputs, while it may take 100+ years for conifers to provide substantial inputs (Heimann 1988). Large wood in transport and deposition reaches is assumed to be at its lowest point approximately 100-150 years following a fire and then slowly increases as the developing forest begins to provide substantial inputs. Unburned patches, which are expected to be more common in deposition reaches, especially near the coast, may not experience as deep a low cycle as burned areas.

Estuary

[Note that all measures are in the units reported by the author cited, followed by conversion to a non-metric measure if appropriate. Any measures not from a published source are in non-metric units.]

The Alsea estuary is about 8.7 km^2 (2,150 acres) in size. Of that area, about 4.7 km^2 (1,161 acres) is submerged, as defined by mean low water (MLW), and the remaining 4.0 km^2 (988 acres) is tideland, defined by MLW and mean high water (MHW) (Proctor 1980). Several studies and literature reviews compiled in the 1970s provide similar estimates of the size of the Alsea estuary; variation in estimates of estuary size and relative distribution of submerged and tide lands are attributable to differing methods of delineating and defining those classifications. Similar variation is also found in estimates of the upstream limits of the estuary. Reported estimates of head of tide vary from river mile (RM) 7.6 to RM 16. The *Alsea Wetlands Review* (U.S. Army Corps of Engineers 1976) reports the limit of tidal effects on river level at RM 15 on the Alsea and at RM 1.5 on Drift Creek.

The headland, channel, and sand spit that define the mouth and throat of the estuary have been relatively stable, with one notable exception, since the first detailed recording of the bay's bathymetry in 1914 (Jackson and Rosenfeld 1987). Significant changes in the shape of the spit and the bay mouth occurred in the mid-1980's and are described in detail in Jackson and Rosenfeld (1987). In short, disruption of the typically observed seasonal patterns of on- and off-shore sand transport, attributed to the effects of the 1983 El Niño-Southern Oscillation (ENSO), set into motion a series of changes that resulted in severe erosion of the spit, increased exposure of the inner bay to wave action, and increased tidal volume. Changes in the gross morphology of the Alsea River mouth during and following the winter of 1997/98 appear similar to those occurring in the months immediately following the 1983 ENSO. The Oregon Department of Land Conservation and Development and Oregon State University have been monitoring these changes and associated erosion of the Alsea spit (Rosenfeld 1998, pers. com.). Apart from the ENSO-related events in the mid-80s, the bedrock-confined channel through the mouth has typically been around 39 feet deep, and the cross-sectional area of the mouth at mean tide has been estimated at 5,520 to 7,000 ft^2 (Jackson and Rosenfeld 1987, McKenzie 1975).

Once inside the mouth, the bay is shallow and dominated by tidelands. The area that transitions from the wide, shallow portion of the bay into a narrower extension of the river is marked by two channels. The southern channel is broad, shallow, and appears as a direct extension of the Alsea River. The narrow northern channel branches off from the southern channel about three-quarters of a mile west of the mouth of Drift Creek and reconnects with the main body of the bay north of RM 2. The northern and southern channels are separated by high marsh islands along the eastern two-thirds of the northern channel. The western portion of the northern channel is delineated by mudflats. The bathymetry recorded in 1914 indicated that the northern channel was slightly deeper than the south-ern channel through most of its length.

Historic information for the Alsea estuary indicates that, at the time of European-American settlement, major structural features of Alsea Bay were fairly similar to those present today. A 1912 survey map and the 1914 bathymetry chart depict a deep, narrow, and well-defined mouth, a broad, shallow embayment dominated by tidelands, and the northern and southern channels described above. Excerpts from an 1849 journal, as reported by Hays (1976), and an 1878 Army survey, as reported by McKenzie (1975), also describe the overall shape and depth of the bay much as it looks today.

The *Alsea Wetlands Review* (U.S. Army Corps of Engineers 1976) and McKenzie (1975) provide an overview of the tidal and mixing dynamics of the Alsea estuary. The mean tidal range, diurnal range, and tidal prism are reported as 5.8 ft, 7.7 ft, and 5×10^8 ft^3, respectively. Reports of maxi-mum limits of salt water intrusion vary between RM 12 and RM 14, and the minimum limit of intru-sion is reported to be around RM 4.5. Mixing regimes are influenced by tidal amplitude, river dis-charge, and basin shape and complexity. Consequently, mixing in the Alsea can be expected to vary seasonally and spatially. In general, the Alsea is partially- to well-mixed in the winter and summer, and partially-mixed to stratified in the spring and fall (U.S. Army Corps of Engineers 1976). However, mixing regimes in the sloughs and minor tributaries to the Alsea within the estuary are dominated by tidal amplitude throughout the year and are consequently characterized as well-mixed (Proctor 1980).

A generalized overview of flow patterns in the *Alsea Wetlands Review* (U.S. Army Corps of Engineers 1976) describes the flood tide as dampened between the mouth and RM 5.7, slightly amplified from RM 5.7 to the point where the shape of the estuary becomes more constant, and from there, gradually diminished by river flow and friction to the head of tide. An interesting characteristic of the flood tide is the differential filling of the north and south channels. Flood flows are deflected by shallow areas and tidelands toward the northeastern margin of the bay. Flows follow the margin of the bay and begin filling the northern portion of the bay, including the north channel, before filling the southern channel. This differential filling results in an internal ebb flow from the north channel to the south channel that continues until the water levels in the two channels equalize. The water level in the north channel has been reported to exceed water level in the south channel by as much as a foot at the peak of this differential filling.

The sediment delivery systems to the Alsea are marine and riverine, with aeolian (wind-blown) transport playing a minor role. McKenzie (1975) estimates that marine-derived sediments predominate from the mouth and through the throat of the estuary to around RM 1.6, riverine sediments are estimated to dominate from upstream down to around RM 2.5, and the area between RM 1.6 and RM 2.5 is described as a transition zone. A map of tideland bottom types in the *Alsea Wetlands Review* (U.S. Army Corps of Engineers 1976) indicates that muds, mud/sands, and sands are well distributed throughout the estuary, with sands being more abundant closer to the mouth and muds and mud/ sands being more common farther up the embayment. Limited areas of gravel-dominated tidelands are present along the northwestern margin of the bay.

Peterson, Scheidegger and Komar (1982) examined marine and riverine sediment transport and deposition processes in the Alsea estuary in detail, including spatial and seasonal variability in the dominance of tidal and riverine influences. These authors found that most sand is moved through the bay's channels and that the primary sand deposition sites are the channel margins. They also determined that the central channels of the bay are dominated by seaward movement of riverine sands, silts, and clays, with silts and clays being transported out of the estuary almost entirely. Submerged aquatic vegetation and emergent marsh influence local deposition and transport by trapping and retaining larger volumes of sediment and a higher proportion of fine grains than surrounding unvegetated areas.

The 1912 survey map, the 1914 bathymetry chart, excerpts from the 1878 Army survey as reported by McKenzie (1975), *The Land That Kept Its Promise* (Hays 1976), historical information in the *Alsea Wetlands Review* (U.S. Army Corps of Engineers 1976), and early aerial photos all provide insight into major habitat features that likely predated European-American settlement and alteration of the Alsea estuary. Much like today, large areas of mature high marsh (*sensu* Jefferson 1975) dom-inated the northern margin of the bay across from McKinney's Slough to a mile or more above the mouth of Drift Creek, extended a mile or more up the mouth of Drift Creek, and formed the islands that separated the north channel from the southern channel. Mature high marsh was also likely pres-ent to some degree within the narrower strip of tidally influenced area along the southern margin of the bay east of McKinney's Slough.

Extensive mudflats also appear to have been present historically. Brackish water marsh and low salt marsh were likely more abundant than observed currently, particularly in the areas that are now the town of Waldport and in Eckman Slough. The sand spit likely supported sparse beach and dune vegetation, with wind primarily, and rain secondarily, acting as dominant factors in maintaining the dynamic nature of native beach and dune habitat. The area that is now the town of Waldport appears to also have supported some degree of open sandy habitat. Forest, most likely dominated by mature conifers, is reported to have extended to the "water's edge;" in this case, "edge" probably corresponds to the limits of Sitka spruce's tolerance of tidal influence.

Large woody debris was probably a feature of the Alsea estuary prior to the mid- to late 1800s. Much as sediment from the watershed is transported downstream and to the estuary, fallen wood entering the stream system within the watershed was also transported downstream. That which did not decay completely, become buried, or was otherwise permanently retained within the watershed, would have eventually reached the estuary. A portion of this wood would have been retained in the estuary by stranding on mudflats and in marshes, snagging in estuary channels, and burial. Other sources of wood moving through or retained in the estuary included that borne by the flood tides and storm surges, and fallen trees from the estuary margins and forested estuary wetlands. While no early accounts were found that described or noted the presence of large wood in Alsea Bay specifically, historical information from similar Oregon estuaries (Gonor, Sedell and Benner 1988) indicates that large wood was probably more abundant and well distributed in the Alsea estuary than is observed currently. Indications of the amount and distribution of large wood in the Alsea may be available from U.S. Army Corps of Engineers reports regarding navigation conditions and navigation hazard removal projects during the 1800s.

Fish Populations

Streams in the analysis area contain populations of fall and spring Chinook salmon, coho and chum salmon, winter steelhead, anadromous and resident cutthroat trout, sculpin species, Pacific and brook lamprey, speckled dace, and three-spined stickleback. A large number of additional fish species are found in the Alsea Estuary, with many of them identified in Gaumer, Demory and Osis (1973).

Fish production potential is related to the amount of suitable habitat that is available. In the watershed analysis area, all miles were assumed to be suitable except where they become too steep for fish to access (ca. 15-20%). The highest production areas for salmonids occur in unconstrained, low gra-dient (<2%) reaches where habitat quantity and quality are high. Historically, the Alsea River from near Salmonberry Creek to the forks probably had the highest production potential of all stream reaches in the watershed analysis area, followed by Canal, Scott, and Lower Fall creeks.

An estimate of historically important habitat areas for anadromous salmonids can be inferred from seasonal changes in habitat use that have been observed in other basins and from the geomorphic characteristics of streams in the analysis area (Map 22: “Historic Fish Distribution”). The Alsea mainstem, from near Salmonbery Creek to the forks, and low gradient (<2%) tributaries probably provide the majority of spawning habitat for Chinook, coho, steelhead and cutthroat. Chum spawning was probably concentrated in estuary tributaries such as Canal, Sudan, and Darkey. High fish abundance and subsequent dispersal from spawning areas made the entire Alsea mainstem important for summer rearing. During low flow conditions in medium to small streams, deep pool habitats contain the majority of salmonids, particularly coho salmon and age 1^+ trout. Beaver ponds are particularly important for coho salmon and cutthroat trout in summer. Young-of-the-year trout may be concentrated in riffle habitats when total fish abundance is high. In the Alsea mainstem, 1^+ steelhead and 1^+ cutthroat trout may concentrate in riffles and at the top end of pools in summer when temperatures are suitable.

During winter, juvenile salmonids probably move downstream into large, deep pools with abundant wood and slow velocities to avoid high stream velocities typical of small pools during high flows. During floods, fish move onto the flood plain and channel margins to escape high flows. High quality flood plain habitats are critical refuges during floods and allow for rapid colonization of the adjacent mainstem after the flood subsides. Most mainstream beaver dams are washed out by winter floods, but some dams remain in the upper portions of the watershed and on the flood plain, and provide excellent rearing habitat when available. Large wood on the flood plain also provides high quality habitat during floods. In spring and early summer, flood plain habitats, such as side channels and tributaries that run along the mainstem valley floor, can contain a disproportionate number of coho salmon fry. Upper portions of mainstem tributaries, such as Drift, Five Rivers, Lobster, North Fork, South Fork, and the Upper Alsea mainstem from near Salmonberry Creek upstream, probably pro-vide important winter rearing areas for fish that were spawned in adjacent tributaries.

The structure of fish assemblages in the relatively steeper tributaries on the northside of the Alsea mainstem (Mill, Fall, and Scott) may differ from those found in southside tributaries (Lint, Sudan, Canal, Grass, and Salmonberry). Differences in habitat conditions may result in a higher fraction of 1^+ steelhead and 1^+ cutthroat trout and a lower fraction of coho salmon in northside tributaries when compared to southside tributaries of the Alsea mainstem. Although this has not been documented in the Alsea, Hicks (1989) documented such differences among steep basalt streams compared to flatter sandstone streams. Anecdotal information indicates that northside tibutaries may be “better” steel-head streams while southside tributaries are “better” coho streams (Keith Nyhus 1998, pers. com.).

AQUATIC HABITAT: Current Conditions

Soil Conditions

Changes in nutrient cycling processes have resulted from both forest management and homestead activities. Clearing land of vegetation results in the reduction of annual inputs of organic material. Burning of slash on forest lands not only reduces organic material input from above ground, but removes the layers of organic matter that have accumulated over time. In the spruce zone near the coast, specifically in the headwaters of Canal Creek, organic accumulations of 14-16 inches were lost during slash burn practices (unpublished USDA Forest Service record).

Soil productivity has been reduced due to forest management, housing development, and farming of the river valleys. Annual accumulations of organic material from river flooding events have been reduced by construction of dikes and levees. Some areas have been actively drained with dikes while others have been highly compacted for housing, road, and outbuilding construction.

Erosion Cycles

Several aspects of erosion processes have been altered due to human activity. Overland flow of water and the resultant surface erosion occur where soils are compacted. The amount of sediment thus delivered to streams is not known. Where roads cross or are adjacent to stream channels, eroded fine sediments are more likely to reach streams.

Large, deep-seated earth flows in the analysis area have not been observed to have increased in dimension or frequency of movement due to human activity. Shallow, rapid landslide events, however, have been documented periodically and have increased in both size and frequency. Road locations on unstable terrain or where surface runoff is concentrated have resulted in accelerated landsliding.

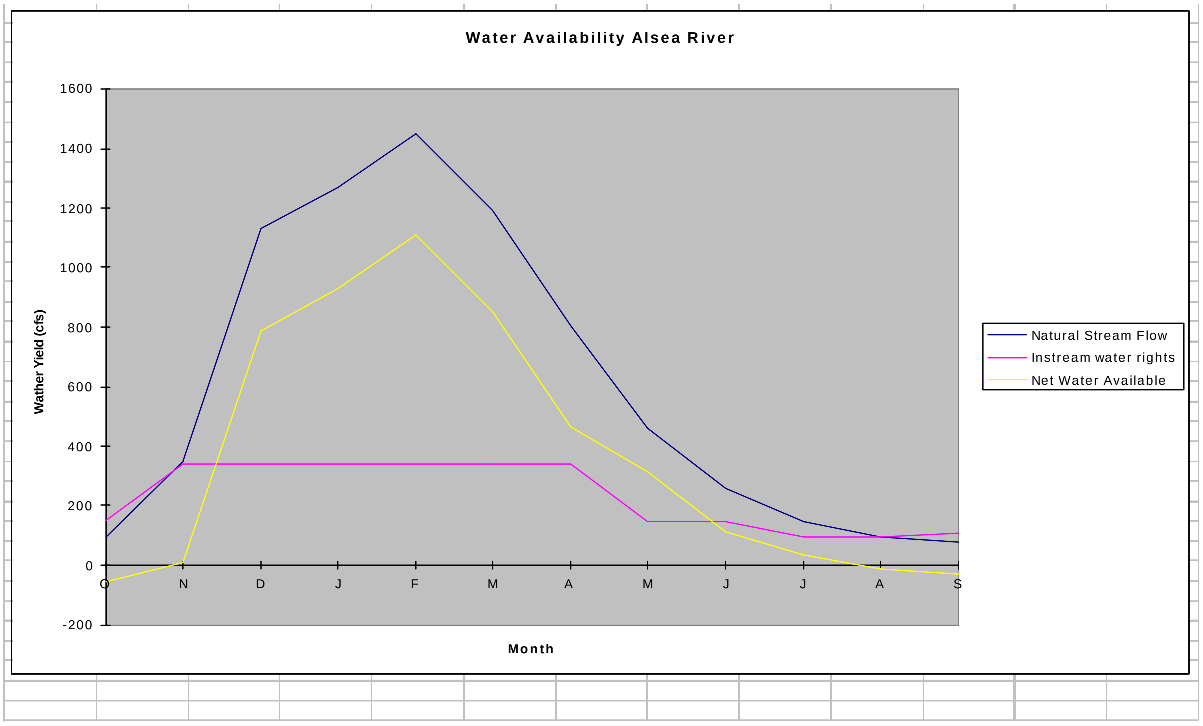
Road location and type of stream crossing affect the delivery of material to the stream channel. Roads block transport of large wood to the stream channel but allow passage of fine sediment. When the stream crossing fill becomes saturated during storm events, the fill may fail and an increased sediment load is delivered to the channel. Several stream crossings have failed in the past or are susceptible to failure in the future (Map 23: "Identified Road System Opportunities").

Hydrology

Water Quantity

Routing of stream flow on the landscape has been altered by road construction. For example, groundwater movement has been intercepted by excavation of the hillslopes for roads. As a result, the channel network has been extended, and runoff is expected to occur more rapidly, with peak flows increased (Jones and Grant 1996). Ridgetop roads in the Lower Alsea watershed account for 27% of the road system; these roads have little effect on stream flow. Midslope roads have the greatest effect on interception of groundwater: 41% of the road system is located midslope. Valley bottom roads also intercept groundwater flow: 32% of the road system is in the valley bottom. (See also "Transportation" later in this chapter.)

Summer low flows are affected by water diversions (see Appendix 6, "Water Rights Information"). There are over two-hundred-fifty water users within the boundaries of the Lower Alsea River, with the majority of use for irrigation and domestic consumption. Several municipal water rights are held by the City of Waldport: one on Weist Creek, one on the North Fork of Weist Creek, and two on Eckman Creek. Two of those municipal water rights are actively used at this time. Several group domestic water rights are actively used in the watershed (Map 24: "Water Uses"). Table 3-9 ("Water Availability (by month) for Different Streams in the Alsea Basin") displays that during many of the low flow months of the year, water use allocations already exceed the average expected flow levels. Figure 3-5 ("Water Availability on the Mainstem Alsea River") is an example of the average flow in the mainstem of the Alsea River and allocated water rights. For the months of August, September and October, there is more water allocated than is available. This allocation includes in-stream water rights which were requested by the Department of Fish and Wildlife



(ODFW) in 1985. Fall Creek and the mainstem of the Alsea River have in-stream water rights granted to ODFW to provide ade-quate aquatic habitat.

TABLE 3-9: WATER AVAILABILITY (BY MONTH) FOR DIFFERENT STREAMS IN THE ALSEA BASIN (OWRD DATA)

River / Month	J	F	M	A	M	J	J	A	S	O	N	D
Alsea R. @ mouth	Y	Y	Y	Y	Y	Y	Y	Y	Y	No	Y	Y
Alsea R. @ Line Cr.	Y	Y	Y	Y	Y	Y	Y	No	No	No	Y	Y
Alsea R. @ Tidewater	Y	Y	Y	Y	Y	Y	Y	No	No	No	Y	Y
Alsea R. @ Five R.	Y	Y	Y	Y	Y	Y	No	No	No	No	No	Y
Fall Cr. @ mouth	Y	Y	Y	Y	Y	No	No	No	No	No	No	Y
S. Fork Alsea @ mouth	Y	Y	Y	Y	Y	No	No	No	No	No	No	Y
Bummer Crk. @ mouth	Y	Y	Y	No	No	No	No	No	No	No	No	No
Lint Slough	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Five R. @ mouth	Y	Y	Y	Y	Y	No	Y	No	No	No	No	Y
Drift Creek	Y	Y	Y	Y	Y	Y	Y	Y	Y	No	Y	Y

Y = Yes: sufficient water is available. No = sufficient water is not available.

Figure 3-5: Water Availability on the Mainstem Alsea River (by month)

Water Quality

Forest harvest activities, population changes, and agricultural/rural land uses are responsible for the majority of impacts to water resources. The Environmental Protection Agency (EPA) Index of Watershed Indicators gives the Alsea Watershed an overall watershed score of 3 on a scale of 1-6, with 1 being better water quality and 6 being the most serious water quality problems. The Alsea River has less serious water quality problems than more industrial watersheds, so therefore it has a lower vulnerability to stressors such as pollutant loadings. Beneficial water uses include drinking water, recreational swimming, and fisheries/aquatic resources.

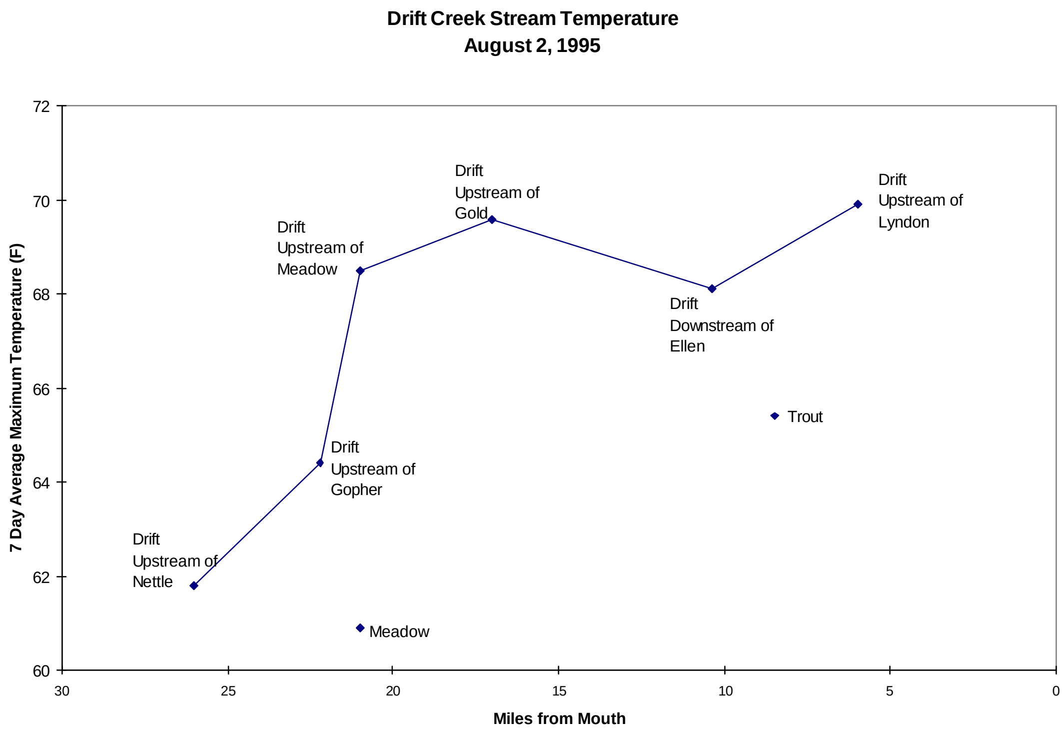
In the 1998 draft of *Water Quality Limited Streams* (Department of Environmental Quality [DEQ]), the mainstem of the Alsea River is listed as water quality limited for temperature from its mouth to the confluence of the North and South Forks. Seventy per cent of summer temperature records exceeded state water quality standards of 64 $^{\circ}$F, with a maximum temperature of 75 $^{\circ}$F. In addition, Fall Creek is listed as water quality limited for temperature from its mouth to the headwaters. Each of the four watersheds that drain into the lower Alsea mainstem contribute water which exceeds state water quality standards for temperature. Monitoring in the North Fork and South Fork of the Alsea River, which enter the analysis area from the east, has shown that water temperatures exceed state standards during the summer. The North Fork is listed by DEQ as water quality limited; the South Fork is not listed at this time. In addition, Five Rivers and Drift Creek are listed as water quality limited for temperature.

Stream Temperature

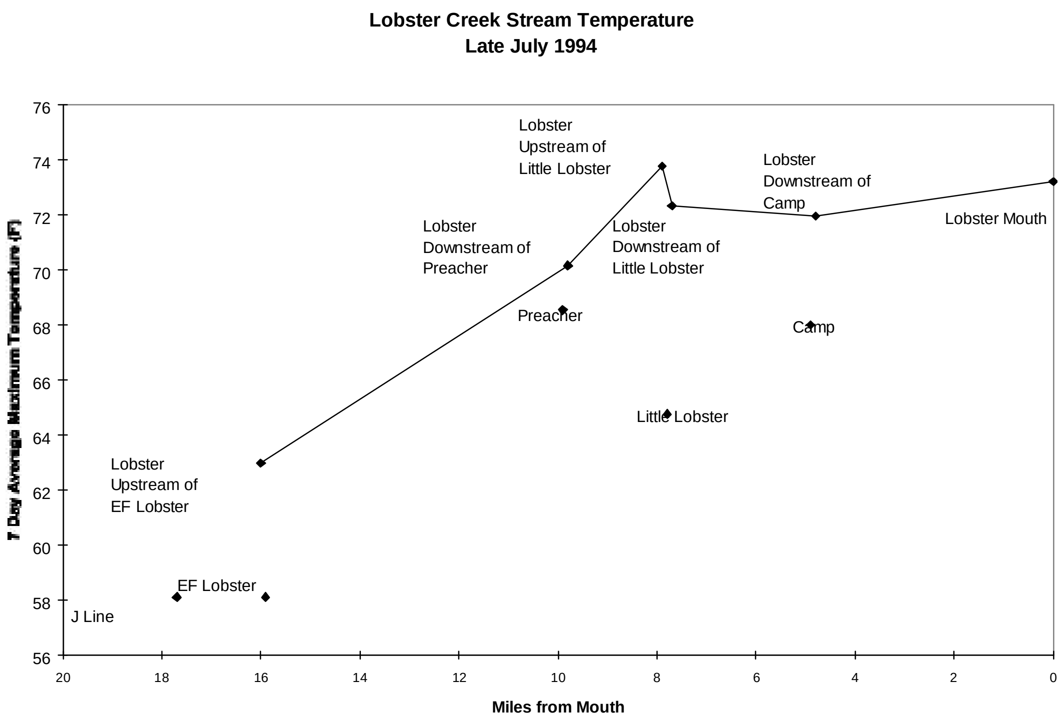
The water quality parameter of greatest concern for salmonids has been identified as water temperature. Stream temperatures in much of the mainstem Alsea and the lower portions of some large tributaries are too high to support rearing salmonids during portions of July and August. Juvenile sampling in the Alsea mainstem in the summer of 1994 found only a few salmonids, whereas dace were abundant (USDA Forest Service 1994). Large increases in juvenile Chinook abundance in the upper estuary coincide with the first hot days in mid-July (B. Buckman, ODFW, pers. com.), indicating that timing of estuary migration may be due, at least in part, to avoid warm stream temperatures. Upstream areas that are suitable for salmonids most often have higher temperatures than are optimum for salmonid production (Oregon Department of Environmental Quality 1995). This, combined with limited habitat availability in areas with suitable summer temperatures, could severely limit production capacity of the basin when seeding is high.

Continuously recording temperature probes have been placed in approximately 100 sites throughout the Alsea Basin by ODFW, BLM, and USFS since the early 1990s (see Appendix 7, "Alsea Basin 7 Day Average Maximum Stream Temperatures"). The data indicate that approximately 150 stream miles exceed the DEQ seven day average maximum (7DAM) temperature standard of 64 °F (Map 25: "Stream Temperatures"). This is a minimum estimate of affected miles since several streams have not been measured recently, and some 7DAM temperatures presented did not capture the warm-est time of year due to equipment malfunction. Only about 10% of sites are below the preferred
60 °F maximum rearing temperature for salmonids (Oregon Department of Environmental Quality 1995); most of these sites are located in small, steep tributaries. Data from approximately sixty similarly located sites in the early 1950s found most sites were less than 60 °F (Oakley 1963). The highest temperature found in the 1950s, 66 °F, was on the Alsea below the forks, with all other sites ranging from 53-63 °F. Although this indicates that stream temperatures may have increased substantially since the 1950s, the absence of data on time of day the temperatures were taken in the 1950s limits comparison with the 1990s data.

The highest rate of increase in stream temperature occurs in upper portions of large tributary mainstems such as the upper portions of North Fork and South Fork Alsea, Lobster, Five Rivers, and Drift, and in small to medium-sized tributaries (<10,000 acre watersheds). Longitudinal data from Lobster and Drift illustrate that most of the heating occurs in the upper portions of the mainstem tributaries, with little change in 7DAM temperatures in the lower mainstem (Figures 3-6 and 3-7, "Drift Creek and Lobster Creek Stream Temperatures"). Although there is little change in mainstem 7DAM temperatures once the stream reaches 70-75 °F, its hourly and daily duration of high temperature typically increases downstream, making habitat less suitable for salmonids (*Lobster/Five Rivers Watershed Analysis* [USDI Bureau of Land Management 1997]). A similar pattern is likely in North Fork Alsea and Five Rivers. If their flows are large enough, cool water tributaries that enter the mainstem after it is already warm, such as Little Lobster (Figure 3-7, "Lobster Creek Stream



Figures 3-6 & 3-7: Drift Creek (above) and Lobster Creek (below) Stream Temperatures



Temperatures"), can have a strong influence on mainstem temperatures and provide salmonids with cold water refuges.

Small to medium-sized, unconfined, low-gradient (<4%) stream reaches have been found to have the highest rates of temperature increase, particularly when shade is reduced. Alsea Basin 7DAM temperatures are relatively consistent (range 70-75 °F) among 20,000 to 206,000 acre watersheds, but are highly variable (range 56-73 °F) among <10,000 acre watersheds (Figure 3-8, "Maximum Stream Temperature by Watershed Area"). Watersheds with approximately 4,000 acres have 7DAM temperatures that range from 59 to 73 °F, while 8,000 acre watersheds range from 63-74 °F (Figure 3-9, "Maximum Stream Temperature by Sub-Basin less than 10,000 Acres").

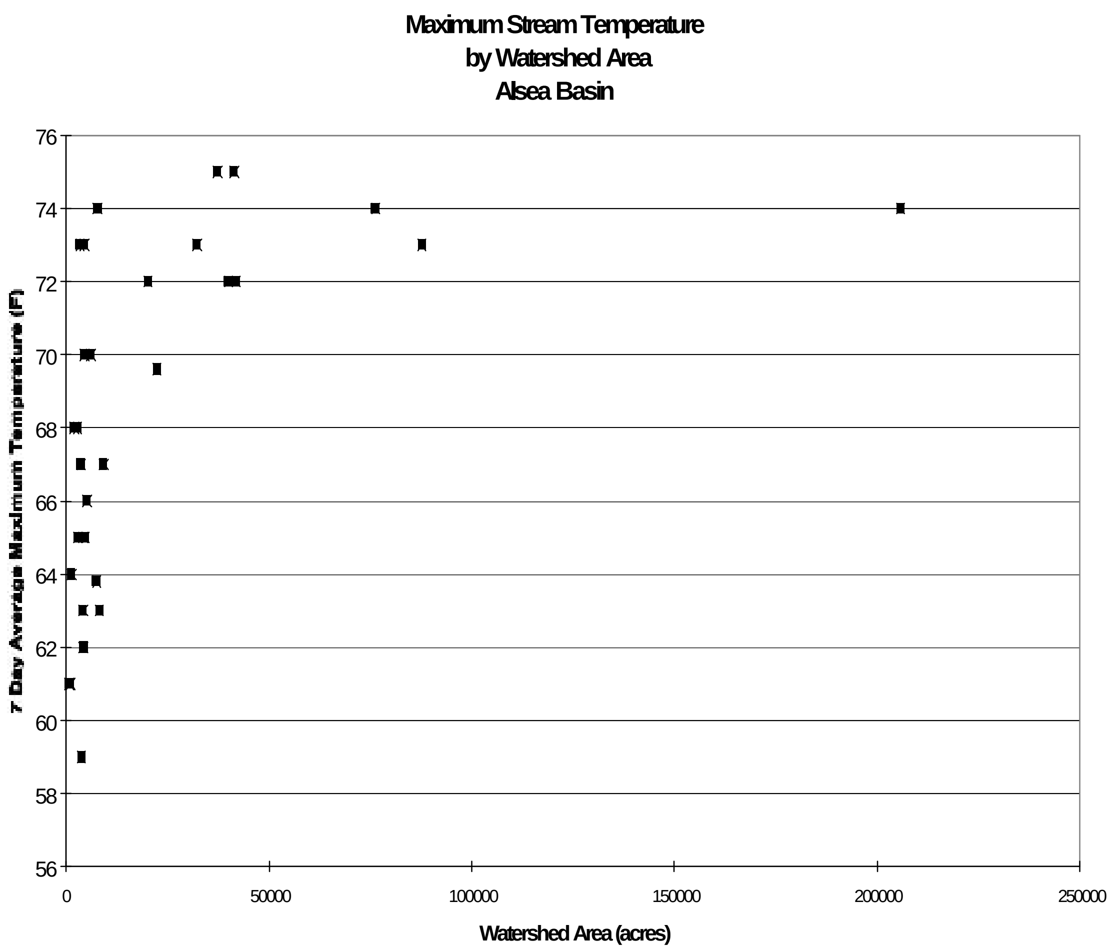


Figure 3-8: Maximum Stream Temperature by Watershed Area

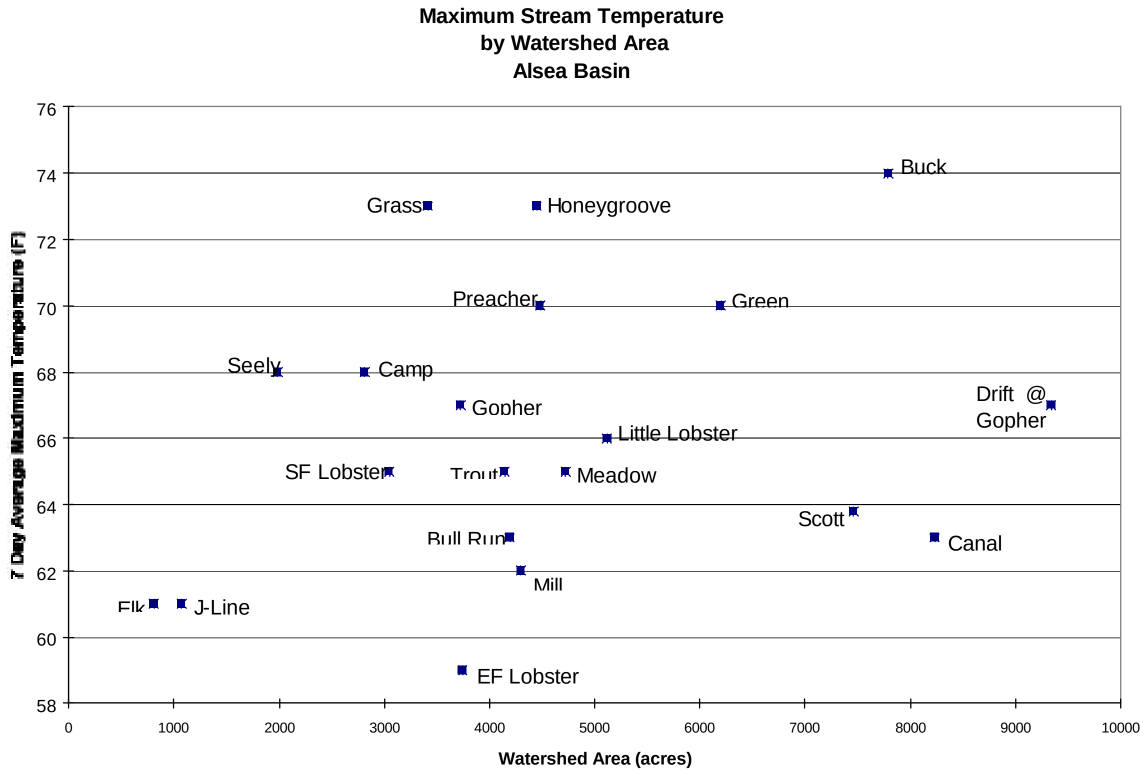


Figure 3-9: Maximum Stream Temperature by Sub-Basin less than 10,000 Acres

The north side of the Alsea seems to have cooler streams (Mill, Scott, and Upper Drift) than the south side (Grass, Buck, Green and Preacher). This may be due to steeper channel gradients with fewer pools on north side streams and/or denser riparian cover and/or potential groundwater influence. Relatively high temperatures in small to medium-sized watersheds are found downstream of reaches where shade has been reduced (Buck, Grass, Honey Grove, Preacher, Meadow Fork, Gopher and Green).

Fall Creek is currently listed as water quality limited for exceeding the state water quality standard of 64 °F during the summer rearing period of June 1 to September 15. The temperature probe which established that the 7DAM stream temperatures exceeded 64 °F (with a maximum of 71 °F) were occurring in Fall Creek does not, in fact, represent true stream temperatures. That probe measured water temperature below the upper pond at the ODFW fish hatchery so the temperature data represent pond surface water temperatures as water was brought into the fish hatchery.

In 1998, BLM, Georgia Pacific, and Willamette Industries met to discuss water quality in Fall Creek and agreed to a strategy of sampling. USFS installed temperature probes mid-summer (August 8) 1998 in 8 locations throughout the watershed. Although the July heat wave was missed, the August heat wave was captured. The upper watershed, above and including Bull Run Creek, showed 7DAM temperatures that ranged from 56.5 to 63 °F. Instantaneous maximum temperatures in mid-August on the Fall Creek gauge in the meadow above the fish hatchery were around 65 °F for four days. Temperatures at the mouth of Skunk Creek had a seven day average maximum of 62.2 °F, with a maximum of 64 °F for that same August heat wave. A temperature probe in Fall Creek above Skunk Creek had unreliable data until late August; the maximum high in September was 64.9 °F. The mouth of Fall Creek had a 7DAM of 66.7 °F with a high of 69.9 °F. At this time, it is unknown how far upstream from the mouth of Fall Creek water temperature exceed state water quality standards. The Alsea Watershed Council is continuing to bracket this watershed with temperature probes for the summer of 1999. The information, which will be summarized in the fall of 1999, will assist in the delisting of portions of Fall Creek as water quality limited.

High temperatures in Meadow Fork, Upper Green, and Lake may be the result of timber harvest that removed tall coniferous shade and temporarily improved habitat for beavers by increasing their food source, deciduous vegetation. Each of these basins has a recent history of extensive beaver ponds that have killed most of the trees on the valley floor. When beaver ponds are not formed, these streams are shallow and have some of the highest rates of heating observed, with daily ranges of 13-15 °F during the hottest period. It is not known if the rate of heating changes when beaver dams flood these valleys, considering the potential cooling that can occur as water is forced subsurface. It is important to note that these, and other similar sites, are quickly colonized by alder when beaver ponds do not form and may become naturally shaded in a relatively short time frame. Several probes were placed in these areas in summer 1998 to better understand these dynamics.

Cool water sources such as tributaries and groundwater likely provide critical refuge for salmonids rearing in warm streams during summer. Cool water refuge areas have not been identified in the Alsea River. However, the presence of coho juveniles in small, steep streams adjacent to the Alsea mainstem, such as Minotti, Bear and Cedar creeks, may be the result of fish migrating out of warm areas in the mainstem into cooler tributaries. In the Grande Ronde Basin in eastern Oregon, salmonids have been observed to have daily migrations into cool water pockets as stream temperatures begin to go higher than 68 °F (Joe Ebersole, OSU, pers. com.). A well-dispersed distribution of cool water refuges allows salmonids to occupy areas that would be otherwise unsuitable, and reduces energy, stress, and predation risk during migrations. This emphasizes the need to maintain and restore cool water sources. Some cool water sources have been lost or reduced by domestic and municipal water withdrawals (Map 24: "Water Uses") or by accelerated heating from a loss of shade.

Effects of altered stream temperatures are not limited to summer rearing of salmonids, but include effects on fry emergence timing, fall, winter and spring production, disease, competition, and dissolved oxygen. A comprehensive review of aquatic effects and basis for standards can be found in the Oregon Department of Environmental Quality's review (1995).

Other Water Quality Parameters

Several other water quality parameters which have been measured in the estuary portion of the Alsea River system are discussed briefly below.

Dissolved oxygen levels are generally high (Matson 1972) at 10-12 ppm, which indicates an unpolluted estuary. (The State Water Quality standard for dissolved oxygen is 6 ppm.) The lowest dissolved oxygen values (5.8 ppm) were measured in the North Channel near the diked end where flushing is poor (McKenzie 1975).

Turbidity measurements show that low turbidity values (0.8 JTUs) occur during low flow periods. These values were higher than the turbidity of the ocean water during high tide events, indicating that the Alsea River is carrying more suspended sediment than the ocean water. Higher turbidity levels occur in the Alsea River during high flow events; turbidity readings of several thousand JTUs could be expected (McKenzie 1975). No attempt has been made to relate turbidity levels to landslides or other forms of erosion that add sediment to the stream channels.

Sediments in the Alsea estuary originate from river-borne material. Marine sands and river-borne silts and sands comprise the majority of sediment deposited in the bay.

McKenzie (1975) also measured pH levels, with the open ocean water at a pH range of 7.5 to 8.4 and the Alsea River during high flow events at pH 6.0. The estuary would be within these ranges. State Water Quality Standards for pH are between 6.5 and 8.5.

The state's water quality standard for fecal coliform (bacteria commonly found in sewage and potentially dangerous to humans) is a maximum of 200 per 100 ml sample (200/100 ml). (The Oregon Department of Agriculture is currently analyzing data from a fecal coliform study done in conjunction with the Port of Alsea. At the time of this writing, that information was not available.) Monitoring of fecal coliform levels in the 1970s indicated that total coliform counts of 460/100 ml occurred frequently in the bay. Fecal coliform counts as high as 240/100 ml have been recorded but are normally less than the water quality standard, with a range of 15-150/100 ml recorded in most of the bay. In the summer months, fecal coliform counts were higher upriver (Bains Slough area) than in the bay; this trend is reversed during the higher flow of the winter months. Winter months in general had a higher fecal coliform count than the summer months due to rainwater running overland and picking up bacteria.

Channel Condition

The biggest change in channel function that has been identified is disconnection with the flood plain. The mainstem of the Alsea is wide, and the flow powerful enough to move large wood deposits. However, there are records of large log jam deposits near Missouri Bend that settlers cleared to transport their goods downstream. In the mainstem, localized deposition of large logs would temporarily create backwater channels. In the lower portions of tributary streams, however, it is expected that a series of log jams would become established over time and would create significant backwater habitats as the stream spread out in the valley bottom during high flow events.

Past management practices required that loggers and landowners remove wood from stream channels to allow for fish passage. As a result, stream surveys show that many of the streams have a low level of large wood accumulation. Removal of this wood allows sediment and water to move more rapidly through the stream system.

Downcutting rates of the river system appear to be occurring within natural levels. High stream terraces along the lower Alsea River and some tributaries are a result of geologic uplift or changes in ocean level. Downcutting as a result of dredging or removal of large woody material has not been documented.

Areas of historic gravel deposits at some tributary junctions are noted by landowners. In the 1970s, these deposits were mined for road rock. Bank erosion and landslides contribute to these gravel sources. A survey of the mainstem showed that these gravel source areas are still occurring today and facilitate spawning within the mainstem of the Alsea River. Hardening of river banks to protect boat launch and residences, and restricting sediment delivery by culvert and road placement across stream channels, reduces the input of gravel to the riverbed.

Channel complexity and roughness in the Alsea Basin have been steadily reduced since the area was settled in the mid-1800s. Initial stream cleaning efforts were focused on the Alsea mainstem by rafters transporting goods from Alsea to Waldport as early as 1870. For example, "trees had the habit of piling up and blocking passage" (of boats) at the narrows, about 4 miles below the forks (Farnell 1981). Rafters would destabilize the "key" piece(s) that would allow the entire jam to float downstream. Occasionally, settlers blasted boulders to improve raft passage. Periodic log drives probably also contributed to early cleaning of the Alsea mainstem.

In 1897, the Corps of Engineers completed a stream cleaning project on the Alsea River to improve boat navigability from the forks to the head of tide. They ". . . provided a high-water boat channel, varying in width from 20 to 50 feet, clear of all obstructions above the plane of low water, which may be run with comparative safety on any ordinary rise . . ." (U. S. Army Corps of Engineers 1898). The preliminary survey of the river in 1894 outlined a plan to remove approximately one hundred boulders (1/3 to 9 yd^3 each) from approximately sixteen sites (U. S. Army Corps of Engineers 1895). Some boulders and bedrock ledges were blasted while smaller boulders were rolled out of the channel. Three wooded islands that ". . . divide the river, making both channels narrow and catches drift badly, as, it is well covered with heavy brush and saplings . . ." were also identified to be "cleared off" (U. S. Army Corps of Engineers 1895). These wooded islands ranged from 150-300 ft. long and 30-50 ft. wide.

In the mid-1900s, stream cleaning efforts extended into tributaries. Surveys by the Oregon Fish Commission in the late 1940s-50s (Oakley 1963) identified several jams on tributaries of the Alsea. Log jams were identified on most tributaries, with the largest jams often recommended for removal to facilitate fish passage. Concern about the effects of excessive logging slash in streams often resulted in overzealous cleaning that removed all wood from stream channels adjacent to harvest units. In the 1990s, logs continue to be removed from stream channels, estuaries and ocean beaches where access is easy or structures are presumed threatened by the debris.

Estuary Condition

The Alsea estuary has experienced numerous alterations that have affected the amount and distribution of habitat and some of the functions of those habitats. McKenzie (1975) provides a list of major alterations to the estuary that occurred prior to 1975. Notable impacts include:

- beginning with European-American settlement in the late 1800s and continuing until 1972, extensive marsh, tideland, and estuary fill in the area that is now the town of Waldport, particularly around the mouth of Lint Slough and the area north of McKinley's marina;
- construction of a wooden groin east of Eckman Slough that extended two-thirds of the way toward the northern shore; construction occurred around 1914 and the last pilings were removed in 1958;
- construction of a railroad trestle crossing the Bay just east of Lint Slough in 1917;
- construction of the first Highway 101 bridge in 1934 (this bridge was replaced with the current bridge in 1991);
- construction of the Highway 34 bridge near Tidewater in 1940;
- in 1956 and 1957, damming of the north channel at its upstream connection to the southern channel, and construction of wooden dikes where the northern and southern channels connected between the high marsh islands; these barriers were partially removed in the early 1980s;
- construction of a dike and tidegate across the mouth of what was Eckman Slough, now Eckman Lake, in 1957; and
- construction of a dam, levee, and water control structures to convert Lint Slough into an experimental salmon smolt rearing facility in 1963.

Other significant alterations to the estuary and associated habitats not noted in McKenzie (1975) or occurring since 1975 include:

- stabilization of the Alsea spit and associated habitat loss by introduction of European beachgrass, residential development, and placement and subsequent augmentation of rip-rap;
- construction of the City of Waldport's wastewater treatment plant, with its outfall at the mouth of Lint Slough;
- construction of dikes around marshes in several locations east of Eckman Slough and in lower Drift Creek;
- installation of a tidegate at Bain Slough; and
- construction and associated fills, culverts, and tidegates of Highway 34 along the southern margin of the Bay, and Bayview Road along the northern margin of the Bay.

The most recent delineations of habitat types within the estuary were done in the mid-70s. The *Alsea Wetlands Review* (U.S. Army Corps of Engineers 1976) reports that in 1976 the Alsea estuary sup-ported 37 acres of low marsh, 503 acres of high marsh, 47 acres of eelgrass, and unquantified acre-age of sand and mud flats. Further delineation and discussion of saltmarsh types can be found in Jefferson (1975). These habitats are important to a tremendous diversity of species: sensitive and declining salmonids such as coho and steelhead; commercially important fish such as starry flounder and herring; commercially and recreationally important shellfish and crustaceans such as cockles and

Dungeness crab; bald eagles, osprey, green and great blue herons, waterfowl, shorebirds, and other resident and migratory birds; and countless numbers of vertebrate, invertebrate, plant, algal, and bacterial species that contribute to the estuarine ecosystem and are part of the natural heritage of Alsea Bay.

Using information in the *Alsea Wetlands Review* (U.S. Army Corps of Engineers 1976) and historic and recent aerial photos, a map was constructed which approximates the locations and types of changes to estuarine habitats around the margins of the bay (Map 26: "Alsea Bay Estuary Disturbance"). From this map, the following extent of loss and functional impairment of the estuary's fringing habitats and sloughs can be estimated:

- 1,019 acres lost to dikes and fill;
- 7 acres lost to excavation;
- 229 acres of sloughs and tributaries where tidal influence has been impaired or eliminated;
- 471 acres of tidelands (marsh and mudflat) with impaired tidal influence; and
- 821 acres of intact tidelands.

These approximations of loss are also indicators of the degree to which the estuary has become disconnected from adjacent upland habitats, its shoreline has become less spatially complex, and its interaction with tributary streams and sloughs impaired or eliminated.

The Alsea estuary also differs from historic conditions in the amount and type of woody debris providing aquatic and intertidal habitat complexity. As discussed elsewhere in this document, large woody debris dynamics within the Alsea watershed have been altered through reduction and changes in the type and delivery of source material, and through purposeful removal of wood from aquatic systems. These changes are evident in the estuary, where some wood is retained, particularly along the north margin of the bay, but large pieces are notably lacking.

Various analyses of the Alsea estuary mention the periodic public perception that Alsea Bay is filling up with sediment. This perception was not voiced in discussions with long-time residents of the Waldport and Tidewater areas during this watershed analysis. McKenzie (1975) speculated that net sediment deposition could be occurring in the north portion of the bay, facilitated by the damming of the north channel. However, by evaluating early descriptions of the estuary, McKenzie concluded that the shallowness of Alsea Bay is natural and not the result of recent alterations. The *Alsea Wetlands Review* (U.S. Army Corps of Engineers 1976) echoed McKenzie's conclusions. Peterson, Scheidegger and Schrader (1984) examined the evolution of the bay's depositional environment over the last 10,000 years; they estimated that estuary's sedimentation rate over the last 5,000 years has been 0.21 cm (0.08 in) per year.

Riparian Vegetation

Activities associated with settlement, roads and timber harvest have substantially altered riparian vegetation conditions in the analysis area. The highest impact has been a substantial reduction in large conifers and reduced stream shade. The loss of large conifers in riparian areas has long-term effects on wood recruitment to stream channels and flood plains.

The Yaquina Fire and settlement in the mid- to late 1800s removed most of the riparian vegetation from streams located in depositional reaches. Subsequent road maintenance and construction have kept these areas in a predominantly early seral condition. Beginning in the mid-1900s and continuing until recently, timber harvest and road construction removed riparian vegetation along steeper streams. These effects are most pronounced and will be longest lasting along stream sections that have roads and houses adjacent to them or continue to be maintained in meadow conditions.

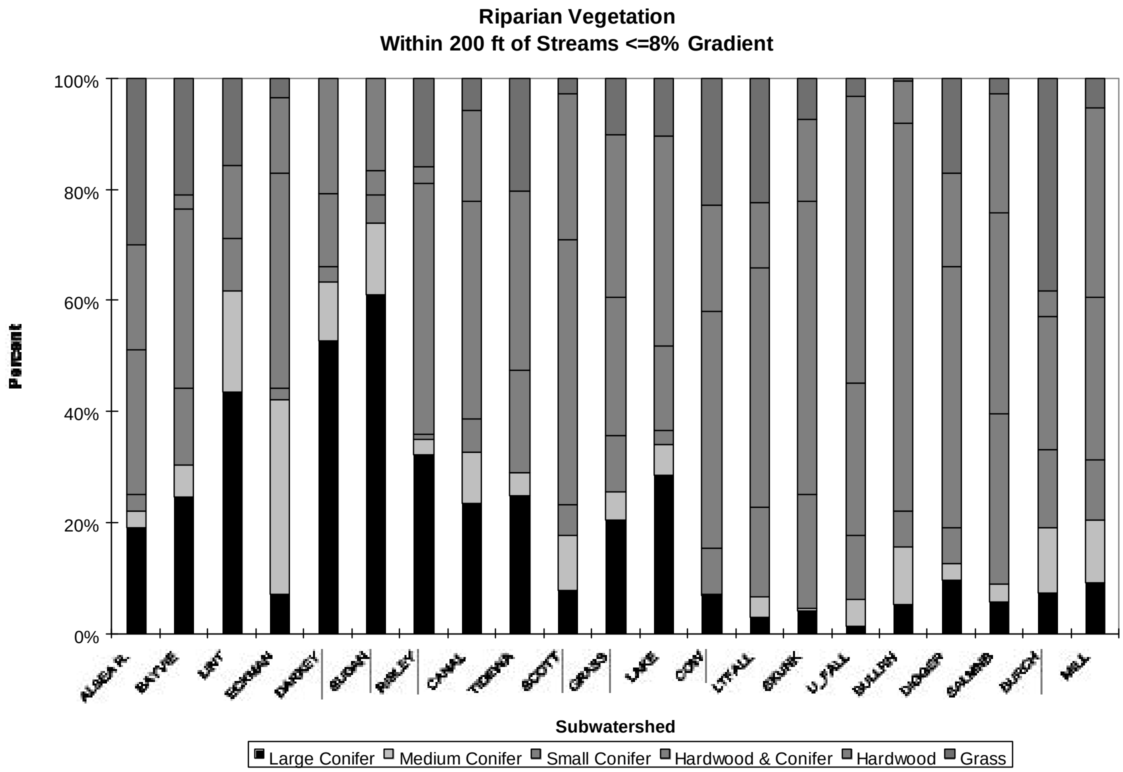
Low Gradient (<8%) Streams

In the late 1930s, there appears to have been slightly more meadow habitat adjacent to the Alsea mainstem than there is today. In part, this is the result of the riparian vegetation being mostly small and young in the 1930s and of its subsequent increase in width with age until the present. However, some meadows have also been abandoned and allowed to revegetate, while others have been converted into house lots, particularly along the tidal portion of the mainstem.

In 1939, the largest patch of natural vegetation along the Alsea mainstem could be found in the Alsea Valley between Salmonberry and Narrows Creeks. The vegetation was composed of a variety of coniferous and deciduous species. Since then, this area has been converted into mostly meadow habitat.

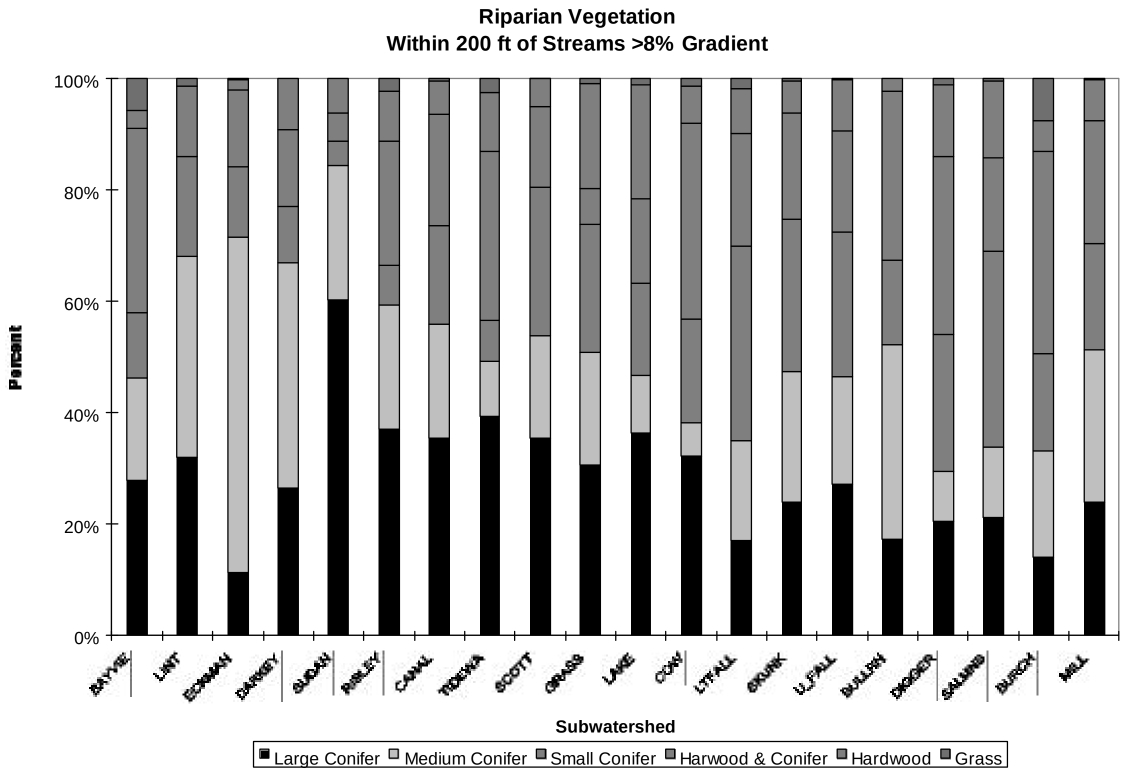
Large conifers in riparian areas are more abundant in the western portion (west of Cow subwatershed) than in the eastern portion of the analysis area (Figure 3-10). Lint, Darkey and Sudan subwatersheds have the least impacted riparian vegetation, with about 40-60% mature conifer remaining. If settlement, road construction and timber harvest impacts had not occurred within these subwatersheds, mature conifers would comprise about 70-80% of the vegetation. Most other subwatersheds in the western portion have about 20-30% large conifer, indicating a two-thirds decrease from what would be expected at this point in succession. The eastern portion has even fewer large conifers, with most subwatersheds having less than 10%. In addition, the high proportion of meadow and hardwood dominated stands within riparian areas indicates that large conifer development will take a long time in these areas. This low level of large conifers in riparian areas will prevent sub-stantial recruitment of large wood to streams for the next several decades.

The removal of tall conifers and other trees adjacent to streams has reduced stream shade, particularly along depositional reaches. The most obvious reductions are adjacent to meadows along the Alsea River, lower Canal, lower Grass, lower Fall, and several small tributaries in the Burch subwatershed. Timber harvest has also reduced shade by removing tall conifers that are capable of casting long shadows (see Figures 3-12, "Canopy Closure by Subwatershed,").



**Fi
gure 3-10: Riparian Vegetation within 200 ft. of Streams <=8% Gradient**

Riparian vegetation along steep streams (>8% gradient) is somewhat similar among subwatersheds within the analysis area (Figure 3-11, "Riparian Vegetation within 200 ft. of Streams >8% Gradient"). Large conifers comprise about 30% of the area, which is about 50% less than expected at this point in natural succession. Conifers (small, medium, and large) are established on about 70% of the area; however, with careful thinning, small and medium conifers could become large within a few decades.



**Fi
gure 3-11: Riparian Vegetation within 200 ft. of Streams >8% Gradient**

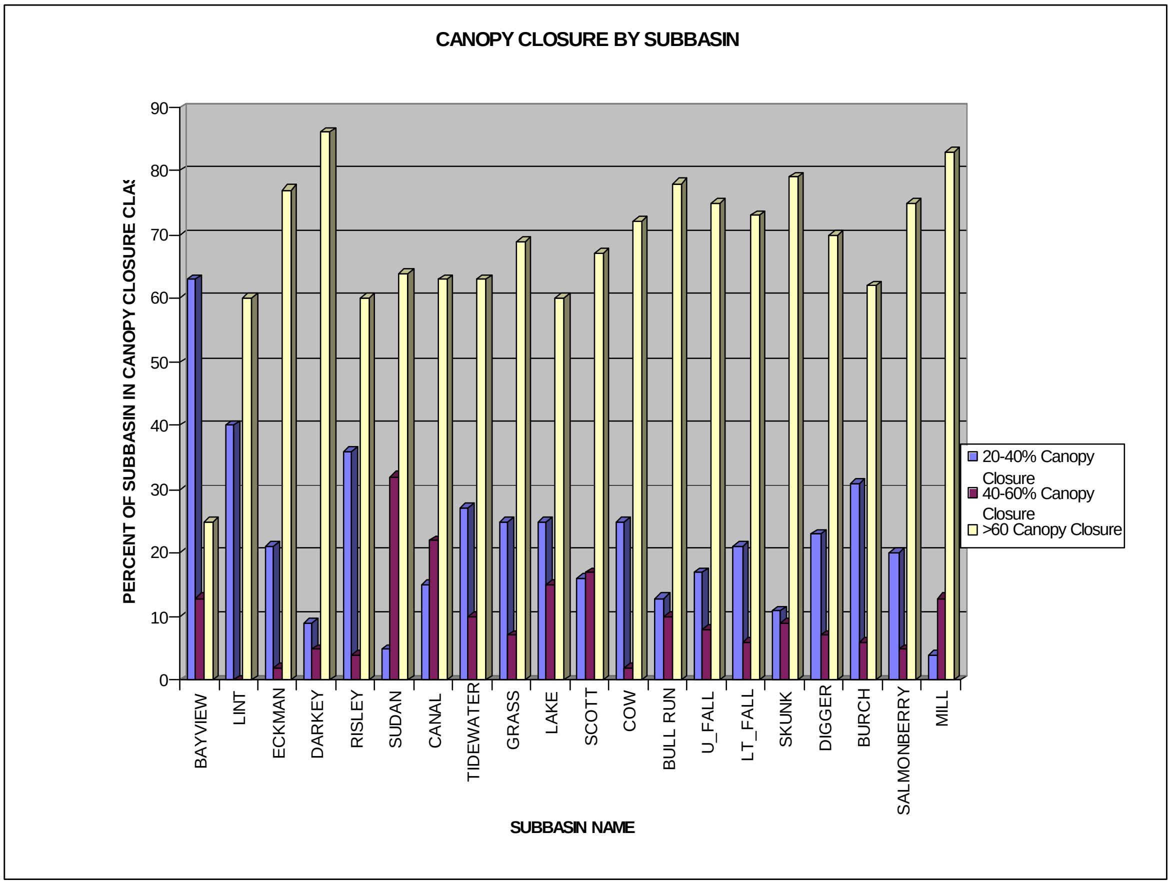


Figure 3-12: Canopy Closure by Subwatershed

Pool habitat and Large Wood

Pool habitat and large wood conditions have been surveyed for low-gradient (<=4%) streams in the Lower Alsea, Drift, and Five Rivers subwatersheds of the Alsea Basin. Weighted average values per stream are displayed in Figures 3-13 ("Pool Habitat in Streams <=4% Gradient") and 3-14 ("Large Wood in Streams <=4% Gradient"). However, it should be noted that some reaches may contain higher or lower values. Wood additions from recent restoration activities through 1997 have been included where known (Green, Wilson, Bear, Cascade and North Fork Cascade).

Since the late 1980s, most low-gradient streams have been surveyed in the lower Alsea, Five Rivers and Drift subbasins. Key streams that do not have recent surveys include the entire Alsea mainstem, Fall, Mill, Eckman, Digger, Lint, Five Rivers downstream of ~RM 19, Lobster downstream of ~RM 17, and Little Lobster. The following discussion of habitat conditions is limited to *surveyed streams only*.

Pools are abundant in Drift Creek (Alsea) and Five Rivers subwatersheds and moderately abundant in the lower Alsea (Figure 3-15, "Pool Habitat in Streams <=4% Gradient"). Average per cent pools for all miles surveyed are 33% in Lower Alsea, 55% in Drift and 69% in Five Rivers. Deep pools (>3 ft.) have a similar trend, with Drift and Five Rivers subwatersheds having 63-75% of surveyed miles with >=20% deep pools, while only 26% of Lower Alsea miles have deep pools. Data from the *Drift Creek (Alsea) Watershed Analysis* (USDA Forest Service 1997a) and field observations indicate that a substantial proportion of pools in all three subwatersheds are formed by beaver dams.

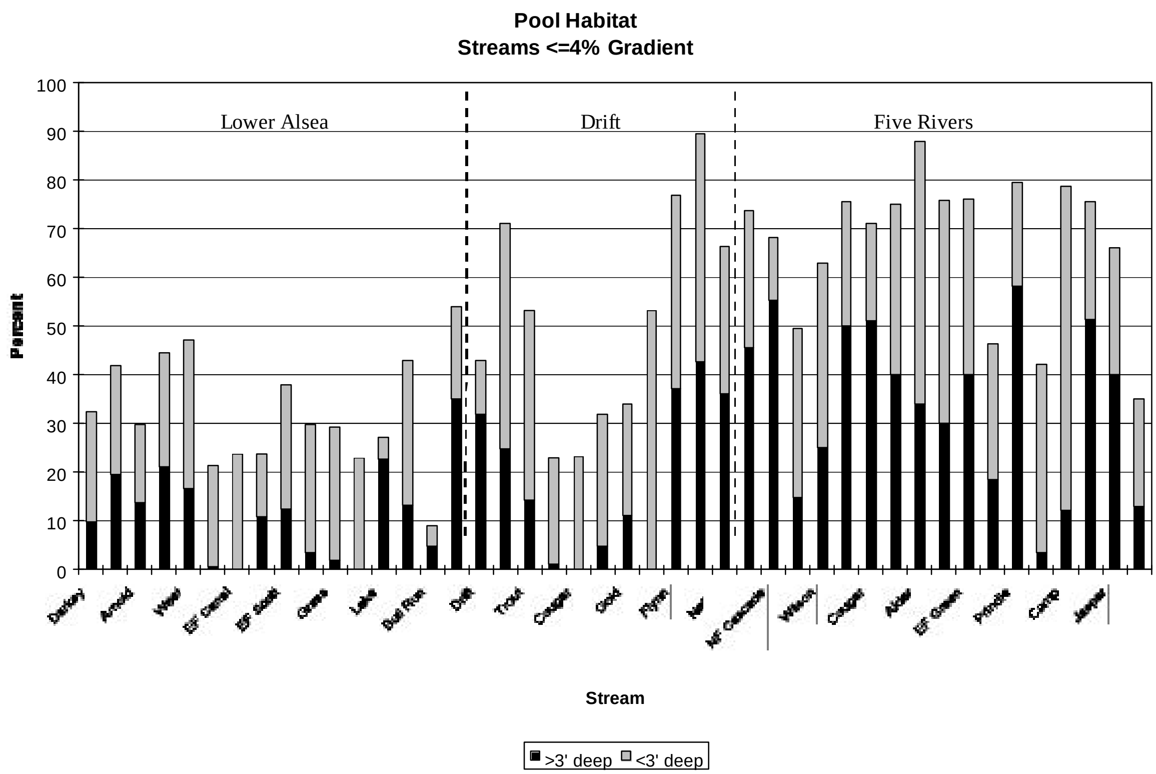


Figure 3-13: Pool Habitat in Streams <=4% Gradient

Almost all streams surveyed have a low abundance of large wood (Figure 3-14, "Large Wood in Streams <=4% Gradient"). Over 90% of the miles surveyed have <40 pieces per mile, while 59% have <20 pieces per mile. Wood abundance among the three watersheds is similar and averages about 20 pieces per mile. In streams with >=20% deep pools, however, large wood is three to four times more abundant in Five Rivers watershed as compared with Drift and Lower Alsea (21, 7, and 5 pieces per mile, respectively). Large wood is almost totally absent (<5 pieces per mile) from 28 miles (21% of surveyed miles), including Canal, Meadow Fork, North Fork Salmonberry, Drift, Meadow, Horse, Nettle and Phillips creeks. Streams where wood is most abundant typically have poor access and were not homesteaded.

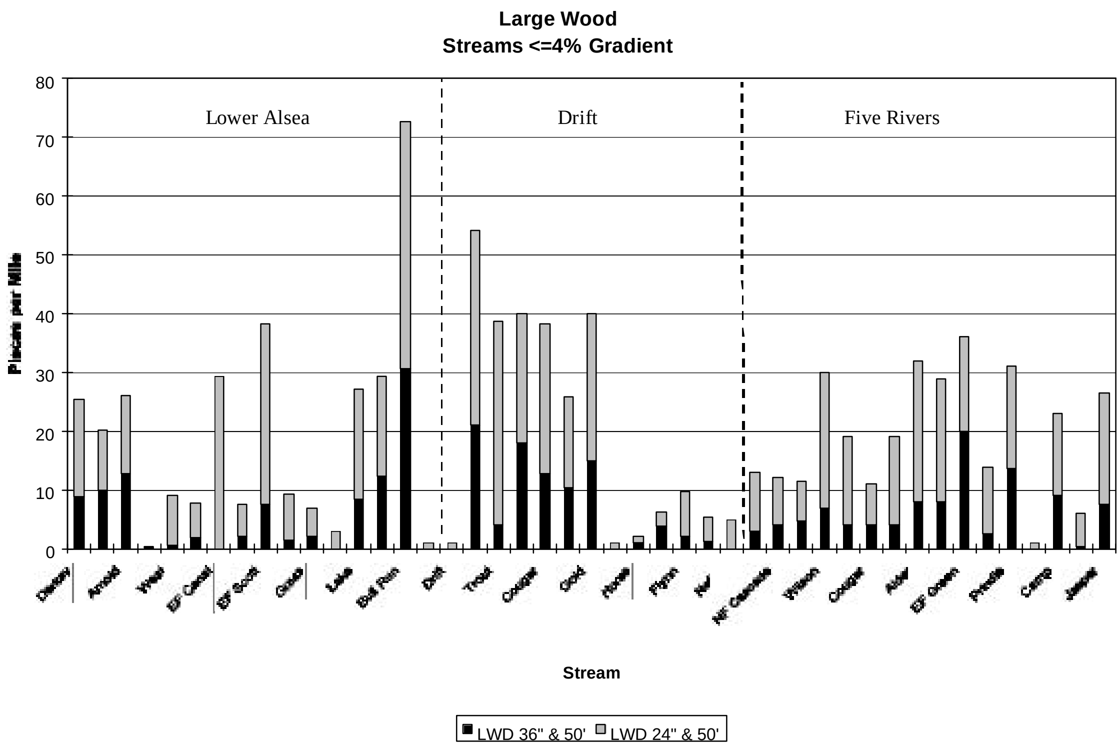


Fig
ure 3-14: Large Wood in Streams <=4% Gradient

Fish Populations: Existing Conditions

The estimated historic distribution of salmonids is presented in Map 22 ("Historic Fish Distribution"). The distribution depicted is based on stream survey observations since the late 1940s, ODFW distribution maps (ODFW 1997), and gradient and confinement classifications identified with this analysis. Historically, lower Fall Creek Falls was probably a barrier to upstream salmon migration prior to the fish ladder construction. However, steelhead were observed to migrate over the falls prior to the ladder being installed in the late 1940s (Ermie Walters and Alvaneda Stouder, pers. com.). It is not known whether anadromous fish passed the falls on Lower Eckman Creek prior to a passage improvement project in 1975. It is possible that, historically, steelhead were the only species to migrate past Eckman Falls, considering its height is similar to Fall Creek Falls.

Current salmonid distribution in the analysis area is similar to historic distribution, with some exceptions. The most obvious change has been an expansion of fall Chinook, coho, and searun cutthroat distribution above Fall Creek Falls after ladder installation in the late 1940s. A similar expansion of coho, searun cutthroat, and possibly winter steelhead may have occurred upstream of Eckman Falls in the mid-1970s, but historic distribution above these falls is not known.

High stream temperatures have likely contracted the summer distribution of salmonids and expanded the distribution of dace. Mainstem Alsea, Five Rivers, Lobster, and lower Drift Creek exceed 72 ºF in summer, which is extremely stressful for rearing salmonids (Oregon Department of Environmental Quality 1995). Although some salmonids rear in cold water pockets within warm streams, most of these reaches appear to be unsuitable for salmonids during summer (USDA Forest Service 1994). For most of the period between large fires, these reaches were assumed to be cooler and/or contained larger cold water pockets due to increased shading and more extensive gravel accumulations associ-ated with large wood. The loss of suitable habitat due to high summer stream temperatures is sub-stantial and has severely reduced the capacity of the Alsea basin to produce salmonids. The expan-sion of warm streams has allowed speckled dace to expand their distribution upstream when com-pared to historic conditions. Similarly, some salmonid species have been found to use short sections of steep streams in summer, presumably to avoid high temperatures in the adjacent mainstems.

Another change from historic distribution is that upstream passage for cutthroat trout is blocked at many headwater road crossings near the upper limit of fish distribution. Although the exact number and location of these sites are not known, most are probably located at some of the road crossings on 8-20% streams within the analysis area.

Anadromous salmonid populations in Oregon coastal streams are substantially reduced from historic abundance. Nickelson et al. (1992) estimate that coastal Chinook salmon and steelhead abundance is about 50% of that estimated near the turn of the century, while coho and chum salmon are less than 10%. Historic, coastwide abundance of cutthroat trout could not be estimated due to poor catch records. Salmonid populations in the analysis area generally follow coastwide trends in abundance.

All salmonid stocks in the analysis area, except fall Chinook and resident cutthroat, are considered depressed with some risk of extinction (Table 3-10). Nehlsen, Williams and Lichatowich (1991) estimated the risk of extinction of stocks, while ODFW (1997) listed stock status relative to historic abundance. Coho salmon are listed as a threatened species under the Endangered Species Act, while chum salmon and Pacific lamprey are Oregon State Sensitive Species. Huntington, Nehlsen and Bowers (1996) listed Alsea fall Chinook as "healthy" considering their abundance was estimated to be 33-67% of historic.

TABLE 3-10: STATUS OF SALMONID STOCKS IN THE LOWER ALSEA WATERSHED

Species	Nehlsen et al. (1991)	ODFW (1997)
Fall Chinook		Healthy
Spring Chinook	Special Concern	Depressed
Chum	High	Depressed
Coho	**Moderate***	Depressed
Winter Steelhead	**Special Concern**	Depressed
Resident Cutthroat		Healthy
Searun Cutthroat	**Moderate (Entire Oregon Coast)**	Depressed

* Bold in this column indicates a high probability of introgression with hatchery fish.

Reasons for the declines in salmonid abundance include both natural and human-caused impacts. Salmonid abundance varies with natural cycles in ocean and freshwater productivity, droughts, and habitat conditions. Since about the mid-1970s, most anadromous salmonids in Oregon have had lower ocean survival than in the previous decades, which is assumed to be due to warmer than average ocean temperatures and weak upwelling, particularly when smolts enter the ocean. Freshwater production may also be depressed due to extended periods without large floods between the early 1980s and mid-1990s, and extended periods of low flow in the early 1990s. Since 1939, over 40% of the days with below average minimum stream flows on the Alsea River at Tidewater have oc-curred since 1986 (last 20% of the record).

Recent human impacts have made the natural low cycle in salmonid populations even lower and have reduced the capacity of the Alsea River to produce salmonids as it did prior to European settlement. Excessive harvest of fish not only left many streams underseeded with juveniles but also substantially reduced salmon carcass abundance. Salmon carcasses provide substantial nutrient inputs at critical times to freshwater habitats (Bilby, Fransen and Bisson 1996). Large hatchery releases may have increased predation on, and competition with, wild stocks. In addition, reliance on hatchery production has de-emphasized the importance of maintaining high quality habitat and diverse life histories of wild fish. Human induced habitat changes have reduced available habitat in the Alsea River and have made the remaining suitable habitat lower quality than expected at this stage of succession.

In the analysis area, the most extensive reduction in freshwater productive capacity from historic conditions has probably occurred in the Alsea mainstem, from the forks downstream to the mouth. Streams in the Alsea Valley, including the North and South Forks, were likely “hot spots” of freshwater production in the Alsea basin during reference conditions. Maintenance of riparian areas in early seral conditions, systematic removal of channel roughness elements (boulders, wood, beaver dams and gravel), and elevated stream temperatures have substantially reduced the capacity of the mainstem to produce salmonids. These effects may not be obvious when salmonid abundance is low, but will be much more apparent when and if population abundance is high. Two recent publi-cations are excellent references for reviewing the complexity of issues impacting salmonid popula-tions in the Pacific Northwest: *Upstream: Salmon and Society in the Pacific Northwest*. (National Research Council 1996) and *Return to the River: Restoration of Salmonid Fishes in the Columbia River Ecosystem* (Northwest Power Planning Council 1996).

Below is a brief outline of key points for each salmonid species in the Alsea Basin. More detailed information is available in ODFW's *Alsea River Basin Fish Management Plan* (1997).

Fall Chinook salmon: Runs in the Alsea basin are considered healthy, with an average size of approximately 10,000 fish (ODFW 1997). Approximately 4,000 fish are caught in the ocean fishery, 2,500 caught in the Alsea, and 4,000 escape to spawn. Hatchery fall Chinook have been released into the Alsea since 1916. Since the late 1980s, approximately 100,000 smolts have been released, which contribute less than 5% to the total run size. Hatchery releases have been discontinued, and fall Chinook are currently managed for wild production only.

Important spawning areas for fall Chinook are found in all major tributaries and in the mainstem from Fall Creek mouth to the Forks. The highest concentrations of spawning Chinook are found in the Alsea Valley upstream of Missouri Bend. Juveniles rear near their spawning sites for only a short period before slowly migrating downstream to rear in the estuary. High summer stream temperatures in the mainstem Alsea limit its capacity to rear salmonids, including fall Chinook, during summer; the estuary provides critical rearing habitat for juvenile Chinook in summer.

Spring Chinook salmon: In the Alsea basin, runs are only a fraction of their historic abundance. Currently only a few hundred fish are estimated annually, while historically there were probably several thousand fish (ODFW 1997). Hatchery releases do not occur for spring Chinook in the Alsea Basin, although some straying of hatchery fish into the Alsea is believed to have occurred in recent years from releases in the Yaquina River. Releases of hatchery spring Chinook in the Yaquina have been recently discontinued.

Important spawning habitat for spring Chinook is located in Five Rivers, Drift Creek and in the mainstem upstream of Fall Creek. The reasons for the decline in spring Chinook abundance are not known, but possible factors are a reduction in suitable holding habitat, disturbance of adults in holding and spawning areas, and competition with juvenile fall Chinook (ODFW 1997).

Chum salmon: The Alsea basin represents the southernmost population with historically consistent returns. Their historic abundance was greater than existing numbers. Catch estimates from 1923-40 report an average of 900 chum landed per year in the Alsea basin. Surveys in about 1950 found chum salmon spawning in Eckman, Darkey, Arnold, Canal and Grass creeks, with about 350 individuals found in Canal Creek. Spawning surveys on the lower mile of Canal Creek in 1993 and 1997 found a peak count of less than 15 chum in each year. In the last decade, chum have also been documented in Grass and Sudan creeks, although only a fish or two were observed. Habitat for chum salmon appears suitable in Lint and Drift Creeks, but there is no documented evidence of them being present in these subwatersheds.

Coho salmon: Abundance in the Alsea basin is severely depressed. The total annual run of coho salmon in the Alsea basin since 1990 has been less than 1,700 fish, except in 1992 when 7,000 fish were estimated (ODFW 1997). From 1923 to 1950, the run size was estimated to average 50,000 fish, with 22,000 of these caught in the commercial net fishery. In 1951, approximately 80,000 coho adults returned to the Alsea, with an estimated 63,000 escaping the fishery to spawn. ODFW (1997) estimates that 15,000-21,000 coho adults are needed to fully utilize current freshwater habitat in the Alsea basin. The numbers of spawners actually needed to maintain life history diversity and the other numerous ecological benefits (for example, nutrient enrichment of streams and riparian areas, food source for predators and scavengers, etc.) that salmon provide to freshwater ecosystems are not considered in this estimate.

Hatchery coho have been released into the Alsea River since about 1908. From the 1960s to the present, Fall Creek Hatchery has been releasing consistently high numbers of coho smolts (around 1,000,000/year, which is the largest amount of smolts released into any Oregon coastal basin). Hatchery coho smolts average about three times the weight of wild smolts.

In 1993, coho harvest was closed in most Oregon coastal basins to increase spawner escapement. While coho abundance in most other basins has stabilized or is increased in the last few years, coho in basins with large hatchery programs, including the Alsea, have declined. Large hatchery programs may be having adverse effects on wild coho by maintaining high predation levels on the few remaining wild smolts during their schooling behavior with the abundant hatchery fish in the estuary. In addition, the relatively abundant and large hatchery smolts may be having adverse effects on wild fish through competition for food during the recent periods of low ocean productivity. ODFW has decided to stop releases of hatchery coho salmon into the Alsea River for five years beginning in 1999, with the intent to improve substantially the survival of wild coho smolts (ODFW 1997).

Winter steelhead: Abundance in the Alsea basin is depressed. The estimated catch from 1923-40 averaged about 3,200 fish per year, and although the total run size is not known, it was probably at least twice or several times larger than the estimated catch (ODFW 1997). Trends in run size based on punch card data show a decline since the 1970s. Hatchery winter steelhead have been released into the Alsea River since at least the 1930s, and hatchery fish have shown a decline similar to that observed with wild fish. Selection for early returns to the hatchery have gradually shifted run timing of hatchery fish from primarily March and April in the 1940s to January and February by the 1970s.

The Alsea has experienced extensive straying of hatchery fish into wild populations: about 50% of steelhead adults caught in Alsea basin traps in the early 1990s were of hatchery origin. The high proportion of hatchery fish in wild populations, combined with a shift toward earlier spawning of hatchery fish, may have adverse effects on wild stocks. Recently, changes in hatchery practices have been implemented which are intended to reduce straying of hatchery fish and to develop a new broodstock from naturally-produced Alsea fish (ODFW 1997).

It is likely that the unique steelhead and cutthroat populations in the Alsea basin have been severely compromised following the “improvement” of barriers to upstream migration. Steelhead that passed these barriers and resident cutthroat populations that existed above them likely evolved unique life history traits, and possibly genetic ones as well, that differed from adjacent populations within the Alsea Basin. Maintenance of life history and genetic diversity allows species to adapt to changing environments and is essential for species persistence. Remaining natural barriers in the Alsea Basin will not be altered to allow anadromous fish passage (ODFW 1997).

Cutthroat trout: This species is the most widespread salmonid in the analysis area (Map 22: "Historic Fish Distribution"). ODFW (1997) assumes that resident populations are healthy due to their wide distribution. However, searun populations, based on creel surveys, have declined substantially since the 1970s. Hatchery cutthroat have been released into the Alsea from the late 1930s to 1996. In 1997, all fisheries for cutthroat trout were placed under catch-and-release regulations due to concern for wild searun cutthroat.

HUMAN USES

Reference Conditions

Historical Use and Development

The Alsea Indians, along with the Yaquina Indians to the North, comprised the Alsea linguistic group, a sub-group of the Yakonan language group. The Alsea, Tillamook and Siuslaw shared the Yakonan language group and many cultural similarities (Zenk 1990).

The Alsea Indians were primarily hunter-gatherers along the Alsea estuary and local coast, although they moved seasonally into the Coast Range for trade and forage. Their diet included freshwater and anadromous fish (including salmon, which they dried and powdered), shellfish and crustaceans, eggs, sea mammals (including whales and sea lions), elk (which they trapped in pits), seasonal fruits, and vegetation. The Alsea also wove many essential items (baskets, fish traps, mats, and cord as well as their clothing) from local plant material (Barnett 1937).

The Alsea participated in trade and cultural exchange centered on the Columbia. The Alsea were skilled wood carvers and actively traded into the headwaters of the Alsea drainage and along the coast at least as far north as the Columbia. Among their most notable exports were carved cedar canoes and slaves. As was common among the wider Columbia group, the Alsea flattened the foreheads of their children through binding, as a sign of free birth (Zenk 1990).

The Alsea winter villages were the primary political and social groups. They were composed largely of the paternal family and were located along the coast and adjacent estuaries. The social structure was patriarchal and patrilineal, and social prominence was gained through the accumulation of wealth (Brauner 1979). Relationships between villages were secured through intermarriage and the exchange of dowry. Dwellings at the winter village were large plank structures sunk into the ground from 3 to 6 feet, accommodating multiple families (Zenk 1990). Summer months were apparently spent somewhat dispersed in the Alsea and Yaquina drainages, gathering stores of food and other resources.

In 1855, President Franklin Pierce created the Siletz Reservation by closing to settlement land along the Coast Range from Lookout Point south to Tahkenitch Lake. In less than two months, however, the reservation was amended for the purpose of building a railroad to Yaquina Bay. A strip 25 miles wide, between Corvallis and Newport, was removed from the Siletz Reservation, and the Alsea people were pushed south of the Alsea estuary. In 1875, under pressure from settlers, Congress closed the Alsea sub-agency entirely and opened the area to homesteaders. The remaining Alsea were removed to other parts of the Siletz Reservation (Zenk 1990).

Estimates of pre-contact populations of Yakonan speakers are as high as 6,000 (Brauner 1979). The population of the Alsea was estimated to be about 1,700 when members of the Alsea made contact (along with other native peoples) with the Lewis and Clark expedition at the mouth of the Columbia in 1806. Their populations plummeted in the 1800s, due largely to exotic diseases introduced with Euro-American exploration and settlement. The census taken in 1875 showed 118 Alseans left (Zenk 1990); by 1930 there were only nine individuals remaining from the entire Yakonan group (Brauner 1979).

Settlement in the Coast Range 1850-1900

Fur trappers probably explored the Alsea drainage prior to 1850; however, they left no historical record or discernible mark on the land. The extent to which their presence impacted the watershed is presumed to be negligible (Reynolds 1993).

Settlement in the lower Alsea watershed may have begun as early 1850 as settlers moved into the Alsea River valley from Corvallis and the Willamette Valley. Settlement occurred rapidly on arable lands immediately adjacent to the main stem of the Alsea. By 1855, most of the good bottomland around the Alsea and its primary tributaries was privately held. Remaining bottomland along the Alsea toward Waldport was settled and put to agriculture through the 1860s, 70s and 80s (Reynolds 1993). By 1886, most of the arable land around Waldport had been claimed and put to agriculture. Settlement was typically agrarian/subsistence and not of a transient nature. Local industry developed in lumber, dairy, grains, and general farm produce. Communities were quickly established in Alsea, Angora, Little Switzerland, Tidewater, Little Albany, and Waldport.

Much of the fertile land surrounding the present town of Alsea was planted in wheat which was harvested and processed in Alsea at a mill erected by David Ruble in 1873. In 1887, he established a saw mill, producing lumber for local use as well as export to Waldport. Early mills were also established at Tidewater in 1872, and Lint Slough and Waldport in the 1880s.

Early Transportation

Initially all goods produced in the Alsea watershed traveled either east up the Alsea and over the Coast Range mountains to Corvallis (along much the same route as Hwy. 34), or west along the Alsea to the coast and then along the beach to Newport. Both of these routes were as arduous as they were dangerous.

Until 1888 when a wagon road was constructed, trade between the Alsea Valley and Corvallis was limited to livestock, which could move to market "on the hoof," and supplies that could be moved by pack animals (Farnell 1981). Even after the construction of the wagon road, the route was exceedingly steep and crooked, putting wagon drivers and cargo at great risk even under the best of conditions. Rain made the dirt track uphill even more difficult, and during winter months, snow often made it impassable (Reynolds 1993).

The route west along the Alsea to the coast was a rough trail limited to pack animal and foot traffic. It had the great advantage, however, of slowly descending in grade, and while the condition of the trail was often degraded by poor weather, it was seldom impassable. Another great advantage was that the trail need only be taken to Tidewater, where the Alsea is navigable to the coast. By 1872 a saw mill and ship building business were present in Tidewater (Farnell 1981).

Cargo was commonly moved on the Alsea River from almost any point along its mainstem in winter or other periods of heavy rain. Cheap wooden scows were typically constructed, packed with wares such as flour, oats, apples and lumber, and then rafted down the swollen river. The trips occurred when the river was 3 to 8 feet over normal flows and exceedingly hazardous. In Waldport, the scow was scrapped for lumber and sold along with the cargo. The dangerous journey downriver was reflected in the price of goods. The return trip was by foot. Local residents and the Army Corps of Engineers sought to improve navigation through the blasting of obstacles such as boulders and logs and the clearing of riparian vegetation and timber (Farnell 1981). Ultimately, improved roads put an end to the dangerous practice.

In 1880, a section of wagon road was constructed from Tidewater over Digger Mountain toward Alsea. Following a of couple of efforts to fund a large-scale road project (1881 and 1884), a wagon road connecting Tidewater and Alsea was ultimately constructed in fragments and largely through local efforts (Reynolds 1993).

Once at the coast, goods bound for Newport were moved north along the beach. The route from Waldport to Newport took well over a day by wagon (these were at risk of being carried out to sea by sudden and large waves) (Ostling [no date]). This basic route was still in place when automobiles became common in the area, a few of which were also lost to the sea or mired in the sand.

On December 31, 1884, a railroad was completed from Corvallis to Yaquina City (four miles east of Newport) and used extensively for freight and recreation between Corvallis and Newport. Travel between Newport and Waldport was rough and slow. Despite the rough trip to Newport, most

Waldport to Corvallis travel took place along this route until the completion of the road through Alsea in 1925 (Morris 1936).

While mail moved between Waldport and Florence weekly, it was an exceptionally difficult route. A passable trail between Waldport and Florence was not completed until 1914.

Present-day Waldport occupies a spit that separates the Alsea Bay from the Pacific. According to early settlers, it was once covered with spruce, "bull pine" (digger pine), huckleberry and rhododendrons. It was a prominent winter village site for the Alsea until their removal, and their plank houses occupied several clearings (Ostling [no date]). Much of the spit was subject to seasonal high water; however, it has been systematically leveled over the years through human efforts. A great deal of fill has been brought in from surrounding hills to raise low areas or to stabilize "soft" spots; dikes and sea walls have been constructed to fortify the spit. Topsoil has been imported to cover the original sand surface, which had little agricultural potential and was subject to constant movement by wind.

Settlement on the north side of Alsea Bay had begun in the late 1860s and spread to the south side even before the closing of the Alsea sub-agency in 1875. Cultural change/turnover occurred so quickly around Alsea Bay that several of the structures once used by the Alsea were appropriated by the settlers as private and municipal buildings. Recent, extensive burial sites were testament to the conditions of the turnover, as the Alsea were decimated by disease.

By 1886 a healthy community had been established at Salmontown on the north side of the bay. Waldport was platted in 1889 by William Keedy and David Ruble (on land owned by Ruble). Substantial industries had already developed in timber and commercial fishing by that time, and oceanic trade had begun. A count taken in 1892 by the Army Corps of Engineers indicated 600 to 640 persons residing in the area of Alsea Bay.

Early Industry

Most settlers maintained a garden for personal use and perhaps to market excess produce as well. Such produce was a common household export, though few seemed to have specialized on a market level. Life on most farms and homesteads was often a marginal venture, and many families supplemented their larder with native fruit, vegetation and other products, such as honey. Fish and game were staples in their diets, as were domestic farm animals such as pigs, sheep, cows and chickens. Stock were raised for market in the Alsea Valley. Cattle ranged over much of what is now National Forest land, long after the creation of the Siuslaw National Forest in 1907 (under special use permit). Dairy products were also a common export on a specialized as well as household level. A creamery was established in Waldport near the turn of the century to process the local dairy products, providing greater longevity in the market place.

Wheat and other grains could not be grown in the lower Alsea Valley due to the moist climate that facilitated fungal diseases, chiefly rust (which stunts the development of the seed head). Wheat was grown in the upper Alsea Valley, however, and milled there for export to markets in Alsea, Waldport and Newport. David Ruble was a pioneer in this field, cultivating not only product but transportation routes and markets as well.

Timber was in constant demand through the turn of the century as a result of local growth. Very little timber was exported out of the area, however, until the turn of the century. Several small mills appeared along the Alsea and its tributaries to meet local demand. Marketable timber was defined in terms of volume of timber, local demand and proximity (ease of transportation) to market/mill. The latter placed the larger constraints on the industry in the latter half of the 20th Century. Marketable timber occurred mainly in steep valleys and along streams of adequate volume to facilitate movement to mill. Logs were commonly rafted down main tributaries as well as the mainstem of the Alsea. A notable occurrence was the export of cherry wood from the watershed to markets in San Francisco. This marks one of the first regional exports of timber and also one of the first oceanic ventures out of Alsea Bay.

Near the turn of the century, an economy in "chittum" (cascara bark) erupted. The bark, collected for medicinal uses, was worth 22 cents a pound in Waldport at its peak worth. Many of the settlers of the lower Alsea watershed participated actively in the trade, but it brought many new faces to the area as well. The newcomers were largely transient, collecting bark seasonally and over a wide area. They built cabins and developed trails but did little clearing or cultivating; their structures were generally not constructed in a manner that lasted. The industry boomed and then largely "went bust" by 1915, although some bark continued to be collected through the 1930s. The greatest legacy of the bark peelers seems to have been their sled trails, which were quickly incorporated into local infrastructure.

The first commercial cannery on Alsea Bay was established in 1886 in Salmontown (just across the bay from Waldport). It produced 52,800 cans of salmon its first year, worth $7,700. In 1887, 240,000 cans were produced, generating $35,000, and a second cannery was built at Lutgins (Ostling [no date]). Chinese workers were brought in to work in the canneries, and local fishermen had little difficulty bringing in adequate amounts of salmon. Overfishing quickly became a serious problem as fishermen sought to catch and sell more fish than the cannery could handle. Excess fish (car-casses) were routinely dumped at the mouth of the bay causing a public nuisance and serious public health concerns. Canning companies were compelled to assign quotas in 1906 in order to protect the resource and keep the peace (Ostling [no date]). While salmon continues to play an important role in the regional economy, the salmon canning industry in Waldport boomed and largely "went bust" by 1930. The Chinese workers did not remain in the community long after the decline of the canning industry. A crab cannery established by Bill Hunter in Waldport in 1930 continued until it was destroyed by fire in 1939.

Transportation existed as an early industry in its own right. Moving cargo on Alsea Bay or over rough roads required some special equipment (a boat, wagon, or automobile) not available to everyone, and moving cargo along the beach or rafting goods down the Alsea at flood stage required special skills. Even the movement of mail over trails between settlements was an activity arduous enough to warrant special compensation and was a significant source of income for many local residents.

Current Conditions

Urban Development

By the turn of the century, the most valuable agricultural land had largely been settled. The population of the watershed continued to grow, however, and more and more marginal lands in the Alsea River valley were settled.

What is now the Siuslaw National Forest was set aside as a forest reserve in 1907, along with numerous other forest reserves across the country. In response to public outcry over the "locking up" of public lands, Congress had earlier created the Homestead Act of 1906. As soon as local Forest Service offices were established, a deluge of homestead applications began arriving. Coast Range lands were surveyed with remarkable speed and impressive detail as the Forest Service began processing the homestead applications.

Very little land in the Coast Range is suitable to agriculture due to steep terrain, poor soils and rapidly encroaching forest and understory. Much of the land in the forest reserve had been subjected to a devastating fire in the mid-1800s, however, giving it the appearance of arable land near the turn of the century. Settlement commonly occurred, and many applications were filed on such parcels under the 1906 Homestead Act. Timber speculation was a common abuse of the 1906 act throughout the region, and a few applications were filed on lands in the Alsea watershed that were clearly valuable only for timberland.

The bulk of the 1906 homestead applications were rejected as lands "not chiefly suited to agriculture." While some homesteads were permitted on land that ultimately proved unfit for settlement, timber speculation in the Alsea watershed seems to have met with little success under the 1906 act.

In the 1910s and 1920s, the value of many existing homesteads as forest land became increasingly apparent. Equally apparent was the inadequacy of the same land for agriculture, and many homesteads were abandoned and reclaimed by the Forest Service; others were sold to private interests.

When the Great Depression gripped the nation in the 1930s, profits realized from the sale of farm produce practically evaporated. Many settlers in the Alsea Valley, living at subsistence levels, succumbed to extreme poverty. In 1936, Congress initiated the Western Oregon Scattered Settlers Project, under the umbrella of the Resettlement Administration. This allowed the Forest Service to appraise existing homesteads and offer the owners cash payment or trade for their properties, ultimately bringing these lands back into the Siuslaw National Forest. These transactions sometimes took the form of a three-way land trade with the Forest Service providing some timber to a logging company, the logging company providing money to the settler (the assessed value provided by the Forest Service), and the landowner providing the Forest Service title to the property. A great deal of forest land was consolidated (and logged) under this arrangement, and many settlers were given a second start. Resettlement generally increased the trend toward urbanization as these people moved to cities (such as Waldport) to find work.

The turn of the century saw rapid change in Waldport. By 1900 there were two canneries on the Alsea Bay, two lumber mills, and a growing oceanic trade. Waldport had a couple of stores and a mercantile, a hotel, and several municipal buildings. By the time Waldport was incorporated in 1911, 150 persons and fifteen businesses resided within its boundaries.

The first gasoline fueled boat appeared on the Alsea Bay in 1901, and by 1902 such boats were common (Ostling [no date]). The new motors were used for tug boats (to help sailing vessels avoid sandbars), ferries, and fishing boats. The Port of Alsea was established in 1909 and began collecting taxes and fees in order to improve dock and landing facilities at Waldport, Tidewater, Alsea, and Five Rivers. Municipal water was brought to Waldport from a spring at the head of Red Creek in 1910. Evidently it had an odd taste to it, and "clear" water was also imported in barrels from a creek feeding Lint Slough (Ostling [no date]). Automobiles appeared in Waldport in the late 1910s. Electricity was first generated at a mill on Eckman Creek in or about 1926 by West Coast Peoples' Power (a local company), but the generating source was replaced several years later by a plant in Toledo which provided power to the entire county.

In 1918, the U.S. Army, in the form of the Pacific Spruce Corporation, built a railroad track from South Beach (just south of Newport) to "Camp 1" (just south of Yachats). The track was constructed, though never used, to access and harvest the Blodget Tract, an excellent stand of spruce (used for aircraft construction in the war effort) located along the coastal strip in the Yachats and Waldport area. The Army was to conduct the harvest because the U.S. Government doubted the ability of local producers to harvest the tract on schedule and did not trust the socialist political views that were prevalent in Northwest logging camps at the time.

The Army built a trestle across the Alsea Bay, driving over a thousand pilings. Over 2,000 soldiers performed the manual labor that produced the track. These soldiers were housed at various locations in and around Waldport.

When the track, mills, and facility at Camp 1 were completed, and just as the Army prepared to harvest the trees, an armistice was signed, ending both World War I and plans for harvest. The troops cleaned up the lines and camps and left the area, and the Government put the holdings of the Pacific Spruce Corporation up for sale.

After the Army departed, an automobile was fitted with flanged tires by John Walker and used to haul freight on the track to Newport. When the track was purchased by C. D. Johnson in 1920, freight and passenger service along the line were stopped. Several appeals were made by the city of Waldport to make the railroad a common carrier, but Johnson insisted such a use would slow down the movement of timber. At the time, this was the only fast and direct link outside the watershed. (Palmer 1982)

C. D. Johnson contracted with Mannery Logging and Lawson Logging to put spur roads up Dicks Fork Creek and along the south side of the Alsea Bay to Green Point. From there, Risley Creek and McKinney Slough were harvested. In 1925 the harvest was completed, and the tracks removed.

Camp 1, the center of operations for the harvest of the Blodget Tract, quickly grew to the size of a small town. Operations were a source of employment for residents of the watershed and a significant market for locally produced goods.

Between 1919 and 1927, Highway 34 was constructed, improved, and graveled by the Bureau of Public Roads. The gravel was quarried at sites adjacent to the road, including the bed of the Alsea River. The first regular freight was hauled along that route in 1923 by wagon. In 1925 the wagon was replaced by a Dodge pickup truck. The trip to Corvallis from Waldport was cut from about three days to about four hours.

Automobiles were also making the trip south along the beach from Newport, then catching a ferry across the Alsea to Waldport. In 1929 a trestle was built to carry the autos from the beach over the foredune to a landing on Alsea Bay. Despite the advent of the automobile, and later the trestle, the trip remained an all day affair. Significant improvements to this route were not made until the completion of the Coast Highway (without the bridge) in 1931. The ferries continued to operate until the Alsea Bridge was opened in 1936. The improvements to Highway 34 and the completion of the bridge marked the end of an era of relative isolation for Waldport and the watershed in general.

Modern Era: Post-World War II

Following World War II, timber became the area's largest industry as demand for building materials boomed nationally. Much of the timber to meet this demand was supplied by the National Forests. The industry grew through the 1950s and 1960s, with harvests peaking in the late 1960s or early 1970s. Douglas-fir was the most common tree species logged and replanted, as it produced marketable timber very quickly and was the dominant tree species on Coast Range lands. Harvest techniques favored clear-cutting from about 1960, as the open canopy promoted rapid growth of Douglas-fir. Map 27 ("Timber Harvest by Decade") displays decadal timber harvest; estimates of private land were made using aerial photos.

Current incomes of most households in the valley are realized in Waldport or Corvallis. Few new industries have developed in the Alsea River Valley since the decline of the timber industry. What timber is harvested within the watershed is transported to mills outside the area. Farming, while common in the Alsea Valley, has become a hobby or secondary income activity rather than a means of subsistence.

There are several day-use and camping areas along the Lower Alsea including Canal Creek, Blackberry Campground, River Edge Campground, Salmonberry Campground, and Missouri Bend day-use area. There are also five public boat launches. Hunting and fishing constitute the bulk of recre-ation (above Tidewater) and draw many people from a local area (mostly Lane, Benton and Lincoln Counties). There are no developed hiking trails.

According to the Economic Development Alliance of Lincoln County, the Port of Alsea ranks second in boating use among all the bays in Oregon and is the eighth busiest body of water in the state.

They estimate recreational crabbing alone generated $378,000 in 1991; recreational steelhead and salmon fishing are also major attractions.

Recreation in Waldport is a booming industry. Oregon Department of Transportation figures for 1997 indicate the average daily traffic volume through Waldport along Hwy. 101 to be 7,500. Visitors are drawn to the coast for various activities, but Waldport is conveniently located to capitalize on visitors to the Drift Creek Wilderness area and several campgrounds operated by the Forest Service and Oregon State Parks. The city also boasts a visitor center, a nine-hole public golf course, restaurants, and hotels.

Transportation

Highway 34 is the primary road through the analysis area (Map 28: "Road System"). The highway and other early roads into the smaller valleys followed the relatively flat ground along streams, particularly Eckman, Canal, Meadow Fork, Five Rivers, Fall, Digger and Mill creeks for access to homesteads. Later, roads were extended between valleys and communities to improve trade. Logging on both public and private lands pushed the developing road network to about 95% of its present length by about 1975.

Numerous road-related landslides occurred during storms in the mid-1960s, dumping thousands of cubic yards of sediment into streams, washing out bridges, and causing property damage. Logging practices and road designs were blamed for much of the storm damage in subsequent reviews. High failure rates were noted on mid-slope roads built using the sidecast, or balanced section, method. By 1975, Forest Service and BLM road design standards had changed to full-bench construction (no sidecast material) on mid-slope roads, but by then most of the roads in the Lower Alsea watershed had been built. Landslides continue to occur more frequently and maintenance costs are higher on the older sidecast roads. Road mileage and density by subwatershed are presented in Table 3-11, "Road Density by Subwatershed."

TABLE 3-11: ROAD DENSITY BY SUBWATERSHED

Subwatershed	Total Road	Road Miles /	Stream Miles /
Bayview	31.02	5.0	4
Bull Run	21.67	3.3	6.0
Burch	55.46	5.0	6.6
Canal	45.67	3.5	7.8
Cow	32.87	3.6	5.8
Darkey	12.85	4.0	7.7
Digger	43.99	4.5	6.4
Eckman	32.98	5.2	6.0
Grass	16.94	3.2	7.3
Lake	21.69	3.0	6.2
Lint	23.83	5.3	5.9
Lower Fall	24.61	3.4	5.9
Mill	33.94	5.1	7.1
Risley	20.00	4.1	6.7
Salmonberry	30.98	6.0	7.8
Scott	45.79	3.9	5.4
Skunk	22.02	4.6	7.1
Sudan	16.63	3.7	8.4
Tidewater	39.78	3.4	5.7
Upper Fall	46.05	4.0	7.3
Totals/Aves.	618.77 (T)	4.2 (A)	6.6 (A)

Subwatersheds near the coast and nearest the Alsea Valley have the highest road densities in the analysis area. Bayview, Eckman, and Lint to the west, and Burch, Digger, Mill, Salmonberry, and Skunk to the east have road densities ranging from 4.5 to 6.0 miles per square mile. Other subwatersheds have road densities range from 3.0 to 4.1 miles per square mile; the average is 4.2 for the watershed as a whole. The proportion of private land ownership is higher than federal ownership in the subwatersheds with high road densities, with the exception of Eckman and Skunk.

Road Location on Slope

Informal surveys of road-related landslides and severe erosion after major storms indicate that more events occur on mid-slope roads than on ridge-top or valley bottom roads. However, valley bottom roads in narrow valleys can impede natural stream interactions with channel banks, limiting the development and maintenance of diverse in-stream and riparian habitats. Both mid-slope and valley bottom roads can reduce or prevent delivery of sediment and large woody material where stream crossing fills act as dams to stop landslide-generated debris flows from moving all the way to lower gradient channel reaches.

Road miles by slope position are presented in Table 3-12, "Road Miles in Subwatersheds by. . ."

TABLE 3-12: ROAD MILES IN SUBWATERSHEDS BY POSITION ON SLOPE, BY LENGTH AND PER CENT OF TOTAL SUBWATERSHED MILES

	Slope Position: miles (%)		
Subwatershed	***Ridge-top***	***Mid-slope***	***Valley Bottom***
Bayview	7.05 (22.7)	12.81 (41.3)	11.16 (36.0)
Bull Run	6.68 (30.8)	11.68 (53.9)	3.31 (15.3)
Burch	10.88 (19.6)	18.35 (33.1)	26.23 (47.3)
Canal	18.34 (40.2)	16.59 (36.3)	10.74 (23.5)
Cow	7.99 (24.3)	9.31 (28.3)	15.57 (47.4)
Darkey	5.13 (39.9)	7.01 (54.6)	0.71 (5.5)
Digger	9.12 (20.7)	17.11 (38.9)	17.76 (40.4)
Eckman	7.34 (22.3)	14.73 (44.7)	10.91 (33.1)
Grass	6.26 (37.0)	7.9 (46.6)	2.78 (16.4)
Lake	6.26 (28.9)	4.96 (22.9)	10.47 (48.3)
Lint	10.72 (45.0)	7.62 (32.0)	5.49 (23.0)
Lower Fall	4.73 (19.2)	9.53 (38.7)	10.35 (42.1)
Mill	9.45 (27.8)	13.53 (39.9)	10.96 (32.3)
Risley	4.21 (21.1)	6.34 (31.7)	9.45 (47.3)
Salmonberry	9.26 (29.9)	12.59 (40.6)	9.13 (29.5)
Scott	13.96 (30.5)	26.38 (57.6)	5.45 (11.9)
Skunk	2.56 (11.6)	13.35 (60.6)	6.11 (27.7)
Sudan	6.08 (36.6)	8.37 (50.3)	2.18 (13.1)
Tidewater	8.83 (22.2)	11.47 (28.8)	19.48 (49.0)
Upper Fall	10.5 (22.8)	23.05 (50.1)	12.50 (27.1)

Public Access

Table 3-13, "Public Access," presents road ownership within the watershed.

TABLE 3-13: PUBLIC ACCESS

Public Roads in the Lower Alsea Watershed		
Ownership	***Miles***	***% of watershed total***
State	39.4	10
County	26.9	7
BLM	91.1	24
FS	222.2	58
Totals	**379.6**	**100**

State Roads: State Highway 34 generally follows the Alsea River through the watershed, connecting numerous county, private, and federal roads. Highway 101 crosses the western edge of the watershed at Waldport.

County Roads: These serve portions of Bayview, Lint, Tidewater, Scott, Upper and Lower Fall, and Skunk subwatersheds. County roads connect to Forest Service or BLM roads as well as providing access to private lands.

BLM Roads: Major roads follow Fall Creek, Bear Creek, and Cove Creek; other routes include Winney Road, Grass Mountain Road, and Lone Springs Mountain Road. All are in good condition, with Mill Creek Road being in fair condition. These roads provide access to private timber company roads and are heavily affected by log hauling from private lands. Transportation Management Objectives (TMO) identify primary uses and maintenance levels for each BLM road. TMO categories for roads in the Lower Alsea watershed are found in Tables 3-14 (“BLM Road System Categories”) and 3-15 (“Miles by BLM TMO Type”).

TABLE 3-14: BLM ROAD SYSTEM CATEGORIES

BLM Road System			
TMO	**Access**	**Description**	**Miles**
2	open	Open all year, general use; maint. level (ML) 4	9.8
3	open	Year-round or seasonal, admin or rec. use; ML 4	5.9
4	open	Year-round or seasonal, admin or rec. use; ML 3	12.7
5	seas.	Seasonal, w/ drainage maint. needs; ML 3	21.2
6	seas.	Seasonal, w/ no drainage maint. needs; ML 3	13.7
7	temp.	ML 1; or ML 3 when in use	7.7
8	perm.	No longer needed; recommend permanent closure	9.33

TABLE 3-15: MILES BY BLM TMO TYPE

	Miles by BLM TMO Type							
Subwatershed	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Totals**
Bull Run	-	-	-	-	-	0.11	0.08	*0.19*
Burch	1.59	1.44	0.95	1.73	1.73	1.74	2.20	*11.38*
Cow	-	-	-	-	-	0.84	-	*0.84*
Digger	1.03	-	2.75	0.45	5.15	2.46	2.27	*14.11*
Lower Fall	0.05	-	-	0.09	0.49	0.31	0.27	*1.21*
Mill	4.60	-	0.26	2.67	2.29	0.35	2.57	*12.74*
Salmonberry	0.60	0.92	-	2.19	2.30	0.58	1.32	*7.91*
Skunk	-	-	2.81	4.81	1.15	1.41	0.62	*10.8*
Upper Fall	1.89	3.51	5.97	9.29	0.58	-	-	21.24
Totals	9.76	5.87	12.74	21.23	13.69	7.8	9.33	80.42

Forest Service Roads: The Forest Access and Travel Management (ATM) Guide provides direction for management of National Forest Roads in the analysis area. Public access needs, recreation, and management activities on federal lands are considered in determining maintenance standards for Forest Service roads. ATM roads account for 71.8 of the 222.2 total system road miles in the analysis area. ATM categories are presented in Table 3-16 ("Forest Service Road System").

TABLE 3-16: FOREST SERVICE ROAD SYSTEM

Forest Service Road System	
Status	**Total miles**
ATM-secondary-low clearance vehicles (SLC)	14.2
ATM-secondary-high clearance vehicles (SHC)	53.8
ATM-other; e.g., campground access (OTH)	3.8
Non-ATM system roads (details below)	150.4

Forest Service non-ATM system roads include open roads (33.3 miles), closed for wildlife protection or other administrative restrictions (10.8 miles), stabilized (23.5 miles), or waterbarred (82.8 miles).

Private Roads: A complete inventory of roads on private lands is not available. In areas of mixed federal and private land ownership, most private roads have been incorporated into Forest Service or BLM databases. This incomplete inventory includes 272.9 miles of private land roads in the Lower Alsea watershed.

Road Conditions

A total of 652.5 road miles have been inventoried in the analysis area (see "Private Roads" above).

A Road Condition Assessment (RCA) was conducted on National Forest roads in 1997 to locate and evaluate road maintenance problems and stream crossing culvert conditions. The RCA did not inventory or evaluate ditch relief culverts, except where malfunction had caused erosion or slope failure.

Anecdotal evidence of the effects of the February 1996 storm and flood on National Forest roads suggests that plugged stream crossing culverts frequently lead to fill-slope erosion or failure unless they are quickly unplugged by maintenance crews. Most plugged culverts occur on mid-slope and stream-bottom roads. In the analysis area, one hundred seventy-seven stream-crossing culverts were inventoried, of which eleven had plugged inlets and thirteen had partially plugged inlets. Canal and Grass subwatersheds each had four partially plugged culvert inlets and two plugged inlets; two plugged inlets were also found in the Risley subwatershed.

Inventoried road problems consist largely of failing sidecast material on ridge-top and mid-slope roads built prior to 1975. Some sidecast fill failures cause significant off-site damage and/or deliver sediment to adjacent streams. In the Lower Alsea watershed, 92 such problem sites were inventoried: 32 were in the Risley subwatershed; 24 in Tidewater; 21 in Canal; Bull Run and Scott had four each; and Cow subwatershed had three problem sites. Many of the Tidewater, Risley and Canal sites are on ATM roads.

BLM inventoried eighty-three stream-crossing culverts: thirty-seven are located such that diversion from the original channel is possible; ten need immediate replacement due to deterioration; five need inlets and/or outlets cleaned; and fifty-two stream culverts do not meet the 100-year flood design criteria. Approximately seven miles of BLM roads in the analysis area are closed by various devices (i.e., gates, berms, logs, vegetation), and there are about four miles of natural surfaced road that are eroding. The majority of BLM roads are gravel surfaced and well maintained.

State and county roads are primary public travel routes and are maintained for safety and full access to connecting private and other public road systems.

Chapter 4: Findings and Recommendations

In this chapter, the sections headed with the title "Recommendations" are intended to apply to federally managed lands; sections headed with "Opportunities for Cooperative Efforts" are identified as areas where public agencies and private landowners may work together to achieve shared goals.

Forest Fragmentation

1) Finding: All but a few interior late-seral forest patches are on Forest Service or BLM lands. The largest patches of this habitat are found in the Tidewater, Sudan, Canal, and Scott subwatersheds. Late-seral interior forest habitat is almost absent from the Eckman, Darkey, Lower Fall, and Burch subwatersheds. All of the late-seral forest on federal lands fall within LSR and/or Riparian Reserve (RR) land use allocations.

When viewed from the larger landscape perspective, the late-seral forest patches in the western half of the watershed are generally aligned in a broad, south-to-north corridor which connects to an area of late-seral forest in the Five Rivers watershed to the south and with another late-seral patch in the Drift Creek (Alsea) watershed to the north. In the eastern half of the watershed, there is a northeast-to-southwest corridor of late-seral habitat that links this watershed to the Upper Alsea watershed (primarily the North Fork Alsea). Late-seral patches in this northeast-southwest corridor are more sparse and have greater inter-patch distances than the south-north corridor. Both of these corridors afford important avenues for dispersal across and through the watershed for highly mobile, older-forest associated species. The larger patches within each corridor may also function as refugia for less mobile species that depend on older forests.

Recommendations:

- Promote late-seral development within identified connectivity corridors as displayed on Map 29 ("Alsea Basin Restoration Priorities").
- North of the Alsea River are Contiguous Large Mature Cells as identified in the LSRA. These cells are high priority for treatment if needed. Key recommendations are to limit entries, treat an entire block at once, and close roads as soon as possible to allow recovery to proceed unhindered.
- South of the Alsea River are Mixed Seral Cells as identified in the LSRA. These are high priority for treatment if needed. Key recommendations are to grow out from adjacent late-successional habitat, and create new and enlarge existing small patches.
- Treatment priority is moderate for the Early Seral Connectivity Cells. Key recommendations are the same as those for the Mixed Seral Cells.

- Treatment priority for Early Seral Corridor and Early Seral Buffer Cells is moderate to low. Key recommendations are to use low risk silvicultural treatments around existing threatened and endangered species and to focus on treating unsuitable habitat for restoration.

C Implement early silvicultural treatments across the landscape based on criteria found in Appendix 8 ("Benefits of Vegetation Management Techniques").

2) Finding: One of the major factors affecting the use of habitats by wildlife is road density because roads can present a significant barrier to movement and dispersal (Meffe and Carroll 1994) and can be a persistent source of disturbance to animals such as deer and elk. This watershed averages 4.2 miles of road per square mile. Using 30 feet as an average road width, a single mile of road occupies about 3.6 acres; thus, about 2,210 acres of forest (2.3%, or 14.5 acres/mi ^{2}) have been lost to road development across the watershed.

Recommendations:

- The Forest Service is implementing an access and travel management plan which will, over time, greatly reduce the miles of open roads by blocking or decommissioning many roads (see Transportation also). The BLM will implement the Western Oregon Transportation Management Plan (June 1999) and will include transportation management objectives for roads inside this watershed. Strategies, including road closures and decommissioning, are identified.

Aquatic Habitat

Hydrology

1) Finding: Water quantity is over-allocated.

Opportunities for Cooperative Efforts:

C Determine if any water rights are not being utilized and can be sold or leased to the state.

- Improve efficiency of distribution of water to users.

- Acquire in-stream water rights for tributary basins.

2) Finding: Water quality is limiting in many streams due to high water temperatures which exceed state water quality standards. Summer stream temperatures throughout most of the Alsea Basin are higher than expected at this point in natural succession following the large fires in the mid-1800s and are too high for optimum salmonid production.
Recommendations:

- Maintain and develop sufficiently wide riparian corridors through planting, thinning, and release of understory conifers to provide shade and cool microclimate conditions adjacent to streams. Plant riparian areas with appropriate native species, including conifer.

- Provide in-stream large wood structure to reconnect flood plains.

Opportunities for Cooperative Efforts:

- Focus efforts on Alsea Basin Priority Areas and stream-adjacent meadows that have less than a 200-foot wide native riparian corridor on each side of the active channel and flood plain.

- Establish conifers adjacent to wide channels to provide shade, particularly along the Alsea main-stem, North Fork and South Fork Alsea, and Drift, Five Rivers, and Lobster creeks.

Fisheries

Suggested priority areas for aquatic restoration within the entire Alsea Basin are presented in Map 29 ("Alsea Basin Restoration Priorities"). Specific restoration needs are outlined in the four watershed analysis documents which, together with this watershed analysis, cover the whole basin. The following section outlines recommendations for potential aquatic restoration activities and their priority areas, where known, for the Lower Alsea Analysis Area. (See also Map 23, "Identified Road System Opportunities.")

1. Finding: The best remaining fish habitat is located in relatively small watersheds (<10,000 acres).

Recommendations:

- Maintain and allow natural processes to develop large patches of high quality fish habitat. These large patches should provide a variety of reach types for salmonids to utilize during their freshwater life histories. Focus limited restoration resources into areas that have the greatest potential to increase salmonid production. Suggested priority areas are:

  - Upper Drift Basin upstream of Gold Creek;
  - Upper Five Rivers Basin upstream and including Buck Creek;
  - Upper Lobster Basin upstream and including Little Lobster Creek;
  - Entire Alsea Valley from just below Salmonberry Creek, particularly the upstream portions;
  - North Fork Basin upstream and including Honey Grove Creek;
  - South Fork Basin upstream and including Bummer Creek; and
  - Entire tidally influenced portion of the Alsea Basin.

2) Finding: There is poor connectivity among the best remaining patches of fish habitat in the Alsea Basin.

Recommendations:

- Maintain and develop connectivity patches of high quality habitat between large priority restoration areas. Examples include restoring vegetation and allowing natural log jams to remain intact. Priority connection areas are located on the Alsea mainstem and its large tributaries at and just downstream of small tributaries:

  - On Alsea near Digger, Fall, Scott, Grass, and Five Rivers;
  - On Five Rivers below Lobster Creek;
  - On Lobster near Camp; and
  - On Drift near Trout and Lyndon Creeks.

3) Finding: Much of the historically productive fish habitat in the Alsea Basin is located on private lands.

Opportunities for Cooperative Efforts:

- Pursue cooperative efforts with, or develop incentives for, landowners to expand riparian and flood plain habitats on private land; alternatively, lease, acquire lands, and/or obtain conservation easements from willing landholders, particularly in priority areas.

4) Finding: Opportunities for riparian and aquatic restoration have been and continue to be lost along the Alsea mainstem and its large tributaries as historically forested valley floors become residential areas with houses adjacent to streams. This is most evident between Waldport and Five Rivers, but occurs throughout the low gradient portions of the basin.

Opportunities for Cooperative Efforts:

- Encourage and support county and state land use policies that maintain and develop adequate riparian widths to support aquatic species and stream system. Adequate riparian widths should allow for development of native vegetation, flood plains, and microclimate conditions needed to support native species. Typically, riparian widths should range from approximately 100-300 feet on each side of the flood plain.

5) Finding: Coldwater pockets within the Alsea mainstem and its large tributaries likely provide refuge where salmonids can escape warm stream temperatures during July and August. The location and use of these areas have not been identified in the Alsea Basin.

Opportunities for Cooperative Efforts:

- Identify the location of cold water pockets which exist, between 15 July and 15 August, in the Alsea mainstem and its large tributaries.

- Develop fish sampling procedures to assess daily and seasonal habitat use of these areas.

6) Finding: Fish bearing streams, flood plains, and the Alsea Bay have much lower amounts of large wood than expected at this point in natural succession following the large fires in the mid-1800s.

Opportunities for Cooperative Efforts:

- Promote an understanding of the value of large wood in aquatic systems. Maintain and enhance large wood in stream channels, flood plains, and tidewater areas unless property damage is likely.

- Mark wood that poses a hazard to boats with buoys to lessen the chances of collisions. Maintain and develop sufficiently wide riparian corridors to provide future recruitment of large wood to all stream channels from headwalls to the estuary.

- Accelerate development of large conifers by thinning plantations and releasing understory conifers from dense hardwood canopies. Thinning should be designed to maintain stream temperatures and vegetative diversity.

- Add large wood to stream channels to increase complexity temporarily until riparian areas develop a future source, particularly in Canal Basin. Guidelines for coarse woody debris and criteria for management activities are presented in Appendix 9 ("Riparian Reserve Project Design — Factors to Consider").

7) Finding: Seasonal habitat use by salmonids throughout the Alsea Basin is not well understood.

Recommendations:

- Conduct summer and winter distribution surveys of salmonids to help identify seasonally important reaches.

Roads

1) Finding: Roads have accelerated delivery of sediment, debris torrents, and flow to stream channels.

Recommendations:

- Decommission or stabilize roads, particularly in valley bottom and mid-slope positions. Decommissioning should include removal of all channel culverts and associated valley fill, pullback of any sidecast material with the potential to enter channels, and decompaction of surfaces and/or waterbarring of them. Road stabilization should include pull back of unstable sidecast, addition or repositioning of ditch relief culverts so that they drain into vegetated filter strips to minimize sediment inputs into streams (Skinner Creek Road), and upgrading of culverts to improve passage of flow, sediment, wood and aquatic biota (Bear Creek to Canal).

2) **Finding:** Portions of Highway 34, and Fall, Eckman, and Canal Creek roads constrain stream channels and intercept riparian vegetation from being recruited into adjacent streams.

Opportunities for Cooperative Efforts:

- Consider opportunities to relocate and/or redesign maintenance practices to minimize effects of valley bottom roads. For example, the suspended power lines along Highway 34 just upstream of Digger Creek could be buried to prevent regular removal of riparian vegetation to protect the lines.

- Connections between valley bottom roads and ridgetop roads could be added to allow decommissioning of valley bottom road segments.

- Driveable fords could be constructed to allow passage of debris torrents where road use is infrequent or restricted to the dry season.

3) **Finding:** There are several culverts located on low gradient (<4%) tributaries.

Recommendations:

- Fish use of these tributaries should be determined and passage provided where needed.

Estuary

1. **Finding:** Flows and tidal mixing dynamics were altered by the damming and diking of the upstream end of the north channel in the estuary. These structures were partially removed; how-ever, it is not certain that natural flows have been completely restored.

Opportunities for Cooperative Efforts:

- Investigate the current status of the dam and dike sites to determine if flows between the north and south channel are still impaired. If flows between the channels are still constrained by the remnants of these structures, develop and implement a plan to remove the remaining dam and dike material.

2) **Finding:** Interaction between the estuary and its sloughs and tributaries has been impaired, and eliminated in some areas, by fill, tidegates, and culverts.

Opportunities for Cooperative Efforts:

- Assess the feasibility of restoring habitat and hydrological connections between the estuary and its tributaries and sloughs. In areas where restoration of connectivity is feasible, develop and implement projects to accomplish this objective. Priority areas for restoring or improving connectivity include Lint, McKinney, and Bain sloughs, and Eckman Lake, and the two locations where Bayview Road separates a large loop of contiguous wetland and lowland from the bay. Oregon Department of Fish and Wildlife and the Mid-Coast Watersheds Council have initiated a project to restore connectivity between the bay and Lint Slough; the Forest Service has provided technical assistance to this project. Assistance and support for this project should continue.

3) Finding: Flow patterns and fish passage in the Alsea Bay have been altered by fill and tide gates.

Opportunities for Cooperative Efforts:

- Restore natural flow patterns by removing or altering fill and tide gates. Specific priority areas include Bain and Lint sloughs, and Lower Drift (three channels that drain into the North Channel) and Eckman creeks.

4) Finding: The Alsea retains a fair proportion of estuarine wetland habitat.

Opportunities for Cooperative Efforts:

- Protect existing estuarine wetlands from fill, excavation, or other impacts. Priority areas include the mature high marsh islands, the mature high marsh around the mouth of Drift Creek, the marsh and mudflats at the mouth of Lint Slough, and the marsh and mudflat north of Highway 34 and across from Eckman Lake.

- The Mid-Coast Watersheds Council (MCWC) is currently assessing wetland protection and restoration priorities in the Alsea and Yaquina estuaries. The MCWC assessment should be reviewed, and the recommendations and priorities offered in this watershed analysis revised accordingly.

5) Finding: A significant proportion of the Alsea estuary's wetlands have been lost to fill or disconnected from the estuary by dikes, roads, and other impacts.

Opportunities for Cooperative Efforts:

- Restore and reconnect wetlands to the estuary where possible. As mentioned above, the Mid-Coast Watersheds Council is currently assessing wetland restoration opportunities and priorities in the Alsea. Using the MCWC assessment to identify suitable sites, develop and implement plans to restore and reconnect estuarine wetlands.

6) Finding: Large wood is lacking in the Alsea estuary.

Opportunities for Cooperative Efforts:

- Allow natural cycling of wood through the estuary by restoring woody debris dynamics in the watershed, and prevent purposeful removal of wood that reaches the estuary.

Human Uses

Commodity Forest Products

1) Finding: The amount of matrix land with mature conifers for sustainable commodity production is low (see Map 30: "Vegetation Outside Reserves").

Recommendations:

- Harvest opportunities on BLM lands are presented on Map 31 ("BLM Timber Harvest Opportunities"). Figures for the approximate numbers of acres available for harvest are given in the Table 4-1 on the following page:

TABLE 4-1: LOWER ALSEA: POTENTIAL TIMBER HARVEST OPPORTUNITIES

Treatment	LUA	In/Out of Riparian Reserves	Stand Age	Acres
Density	LSR	In	20-40	989
Density	LSR	Out	20-40	663
Density	LSR	In	41-80	236
Density	LSR	Out	41-80	293
Regeneration	GFMA	Out	70+	0
Comm. Thinning	GFMA	Out	20-60	180
Comm. Thinning	GFMA	In	20-60	300

Transportation Management

1) **Finding:** BLM major access routes (Fall Creek, Bear Creek, Winney, Cove Creek, Grass Mtn., and Lone Springs Mtn. roads) are well maintained and in good condition. Fall Creek and Bear Creek roads are the only major roads that parallel fishery streams closely. Mill Creek Road is also a primary route and is in fair condition. There are several intermittent and perennial streams with culverts that are deteriorating and do not meet the 100-year flood criteria. There are several local spur roads across the entire watershed that have not been maintained for several years and are now grown over with vegetation. The 1996 flood provided BLM with the opportu-nity to know what roads were potential problems, and most have since been repaired. There are a number of roads that should be considered for decommissioning after LSR stand criteria have been met. Priorities should be the landslide prone areas in Digger, Upper Fall, and Sulman creeks. Ridgetop roads generally are not causing problems for fish or water quality in this watershed; cut-and-fill slopes are well vegetated and roads are surfaced with some rock. BLM opportunities with respect to roads are influenced by private road systems and the landowners' needs for continued access. These private landowners include Willamette Industries, The Tim-ber Company (formerly Georgia-Pacific West), and Starker Forests.

Recommendations:

- Replace culverts and perform road maintenance on an “as needed” basis.
- Inventory roads at regular intervals and implement restoration to prevent damage prior to large storm events.

- Alter road maintenance on stream-adjacent roads (e.g., Fall Creek) to reduce sediment entry to creeks.

2) **Finding:** The Forest Service has identified several roads, and associated activities, which require attention; these roads are listed below:

Recommendations:

- **FS Road 3462000** : a major access route (ATM) in the Canal and Risley creek subwatersheds; more than 30 identified sites need repair to prevent sediment delivery to adjacent streams or to improve driving safety. At least two stream-crossing culverts have outlet drops of two feet or more.

- **FS Road 3446000:** an ATM route in the Risley Creek subwatershed with 11 identified sites needing repair to prevent sediment delivery to adjacent streams or to improve driving safety.

- **FS Road 5200000:** an ATM route in the Scott and Tidewater subwatersheds with 28 identified sites needing repair to prevent sediment delivery to adjacent streams or to improve driving safety, including three retaining walls in need of repair.

- **FS Road 3430000:** in the Grass subwatershed; five stream-crossing culverts have outlet drops of two feet or more.

- **FS Road 3413000:** in the Bull Run subwatershed; four identified sites need repair to prevent sediment delivery to adjacent streams or to improve driving safety. One stream-crossing culvert on this road has an outlet drop of two feet or more.

- **Road Closures:** 33.3 miles of open, non-ATM roads are candidates for closure, depending on transportation system analysis during future project planning.

References

Agee, J. K. 1993. *Fire Ecology of Pacific Northwest Forests*. Island Press, Covela, CA. 475 pp.

Barnett, H. G. 1937. "Culture element distributions: VII, Oregon coast." *Anthropological Records*, Vol.1, No. 3, University of California Press, Berkeley, California.

Benda, L. E., and T. W. Cundy. 1990. "Predicting deposition of debris flows in mountain channels." *Canadian Geotechnical Journal* 27:409-417.

Bilby, R. E., and J. W. Ward. 1989. "Changes in characteristics and function of woody debris with increasing size of streams in western Washington." *Transactions of the American Fisheries Society* 118:368-378.

________, B. R. Fransen, and P. A. Bisson. 1996. "Incorporation of nitrogen and carbon from spawning coho salmon into the trophic system of small streams: evidence from stable isotopes." *Can. J. Fish. Aquat. Sci.* 53:164-173.

Brauner, David R. 1979. *Archeological Reconnaissance of the Proposed Newport to Waldport and Waldport to Yachats Sewer Systems, Lincoln County, Oregon*. Department of Anthropology, Oregon State University, Corvallis, Oregon.

Csuti, B., A. J. Kimerling, T. A. O'Neil, M. M. Shaughnessy, E. P. Gaines, and M. M. P. Huso. 1997. *Atlas of Oregon Wildlife: Distribution, Habitat, and Natural History*. Oregon State University Press, Corvallis, Oregon. 492 pp.

Farnell, J. E. 1981. *Lincoln County Rivers Navigability Study*. Division of State Lands, Salem, Oregon.

FEMAT. 1993. *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment*. Report of the Forest Ecosystem Management Assessment Team (FEMAT), GPO (1993-793-071).

Franklin, J. F. and C. T. Dyrness. 1973. *Natural Vegetation of Oregon and Washington*. USDA, Forest Service, General Technical Report PNW-8, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon. 48 pp.

Gaumer, T., D. Emory, and L. Osis. 1973. *1971 Alsea River Estuary Resource Use Study*. Fish Commission of Oregon, Division of Management and Research, 28 pp.

Gonor, J. J., J. R. Sedell, and P. A. Benner. 1988. "What we know about large trees in estuaries, in the sea, and on coastal beaches." In *From the Forest to the Sea: A Story of Fallen Trees*. C. Maser, R. F. Tarrant, J. M. Trappe, and J. F. Franklin, eds. U. S. Forest Service, Pacific

Northwest Research Station, Portland, Oregon. General Technical Report PNW-GTR-229. 153 pp.

Griswald, Harry. 1993. "Recollections of Electricity Coming to Waldport, Oregon." Unpublished document, Lincoln County Historic Society, Newport, OR. 2 pp.

Hays, M. H. 1976. *The Land That Kept Its Promise: A History of South Lincoln County*. Lincoln County Historical Society, Publication No. 14. Newport, Oregon. 157 pp.

Heimann, D. C. 1988. "Recruitment trends and physical characteristics of coarse woody debris in Oregon Coast Range streams." M. S. thesis, Oregon State University, Corvallis, Oregon. 121 pp.

Hemstrom, M. A., and S. E. Logan 1986. *Plant Association and Management Guide: Siuslaw National Forest*. USDA, R6-Ecol 220-1986a.

Hicks, B. J. 1989. "The influence of geology and timber harvest on channel geomorphology and salmonid populations in Oregon Coast Range streams." Ph.D. dissertation, Oregon State University, Corvallis, Oregon. 199 pp.

Huntington, C., W. Nehlsen, and J. Bowers. 1996. "A survey of healthy native stocks of anadromous salmonids in the Pacific Northwest and California." *American Fisheries Society*, Vol. 21, March 1996, pp. 6-14.

Impara, P. C. 1998. "Spatial and temporal patterns of fire in the forests of the central Oregon Coast Range." Ph. D. dissertation, Oregon State University, Corvallis, OR. 354 pp.

Jackson, P. L., and C. L. Rosenfeld. 1987. "Erosional changes at Alsea Spit, Waldport, Oregon." *Oregon Geology*: 49(5): 55-59.

Jefferson, C. A. 1975. "Plant communities and succession in Oregon coastal salt marshes." Ph. D. dissertation, Department of Botany and Plant Pathology, Oregon State University, Corvallis, Oregon. 192 pp.

Johnson, N. K., J. F. Franklin, J. W. Thomas, and J. Gordon. 1991. "Alternatives for management of late-successional forests of the Pacific Northwest." A report to the Agriculture and Merchant Marine Committee of the U.S. House of Representatives. 59 pp.

Jones, J. A., and G. E. Grant. 1996. "Peal flow responses to clear-cutting and roads in small and large basins, Western Cascades, Oregon." *Water Resources Res*. 32(4), pp. 959-974.

Jones, Lucille. 1966. "Lincoln County pioneer recalls early days." *News Times*, Newport, Oregon (August 4).

Long, B. A. 1987. "Recruitment and abundance of large woody debris in an Oregon coastal stream system." M. S. thesis, Oregon State University, Corvallis, OR. 68 pp.

Lyon, Homer G. 1962. *Opportunities for Forest Industries in Lincoln County, Oregon*. USDA Forest Service, Portland, Oregon.

Maser, C., R. F. Tarrant, J. M. Trappe, and J. F. Franklin, tech. eds. 1988. *From the Forest to the Sea: a Story of Fallen Trees*. Gen. Tech. Rep. PNW-GTR-229. 153 pp.

Matson, A. L. 1972. "Zooplankton and hydrography of the Alsea Bay, Oregon, September 1966 to September 1968." Ph. D. dissertation, Dept. of Civil Engineering, Ocean Engineering Program, Oregon State University, Corvallis, Oregon.

McKenzie, D. R. 1975. "Seasonal variations in tidal dynamics, water quality, and sediments in the Alsea estuary." M. S. thesis, Dept. of Civil Engineering, Ocean Engineering Program, Oregon State University, Corvallis, Oregon. 252 pp.

Meffe, Gary K., and C. Ronald Carroll. 1994. *Principles of Conservation Biology*. Sinauer Associates, Inc., Sunderland, MA. 600 pp.

Montgomery, D. R., T. B. Abbe, J. M. Buffington, N. P. Peterson, K. M. Schmidt, and J. D. Stock. 1996. "Distribution of bedrock and alluvial channels in forested mountain drainage basins." *Nature* 381:587-589.

________, and J. M. Buffington. 1993. "Channel classification, prediction of channel response, and assessment of channel condition." Report for Washington State Timber/Fish/Wildlife-Sediment, Hydrology, and Mass Wasting Committee. 84 pp.

Morris, Winnefred D. 1936. "History of Waldport country." *Corvallis Gazette-Times*, Corvallis, Oregon (April 27).

National Research Council. 1996. *Upstream: Salmon and Society in the Pacific Northwest*. National Academy Press, Washington, D.C.

Nehlsen, W. A., J. E. Williams, and J. A. Lichatowich. 1991. "Pacific salmon at the cross-roads: stocks at risk from California, Oregon, Idaho, and Washington." *Fisheries* 16(2):4-21.

Nickelson, T. E., J. W. Nicolas, A. M. McGie, R. B. Lindsay, D. L. Bottom, R. J. Kaiser, and S. E. Jacobs. 1992. "Status of anadromous salmonids in Oregon coastal basins." Oregon Department of Fish and Wildlife, Portland. 83 pp.

Northwest Power Planning Council. 1996. *Return to the River: Restoration of Salmonid Fishes in the Columbia River Ecosystem*. Northwest Power Planning Council, Portland, Oregon.

Noss, R. F. 1993. "A conservation plan for the Oregon Coast Range: some preliminary suggestions." *Natural Areas Journal* 13(4):276-290.

Oakley, A. 1963. "Stream surveys of the Alsea River system." *Investigational Report No. 3,* Fish Commission of Oregon, Clackamas, Oregon. 105 pp.

Oregon Department of Agriculture. 1995. "Noxious Weed Policy and Classification System." Noxious Weed Control Program, Oregon Department of Agriculture.

ODFW. 1990. "Plan review criteria to conserve fish & wildlife resources on Bureau of Land Management forest lands in western Oregon." Habitat Conservation Division, Oregon Department of Fish and Wildlife, Portland, OR. 27 pp.

________. 1993. *Oregon Wildlife Diversity Plan, 1993-1998*. Oregon Department of Fish and Wildlife. Portland, Oregon. 309 pp.

________. 1997. *Alsea River Basin Fish Management Plan*. Oregon Department of Fish and Wildlife, Portland, Oregon. 127 pp.

Oliver, Chadwick D., and Bruce C. Larson. 1990. *Forest Stand Dynamics*. McGraw-Hill, Inc., New York.

ONHP. 1998. *Rare, Threatened and Endangered Plants and Animals of Oregon* . Oregon Natural Heritage Program, Portland, Oregon. March 1998 edition. 92 pp.

Oregon Department of Forestry. 1998. "Swiss needle cast of Douglas-fir in coastal western Oregon." Tech. Rep.: http://www.odf.state.or.us/fh/snc98/snctxt.htm.

Oregon Department of Environmental Quality. 1976. *Proposed Water Quality Management Plan, Mid-coast Basin.* Oregon Department of Environmental Quality, Portland, Oregon.

________. 1995. *Water Quality Standards Review*. Oregon Department of Environmental Quality, Portland, Oregon.

________. 1998. *Water Quality Standards Review*. Oregon Department of Environmental Quality, Portland, Oregon.

Ostling, Elmer. (No date) *Waldport History*. (Source unknown.)

Palmer, Lloyd M. 1982. *Steam Toward the Sunset: The Railroads of Lincoln County*. Lincoln County Historical Society, Newport, Oregon.

Peterson, C. D., K. F. Scheidegger, and P. Komar. 1982. "Sand dispersal patterns in an active margin estuary of the Northwestern United States as indicated by sand composition, texture and bedforms." *Marine Geology* 50(1982):77-96.

________, K. F. Scheidegger, and H. J. Schrader. 1984. "Holocene depositional evolution of a small active margin estuary of the Northwestern United States." *Marine Geology* 59(1984):51-83.

Proctor, C. M. 1980. *An Ecological Characterization of the Pacific Northwest Coastal Region*. U. S. Fish and Wildlife Service, Biological Services Program. FWS/OBS-79/11 through 79/15. Five volumes.

Reeves, G. H., L. E. Benda, K. M. Burnett, P. A. Bisson, and J. R. Sedell. 1995. "A disturbance-based ecosystem approach to maintaining and restoring freshwater habitats of evolutionarily significant units of anadromous salmonids in the Pacific Northwest." *American Fisheries Society Symposium* 17:334-349.

Reneau, S. L., and W. E. Deitrich. 1990. "Depositional history of hollows on steep hillslopes, coastal Oregon and Washington." *National Geographic Research* 6(2):220-230.

Reynolds, Susan P. 1993. *Historical Overview of the Alsea/Lobster Valley Region of Benton County, Oregon*. Benton County Historical Society, Philomath, Oregon.

Ripple, William J. 1994. "Historic and spatial patterns of old forests in western Oregon." *Journal of Forestry* 92:11.

Sessions, J., J. C. Balcom, and K. Boston. 1987. "Road location and construction practices: effects on landslide frequency and size in the Oregon Coast Range." *Western Journal of Applied Forestry*, Vol. 2, No. 4, pp. 119-124.

Shaw, S. C., and D. H. Johnson. 1995. "Slope morphology model derived from digital elevation data." *Proceedings*, 1995 Northwest ArcInfo Users Conference, Coeur d'Alene, Idaho.

Smith, David M. 1986. *The Practice of Silviculture*. John Wiley & Sons, New York.

State of Oregon. 1963. ORS 564.010 to 564.994. (The "Oregon Wildflower Law") Salem, OR.

________. 1997. *Coastal Salmon Restoration Initiative: Restoring an Oregon Legacy Through Cooperative Efforts*. ("The Oregon Plan") Salem, Oregon.

Teensma, P. D. A., J. T. Rienstra, and M. A. Yeiter. 1991. *Preliminary Reconstruction and Analysis of Change in Forest Stand Age Classes of the Oregon Coast Range From 1850 to 1940*. Tech-nical Note T/N OR-9, Filing Code: 9217. USDI Bureau of Land Management, Portland, Oregon. 12 pp.

Thomas, J. W., E. D. Forsman, J. B. Lint, E. C. Meslow, B. R. Noon, and J. Verner. 1990. *A Conservation Strategy for the Northern Spotted Owl: A Report of the Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl*. Portland, OR: USDA Forest

Service, USDI Bureau of Land Management, Fish and Wildlife Service, and National Park Service. 427 pp.

________. M. G. Rapheal, R. G. Anthony, E. D. Forsman, A. G. Gunderson, R. S. Holthausen, B. G. Marcot, G. H. Reeves, J. R. Sedell, and D. M. Solis. 1993. *The Scientific Analysis Team Report: Viability Assessments and Management Considerations for Species Associated with Late-Successional and Old-Growth Forests of the Pacific Northwest.* USDA Forest Service, Portland, Oregon. 523 pp.

U. S. Army Corps of Engineers. 1895. "Survey of Alsea River, Oregon." In *Annual Report of the Chief of Engineers* (ARCE). In House of Representatives Executive Document 235, U. S. Government Printing Office, Washington, D. C.

________. 1898. "Preliminary examination of Alsea River, Oregon, from Head of Tide Water to Upper Alsea Valley." In *Annual Report of the Chief of Engineers* (ARCE). In House of Representatives Executive Document 111, U. S. Government Printing Office, Washington, D. C.

________. 1976. *Alsea Wetlands Review*. U.S. Army Engineer District, Portland, Oregon. 345 pp.

USDA Forest Service. 1990. *Siuslaw National Forest Land and Resource Management Plan.* Siuslaw N. F., Corvallis, OR.

________. 1994. *Alsea Basin Fish Sampling.* Siuslaw National Forest, Waldport Ranger District, Waldport, Oregon.

________. 1995. *Assessment Report: Federal Lands in and Adjacent to the Oregon Coast Province*. Two volumes. 200 pp. On file at the Siuslaw N. F., Corvallis, OR.

________. 1996. *Late Successional Reserve Assessment, Oregon Coast Province - Southern Portion.* Supervisor's Office, Siuslaw National Forest, Corvallis, Oregon.

________. 1997a. *Drift Creek (Alsea) Watershed Analysis*. Siuslaw National Forest, Corvallis, Oregon. 62 pp.

________. 1997b. *Late Successional Reserve Assessment, Oregon Coast Province - Southern Portion (RO267, RO268), Version 1.3 June 1997*. Supervisor's Office, Siuslaw National Forest, Corvallis, Oregon. 86 pp. + map packet and appendices.

________. 1998. *Late Successional Reserve Assessment, Oregon's Northern Coast Range Adaptive Management Area (RO269, RO270, RO807), January 1998*. Supervisor's Office, Siuslaw National Forest, Corvallis, Oregon. 117 pp. + map packet and appendices.

________ and USDI Bureau of Land Management. 1994a. *Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest*

Related Species Within the Range of the Northern Spotted Owl. Vols. I and II ("Northwest Forest Plan"). Portland, Oregon.

________. 1994b. *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents within the Range of the Northern Spotted Owl* (ROD)*; and Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl* (S&G). Portland, Oregon.

USDI Bureau of Land Management. 1995. *Salem District Record of Decision and Resource Management Plan* (RMP). USDI-BLM, Salem District, Salem, Oregon. 81 pp. + appendices.

________. 1995. *South Fork Alsea Watershed Analysis*. Marys Peak Resource Area, Salem District, Bureau of Land Management, Salem, Oregon. 169 pp., including maps and appendices.

________. 1996. *North Fork Alsea Watershed Analysis*. Marys Peak Resource Area, Salem District, Bureau of Land Management, Salem, Oregon. 230 pp., including maps and appendices.

________. 1997. *Lobster/Five Rivers Watershed Analysis*. Marys Peak Resource Area, Salem District, Bureau of Land Management, Salem, Oregon. 146 pp. + maps and appendices.

Zenk, Henry B. 1990. "Alseans." In the *Handbook of North American Indians,* Vol. 7. (Northwest Coast), Smithsonian Institution, Washington, D. C.

Appendix 1: Successional Pathways

The flowcharts below indicate the successional pathways we expect for the dominant environments. These pathways were developed from examination of data summaries in the *Plant Association Guide* ("PAG;" Hemstrom and Logan 1986) and knowledge of plantation success and difficulty in each of the PAG types. These pathways may be used at the appropriate age to guide restoration treatments of plantations where the objective is to favor species composition common in natural stands of similar age. Due to a general lack of information, they should be regarded as hypotheses that need to be tested; they present excellent opportunities for adaptive management and monitoring. The flowcharts of successional pathways indicate expected species composition through time for three types of environments (dry, wet, and moist).

For the dry environments (TSHE/GASH [1]), two successional pathways are proposed, both beginning with Douglas-fir (PSME) in the early seral stage (first 10 years). In the young seral stage (10-80 years), shade-tolerant western hemlock (TSHE) may be a small component of the understory and increase as a component in mature (80-150 years) and late seral stages. Regeneration of dense stands with conifer results in considerable self-thinning between the young and mature seral stages. Old-growth structure develops slowly, 150 to 180 years after stand initiation, when gaps develop. Decid-uous trees are a small component of stands throughout succession and are not shown as a species in the flowchart.

Table A1-1: DRY ENVIRONMENT FLOWCHART: Salal Types (TSHE/GASH)

Dominant Seral Composition	Early Seral (0-10 yrs.)	Young Seral (10-80 yrs.)	Mature Seral (80-150 yrs.)	Late Seral (150-300 yrs.)
1. Conifer o	PSME	o o	PSME/TSHE	TSHE
2. o	PSME	PSME/TSHE	o o	TSHE

In the moist environments (TSHE/POMU), four pathways are proposed. It is expected that two would be dominated by conifers throughout succession, the other two by a conifer/deciduous mixture, and that the two groups would occur with equal probability. In the stands that are conifer throughout succession, the first pathway begins with Douglas-fir in the Early Seral stage; the second pathway, with a mix of Douglas-fir and western hemlock (PSME/TSHE). By the Mature Seral stage, both paths develop a mixture of PSME/TSHE. Stands that have a mixture of conifer/deciduous species represent the third pathway for the moist environment. These begin with a mixture of alder and Douglas-fir (ALRU/PSME) in the Early and Young Seral stages. In the Mature Seral stage, the major species would be Douglas-fir and western hemlock/western red cedar (PSME/TSHE [THPL]).

[1] An explanation of these abbreviations appears at the end of this appendix.

A fourth pathway begins with alder (ALRU) in the Early through Young Seral stages, and develops into a TSHE stand in the Mature and Late Seral stages.

Table A1-2: MOIST ENVIRONMENT FLOWCHART: Swordfern Types (TSHE/POMU)

Dominant Seral Composition	Early Seral (0-10 yrs.)	Young Seral (10-80 yrs.)	Mature Seral (80-150 yrs.)	Late Seral (150-300 yrs.)
1. Conifer °	PSME	° °	PSME/TSHE	TSHE
2. °	PSME/TSHE	° °	° °	TSHE
3. Conif./decid. Mix °	ALRU/PSME	° °	PSME/TSHE/ THPL	TSHE (THPL)
4. °	**ALRU**	° °	TSHE	° °

For the wet environments (TSDHE/RUSP), six pathways were proposed. Regeneration of conifers is sparse. Alder has a larger role than conifers in Early Seral stages and remains a large component in Young and Mature stages. Understory development of conifer is slow due to high salmonberry competition. There are often 1-2 seral stages present at any one time since wide spacing of conifers allows for understory development to begin early in succession. The rapid growth and tree shape of Douglas-fir that results from wide spacing appears to accelerate old-growth structure earlier (at about year 120) than in the other PAGs.

Table A1-3: WET ENVIRONMENT FLOWCHART: Salmonberry Types (TSHE/RUSP)

Dominant Seral Composition	Early Seral (0-10 yrs.)	Young Seral (10-80 yrs.)	Mature Seral (80-150 yrs.)	Late Seral (150-300 yrs.)
1. Conifer °	PSME	° °	PSME/TSHE	TSHE
2. °	PSME/TSHE	° °	° °	TSHE
3. Conif./Decid. Mix °	**ALRU**	° °	ALRU/TSHE	TSHE (THPL)
4. °	ALRU/PSME	° °	PSME	TSHE (THPL)
5. °	ALRU/TSHE	° °	TSHE (THPL)	TSHE (THPL)
6. Deciduous (Uncommon) °	**ALRU**	° °	° °	° °

Abbreviations:

Species in the PAG are abbreviated by taking the first two letters from their scientific names (binomials) as follows:

ALRU = *Alnus rubra* (red alder)
GASH = *Gaultheria shallon* (salal)
POMU = *Polystichum munitum* (sword fern)
PSME = *Pseudotsuga menziesii* (Douglas-fir)
RUSP = *Rubus spectabilis* (salmonberry)
THPL = *Thuja plicata* (western red cedar)
TSHE = *Tsuga heterophylla* (western hemlock)

Appendix 2: Seral Class Definitions

Grass: mainly grass/forbs. Contains both natural meadows and maintained pasture/grass fields.

Early seral: young managed stands (from recent timber sales through 10 years of age).

Conifer pole: >80% conifer, 11 - 24 years old or 5 - 9 in. diameter at breast height (dbh).

Mixed pole: 50 - 80% conifer, 20 - 50% hardwood, 11 - 24 years old or 5 - 9 in. dbh.

Old plantations: 51 - 80 year-old managed stands.

Mid-aged conifer: >80% conifer, 9 - 21 in. dbh, and 25 - 50 year-old managed stands.

Mid-aged conifer mix: 50 - 80% conifer, 9 - 21 in. dbh, and 25 - 50 year-old managed stands.

Mature conifer: >80% conifer, >21 in. dbh.

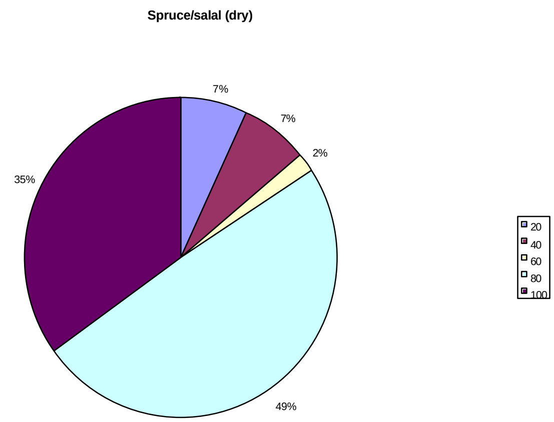
Mature conifer mix: 50 - 80% conifer, 20 - 50% hardwood, >21 in. dbh.

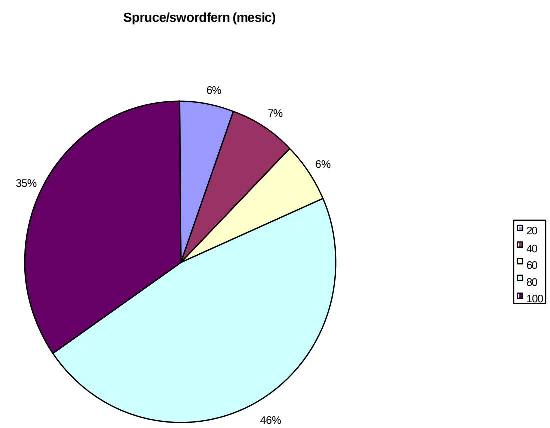
Multi-layered mature: mature conifer or mature conifer mix, with conifers in second layer that are >5 in. dbh. Canopy closure in first layer >30%.

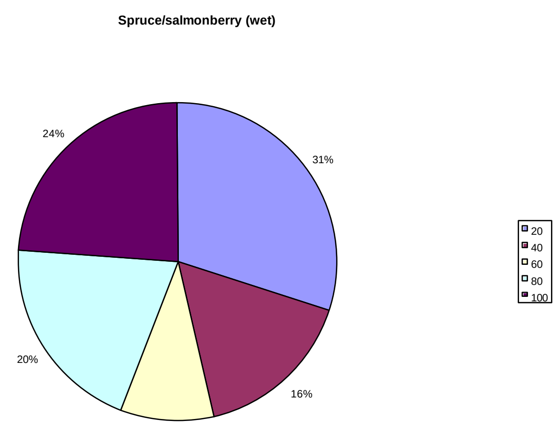
Pure hardwood: >80% hardwood, all ages.

Hardwood/conifer mix: 50 - 80% hardwood, 20 - 50% conifer, all ages.

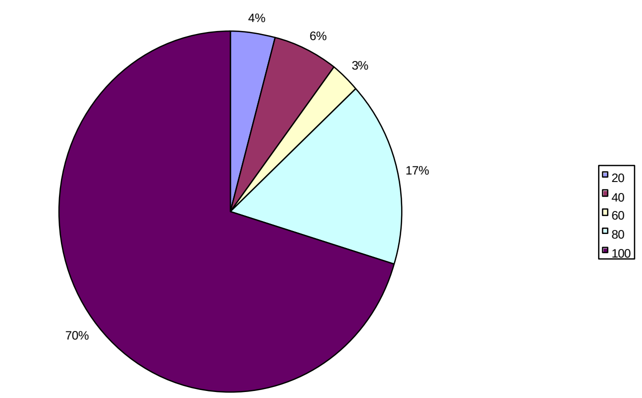
Appendix 3: Plant Association Group Overlay with Current Vegetation


Spruce/salal (dry)
7%
7%
2%
35%
49%
20
40
60
80
100

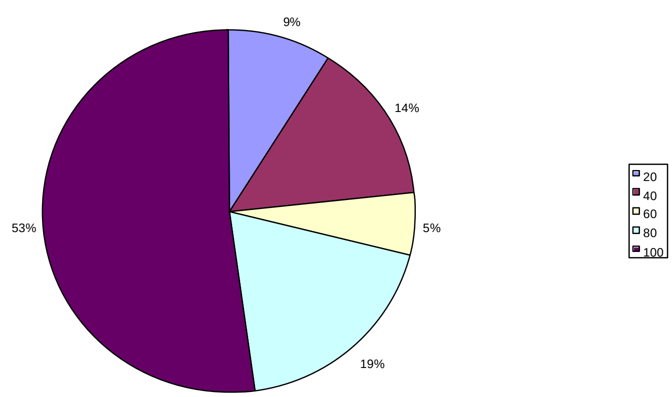

Spruce/swordfern (mesic)
6%
7%
6%
35%
46%
20
40
60
80
100


Spruce/salmonberry (wet)
24%
31%
20%
16%
9%
20
40
60
80
100

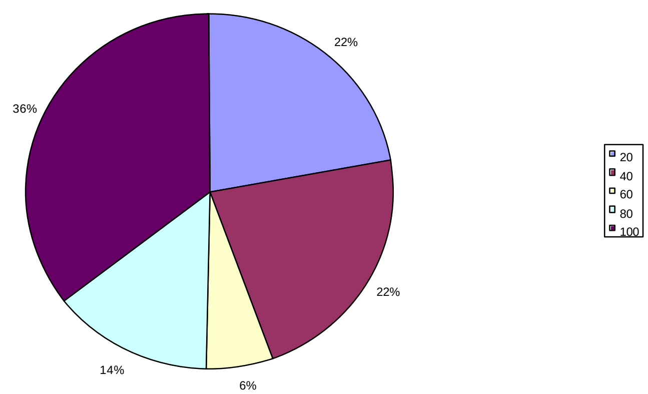
Hemlock/salal (dry)



Hemlock/swordfern (mesic)



Hemlock/salmonberry (wet)



Appendix 4: Shallow-rapid Landslide Susceptibility Model for Lower Alsea Watershed Analysis

This rating is based on the protocol outlined in "Slope morphology model derived from digital elevation data" (Shaw and Johnson 1995). Relationships among slope formùconvex, planar, and concaveù and slope gradients are combined using standard ArcInfo GRID analysis routines. The slope classes recommended for this analysis are based on information collected as part of earlier landslide inventories conducted on the Waldport and Mapleton Ranger Districts. The terrain, geol-ogy, and soils of the Lower Alsea Watershed Analysis area is largely the same as found on those two districts.

The results of this DEM-based analysis are useful for identifying areas in a watershed or drainage basin where landslides are likely to occur. While soil thickness and mechanical properties, and groundwater conditions are not factored into this analysis, the model is based on two primary assumptions: 1) soils are generally thin (less than about 1.5 meters) on steep slopes; and 2) concave landforms (the heads of drainages, also called "headwalls") concentrate groundwater flow. During high intensity storm events, water flowing in a concave landform on steep slopes is more likely to destabilize thin soils. This model does not predict that landslides will occur in a particular place or within a short time-frame. It does indicate areas where landslides are likely to occur *if* soil conditions and precipitation rates are right.

Areas identified as having moderate and high landslide susceptibility should be targets for field examination of soil thickness and strength characteristics, and other factors known to contribute to slope failure. Field examination will usually result in a reduction of the areas identified by this model as potentially unstable.

TABLE A4-1. SHALLOW-RAPID LANDSLIDE SUSCEPTIBILITY RATING MATRIX

Slope Form	Slope Gradient (percent)		
	A (<50)	B (50-70)	C (>70)
Convex	low (11)	low (21)	low (31)
Planar	low (12)	moderate (22)	high (32)
Concave	low (13)	moderate (23)	high (33)

Appendix 5: Stream Channel Classification

Methodology for the determination of confinement and gradient is described in detail in Washington Timber Fish and Wildlife's *Watershed Analysis Manual* (Washington DNR 1993). As prescribed in the manual, aerial photography was used to determine confinement by stream segment. Confinement classifications are based upon aerial photography and should be considered estimates that require field verification to determine their accuracy. Stream segments with valley width less than two times the channel width were identified as "confined," those with valley widths between two and four times the channel widths were identified as "moderately confined," and those with valley widths greater than four times the channel widths were identified as "unconfined." Confinement information was drawn on base maps and digitized into GIS.

USGS 7.5 minute topographic maps were used to determine gradient for all segments of the stream network. As described by the TFW *Watershed Analysis Manual* (Washington DNR 1993), six gradient ranges, when coupled with confinement, generally correspond to distinct transport capacities, and they are as follows: 0-1%, 1-2%, 2-4%, 4-8%, 8-20%, and >20%. As with the confinement data, gradient information was drawn on base maps and digitized into GIS.

Appendix 6: Water Rights Information

Under Oregon law, all water is publicly owned, and it is the state's responsibility to manage the allocation of water. Oregon's water laws are based on the principle of prior appropriation: the first person to obtain a water right on a stream is the last to be shut off in times of low streamflows. The date of application for a permit to use water usually becomes the priority date of the right.

A water right is attached to the land where it was established, as long as the water is used. If the land is sold, the water right goes with the land to the new owner. Once established, a water right must be used at least once every five years as provided in the water right. With some exceptions established in law (e.g., municipal use), after five consecutive years of non-use the right is considered forfeited and is subject to cancellation. Generally, Oregon law does not provide a preference for one kind of use over another. If there is a conflict between users, the date of priority determines who may use the available water.

Water can only be used for the type of use designated in the water right and without waste up to the amount specified in the right. Table 3-9 summarizes water rights demands in the analysis area.

Minimum Stream Flows & In-stream water rights

Minimum stream flows are administrative rules adopted by the Water Resources Commission. Most minimum stream flows have been converted to in-stream water rights. In-stream water rights establish flow levels to stay in a stream on a month-by month basis and are usually set for a certain stream reach and measured at a specific point on the stream. They are established for fish protection, minimizing the effects of pollution, or maintaining recreational uses. In-stream water rights have priority dates and are regulated in the same way as other water rights. While minimum streamflows have been authorized since 1955, in-stream water rights were established by the 1987 Legislature. These are not guarantees that a certain quantity of water will be present in the stream; rather, they will act as a senior priority water date to junior water right holders. There are several in-stream water rights in the Alsea River.

Water Conservation

Oregon law currently requires that all water that is diverted by water right holders be used beneficially and without waste. This means that a right holder is required by law to use only the amount necessary for the intended purpose and no more, up to the limits of the water right. State law allows a water right holder to submit a conservation proposal to the Commission and receive authorization to use a portion of the conserved water on additional lands, apply the water to new uses, or dedicate the water to in-stream use.   Metering of water use has reduced consumption from the Coastal Frontal streams.

Cancellation, Transfer, Leasing Water Rights

Water rights may be transferred to in-stream uses, either permanently or temporarily. These transferred rights become in-stream water rights with the priority date of the original right. Oregon law allows water right holders to sell, lease or donate water rights to be converted to in-stream water rights.

Appendix 7: Alsea Basin 7 Day Average Maximum Stream Temperatures (in ^oF)

Note: Column 1991-1996 contains data where the exact year was not identified.

				Year						
Station	**Subbasin**	**Stream**	**Location**	**91-96**	**94**	**95**	**96**	**97**	**Max**	**Source**
154	Lower Alsea	Alsea	upstream of Five Rivers		74				74	FS
150	Lower Alsea	Alsea	downstream of Mill Cr		73				73	FS
169	Lower Alsea	Bull Run	mouth				63		63	FS
160	Lower Alsea	Canal	upstream of EF			65			65	FS
59	Lower Alsea	Canal	Mile 0.8				63		63	FS
73	Lower Alsea	Grass	near mouth				71	73	73	FS
74	Lower Alsea	Grass	top of meadow					65	65	FS
	Lower Alsea	Grass	meadow fork					61	61	FS
58	Lower Alsea	Lake	at mouth				66		66	FS
197	Lower Alsea	Meadow fork	mouth					72	72	FS
	Lower Alsea	Mill	mouth			62			62	BLM
72	Lower Alsea	Scott	near mouth				63.8		63.8	FS
	NF Alsea	Crooked	upstream of Yew			61	57	61	61	BLM
	NF Alsea	Honey Grove	mouth					73	73	ODFW
	NF Alsea	Honey Grove	Mile 4.0				57		57	BLM
159	NF Alsea	NF Alsea	mouth		69	72			72	FS
	NF Alsea	NF Alsea	at hatchery		70	69			70	ODFW
	NF Alsea	NF Alsea	upstream of Crooked			70			70	BLM
118	NF Alsea	NF Alsea	downstream of Parker			68			68	FS
	NF Alsea	Seely	mouth					68	68	ODFW
	NF Alsea	Seely	near pond					65	65	ODFW
	NF Alsea	Seely	at forks					62	62	ODFW
	SF Alsea	Peak	mouth			68	69		69	BLM
	SF Alsea	Rock	Mile 1.0				71		71	BLM
	SF Alsea	SF Alsea	upstream of Bummer		72	75			75	FS
149	SF Alsea	SF Alsea	upstream of Rock			67		67	67	BLM
	SF Alsea	Swamp	upper SF (Sec. 36)					71	71	ODFW
	SF Alsea	Swamp	upstream of Brown					66	66	ODFW
	SF Alsea	Swamp	near mouth			60		60	60	BLM
	SF Alsea	Tobe	mouth		65	63	66	57	66	BLM
174	Drift	Cape Horn	at mouth				62	61	62	FS
147	Drift	Cedar	at mouth		57				57	FS
143	Drift	Drift	upstream of Gold			75			75	FS
18	Drift	Drift	Mile 6.0		72	70			72	FS

				Year						
Station	**Subbasin**	**Stream**	**Location**	**91-96**	**94**	**95**	**96**	**97**	**Max**	**Source**
66	Drift	Drift	downstream of Ellen Cr.		70	69	69		70	FS
62	Drift	Drift	upstream Meadow			69	69		69	FS
194	Drift	Drift	upstream Gopher		64	65	67		67	FS
161	Drift	Drift	upstream of Nettle Cr		59	63			63	FS
64	Drift	Drift	below Bahanon Falls				63		63	FS
195	Drift	Gopher	at mouth		64		67	66	67	FS
171	Drift	Gopher	upstream of Cape Horn				67	60	67	FS
	Drift	Gopher	upstream of Traxel					66	66	FS
172	Drift	Gopher	top of canyon				66	63	66	FS
173	Drift	Gopher	top of marsh				65	61	65	FS
	Drift	Gopher	South Fork					61	61	FS
	Drift	Gopher	North Fork					57	57	FS
	Drift	Gopher	Middle Fork					56	56	FS
61	Drift	Meadow	at mouth		61	62	65		65	FS
63	Drift	Nettle	at mouth				62		62	FS
	Drift	Traxel	at mouth					59	59	FS
146	Drift	Trout	at mouth			65			65	FS
	Five Rivers	Bear	mouth				64		64	FS
165	Five Rivers	Buck	Mile 1.1				74		74	FS
49	Five Rivers	Buck	Mile 5.3				66		66	FS
53	Five Rivers	Buck	Mile 6.7				63		63	FS
	Five Rivers	Camp	mouth		68	68			68	BLM
46	Five Rivers	Camp	Mile 1.1		63	63.5			63.5	FS
163	Five Rivers	Cascade	upstream NF				69		69	FS
54	Five Rivers	Cascade	Mile 3.3				68		68	FS
55	Five Rivers	Cascade	Mile 2.5				66		66	FS
166	Five Rivers	Cougar	near mouth				63.9		63.9	FS
	Five Rivers	Crab	near mouth					70	70	FS
50	Five Rivers	Crab	Mile 3.1				68		68	FS
	Five Rivers	Debris Flow Trib	mouth	69					69	FS
198	Five Rivers	EF Green	mouth				68	67	68	FS
	Five Rivers	EF Green-EF	ef of ef					59	59	FS
	Five Rivers	EF Green-SF	sf of ef					58	58	FS
105	Five Rivers	EF Green-WF	wf of ef					67	67	FS
167	Five Rivers	Elk	mouth above culvert				61		61	FS
	Five Rivers	Five Rivers	below Lobster Cr		73	74			74	ODFW
	Five Rivers	Five Rivers	below Green River		68	71			71	ODFW
	Five Rivers	Five Rivers	upstream of Prindle				69		69	FS
188	Five Rivers	Green	mouth				69	70	70	FS

				Year						
Station	**Subbasin**	**Stream**	**Location**	**91-96**	**94**	**95**	**96**	**97**	**Max**	**Source**
109	Five Rivers	Green	nf					69	69	FS
101	Five Rivers	Green	at Ryan					68	68	FS
102	Five Rivers	Green	just above sb trib in sec 20					68	68	FS
189	Five Rivers	Green	upstream EF				66	67	67	FS
	Five Rivers	Green	green sec 25 top above trib					63.5	63.5	FS
108	Five Rivers	Green	sf					59	59	FS
	Five Rivers	Green-TS25	sb trib sec 25 top					57	57	FS
100	Five Rivers	Ryan	mouth					68	68	FS
168	Five Rivers	Summers	0.12 mile upstream mouth				61		61	FS
	Lobster	Bear	mouth	61					61	BLM
	Lobster	EF Lobster	mouth	59					59	BLM
	Lobster	EF Lobster	Mile 1.0					59	59	BLM
	Lobster	J Line	mouth				61		61	BLM
	Lobster	Little Lobster	mouth		64	66			66	BLM
	Lobster	Lobster	mouth	75	73		73		75	BLM
	Lobster	Lobster	upstream of Little Lobster	74	74	74			74	BLM
	Lobster	Lobster	downstream of Little Lobster	73	72	68			73	BLM
	Lobster	Lobster	downstream of Camp	73	72	72			73	BLM
	Lobster	Lobster	downstream of Preacher	72	70	71			72	BLM
	Lobster	Lobster	upstream of Debris Torrent				70		70	BLM
	Lobster	Lobster	upstream of Martha	68					68	BLM
	Lobster	Lobster	upstream of Bear	66	63	64	66		66	BLM
	Lobster	Lobster	upstream of J-Line				66		66	BLM
	Lobster	Lobster	downstream of Debris Torrent				64		64	BLM
	Lobster	Phillips	mouth	68					68	FS
	Lobster	Preacher	mouth	70					70	FS
	Lobster	Preacher	Mile 2.2	60					60	FS
	Lobster	SF Lobster	Mile 19.8 on Lobster	65					65	BLM

Appendix 8: Benefits of Vegetation Management Techniques

Thinning reduces trees per acre and increases diameter growth. It maintains stand vigor and puts acres on a faster developmental track toward late-successional habitat. By using certain criteria in removing trees, the spacing uniformity of plantations can be broken up, and differentiation in tree development can be enhanced. Thinning can provide the opportunity to underplant shade-tolerant species and create snags and coarse woody debris and other diversity components.

The effects of leaving overstocked stands untreated include severe inter-stand competition that results in decreased diameter growth and a general lack of vigor. With the even spacing that exists in plantations, it takes a long time for stands to differentiate. The low level of pest resistance in the trees' systems makes the stands more susceptible to disease or insect attacks, and can mean a decline in overall stand health. A result of the reduced diameter growth is increased windthrow susceptibility, due to increased height-to-diameter ratio. As the trees grow taller, they keep the same crown size they had at crown closure, resulting in a reduced percentage of crown. Also, understory vegetation is dramatically reduced from lack of available sunlight.

Modifying stand density by thinning can cause very large increases in diameter growth, but height growth of the *dominant* trees of a stand is essentially independent of spacing. At the extremes of density there can be some effect, i.e., in very dense conditions, height growth can be slowed by reduction in crowns, and in very wide spacing, height growth can be slowed due to energy going into branch production. The height growth of trees of the lower crown classes (co-dominants, intermediate, overtopped) is stunted by competition. The greater the number of trees being overtopped through competition, the lower is the average height. The common opinion that trees grow taller in dense stands is not correct. The slender trees merely look taller than the more tapered ones of a less dense stand. (Smith 1986; Oliver and Larson 1990)

The LSRA (USDA Forest Service 1996) determined that given the high density and predominant monoculture of trees in the managed plantations on federal land, several management options are appropriate and desirable to accelerate the attainment of late-successional characteristics. These include:

- thinning to control density and produce desirable characteristics
- underplanting with shade-tolerant species
- selecting for both species and structural diversity
- developing prescriptions that are ecologically based, i.e., working within the successional pathways of different environments.
- creation or maintenance of snags and CWD
- vegetation management including control of noxious weeds
- riparian planting and felling of trees for stream structure

REO guidelines for silvicultural treatments in both precommercial and commercial age classes emphasize the need to maintain diversity in meeting LSR objectives, including leaving some areas untreated. One objective when treatments are applied is to mimic natural disturbance patterns, including such characteristics such as patch size, seral types, density and variability.

For silvicultural prescriptions of CWD in managing plantations, a recommended "number" or volume is less important than an understanding of the dynamics of CWD, and particularly, a determination of whether the managed area is currently on the upward or downward trend for coarse woody debris. The importance of managing for CWD in plantations is to maintain nutrient cycling processes and to provide continuity and critical habitat for the succession of fungi, lichens, small mammals, insects, amphibians, mycorhizae and a host of other species.

The final objectives of stand characteristics should dictate the application of various silvicultural prescriptions. Care must be taken to ensure that key structural, functional or diversity components in the stand are not eliminated. Map 16 ("Managed Stands") shows generally where potential plantation units are located.

Early silvicultural projects are identified by vegetation surveys. The following describes the criteria that are used to identify early silvicultural treatment projects:

Site Preparation

Purpose: To reduce competing vegetation and logging debris (also reduces fire hazard), to provide room for seedlings to be planted, to lessen competition to seedlings from other vegetation, and to limit cover for seedling-damaging rodents. Site preparation methods include prescribed fire, underburning, manual vegetation cutting, hand piling/burning in the fall, and mechanical clearing.

Criteria for identification of projects:

1) Stands which have been regeneration harvested.
2) Hardwood conversion areas: areas which are currently growing hardwoods but which have the potential to grow a conifer stand.
3) Stands planned for understory development/creation of a second canopy layer.

Reforestation

Purpose: To plant harvest sites, within one year if possible, after site preparation has been completed. The selection of tree species, density and stock type will depend on the site characteristics, stand composition and future project management objectives.

Criteria for identification of projects:

1) Stands which have been recently regeneration harvested and for which site preparation has recently been done.
2) Hardwood conversion sites which have been prepared for planting.

3) Stands identified for understory development (generation of a second canopy layer).

Stand Protection

Purpose: To provide protection to seedlings from rodents and big game by trapping or through the use of plastic tubing or netting around seedlings.

Criteria for identification of projects:

1) Units where animal damage to planted seedlings is severe.
2) Units where stocking levels have fallen below desired levels due to animal damage.

Stand Maintenance and Release

Purpose: To provide sufficient light and growing space for growing conifer seedlings.

Criteria for identification of projects:

1) Select units where hardwoods overtop conifers or where competing brush or conifers threatens the survival or decreases the growth of preferred conifer seedlings.
2) Select stands 3-15 years of age for best results.
3) Treat between June and August for most effective treatment.
4) Treat before conifer growth has slowed significantly from competition.

Young Stand Density Management/Pre-commercial Thinning

Purpose: To promote desired species composition, stem quality, spacing, and growth performance in young stands by reducing the stem count. Typical spacings are 12' x 12' to 16' x 16', but they can be variable.

Criteria for identification of projects:

1) Over-stocked stands, generally with stem counts over 300.
2) Stands 10-20 years-old have usually reached the necessary height and crown closure to allow conifer release without also releasing competitive species.

Early Commercial Thinning

Purpose: To promote desired species composition, stem quality, spacing, and growth performance in young stands (mostly 20-30 year-old stands) by reducing the stand density.

Criteria for identification of projects:

1) Over-stocked stands (generally with stem counts over 300).
2) Stands 20-30 years-old which have reached the necessary size to allow the harvest of conifers with enough merchantable material to produce a profitable sale.
3) Stands predominantly containing slopes <35%, allowing the operation of ground-based equipment.

Fertilization

Purpose: To increase tree growth (volume) and improve the nutrient condition of the soils.

Criteria for identification of projects:

1) Response to fertilization is usually greatest on sites deficient in the nutrients applied (i.e., generally, poor quality sites usually result in a positive growth response).
2) Younger stands with early stocking control are usually favored for greatest response.
3) Timing of fertilization should be 10-20 years before the next thinning or final harvest in order to maximize the return from the treatment.
4) Minimal ground cover so that fertilizer reaches the seedling roots.
5) Combining fertilization with thinning, resulting in greater foliage biomass and photosynthesis.
6) Fertilizing thinned stands results in a high value response due to gain in growth being distributed among fewer, larger stems.

Pruning

Purpose: To enhance future wood quality.

Criteria for identification of projects:

1) Stands with young trees; age 15-50 years; may be performed several times.
2) Trees should be at least 4 inches diameter.
3) Trees with good growth form and minimal defect should be selected for treatment.
4) Best return is found on high site class lands.
5) Stands that have been recently thinned or will be thinned within 5 years.

Hardwood Conversion

Purpose: To convert conifer sites currently dominated by hardwoods to conifer or a conifer mix.

Criteria for identification of projects:

1) Hardwood dominated stands which have the site potential to grow conifers
2) Best return if stands are incorporated into planned thinning or regeneration harvest sales or are of a large enough magnitude to be performed separately as a treatment.
3) If converting red alder, best results if treated between mid-May and mid-July, a period starting after bud-break.

Appendix 9: Riparian Reserve Project Design — Factors to Consider

- Management objectives for the site should be based on the physical and biological potential, and geomorphic context of the site. The geomorphic context should be field investigated, and an explanation of its significance to the site's physical and biological processes should be addressed in the EA. This description should include an estimate of the extent of true riparian zone (i.e., the stream-adjacent zone that directly influences conditions in the aquatic environment) as distinguished from the uplands that lie within the Riparian Reserve area.

  Factors to consider when distinguishing the uplands from the true riparian include:

  - Slope breaks: that point on the slope where erosional processes have produced an oversteepened and actively eroding surface that contributes sediment directly to the channel and/or flood plain
  - Geomorphic type: flood plains, terraces, alluvial-colluvial fans, debris torrents, in-channel landslide deposits, streambanks and vertical canyon walls ("gorges") are all considered actively and directly influencing aquatic conditions, and are therefore part of an ecological riparian zone, while a stable colluvial hillslope, bench or ridge line is considered upland
  - Water table: as evidenced by plant communities and physical conditions at the site
  - Stream channel type: steep, intermittent "source" stream versus low gradient depositional reach

- Upland sites within the riparian reserve allocations are transitional, and their direct influence on aquatic conditions quickly approaches a limit where management activities carry small potential for improvement, or risk, for the aquatic system. How quickly this limit is approached varies by issue (e.g., stream temperature vs. sediment supply) as well as spatially and temporally. This should be recognized in project planning by addressing these specific effects at the project level.

- Since standards and guidelines for a properly functioning riparian zone have not been well quantified, there is a need to develop them on a site-specific basis. For the true riparian zone, they should identify reference sites that can serve as a model for how it is thought the site in question should or could function. This would help define the "range of natural variability" for the site. Where no adequate reference site can be identified, "professional judgement" is relied upon and backed up by whatever research and reference work can be located, together with evidence from the site in question.

- Treatment prescriptions should include all subsequent treatments necessary to achieve older forest characteristics, ACS objectives, and coarse woody debris (CWD) goals for the stand. Monitoring needs to be specifically identified to insure that it is completed and the results carried on into future planning.

Major riparian vegetation functions which need to be addressed when assessing project level conditions are contained in Table A9-1, "Riparian Reserve Functions and the Role of Vegetation:"

TABLE A9-1: RIPARIAN RESERVE FUNCTIONS AND THE ROLE OF VEGETATION

Riparian Vegetation Function	Requirements for Proper Function
Shade C regulates instream temperatures for fish/amphibians/invertebrates C regulates terrestrial microclimate	C large trees and other vegetation with high % canopy closure
Allochthonous* input C food resource for invertebrates/microbes (99% in 1st-order streams)	C diverse species of trees and other vegetation
LWD source C provides habitat for fish, amphibians, invertebrates, beaver, fungi, and bryophytes C helps frame stream channel morphology	C mature and understory conifers in abundant supply and well distributed
Nutrient/sediment filter C maintains high water quality	C periodic inundation of flood plain provided by connectivity of flood plain and stream (promotes denitrification) C trees and other vegetation to trap sediment
Habitat/dispersal corridors C provides cover, forage, water C provides connectivity to dispersal areas within and between watersheds	C mature to late-successional forest characteristics
Bank stability C lowers erosion potential C maintains high water quality	C trees and other vegetation with good root strength
Energy dissipation C lowers erosion potential C builds flood plains C maintains high water quality	C LWD in channel and on flood plain C streamside trees and other vegetation C connectivity of stream and flood plain (flood plain inundated every 1-3 years)

* Coming from outside of the stream (e.g., tree leaves and needles)