Big Creek
Watershed Analysis

Bureau of Land Management

Coos Bay District

Myrtlewood Resource Area

First Iteration: May 1997

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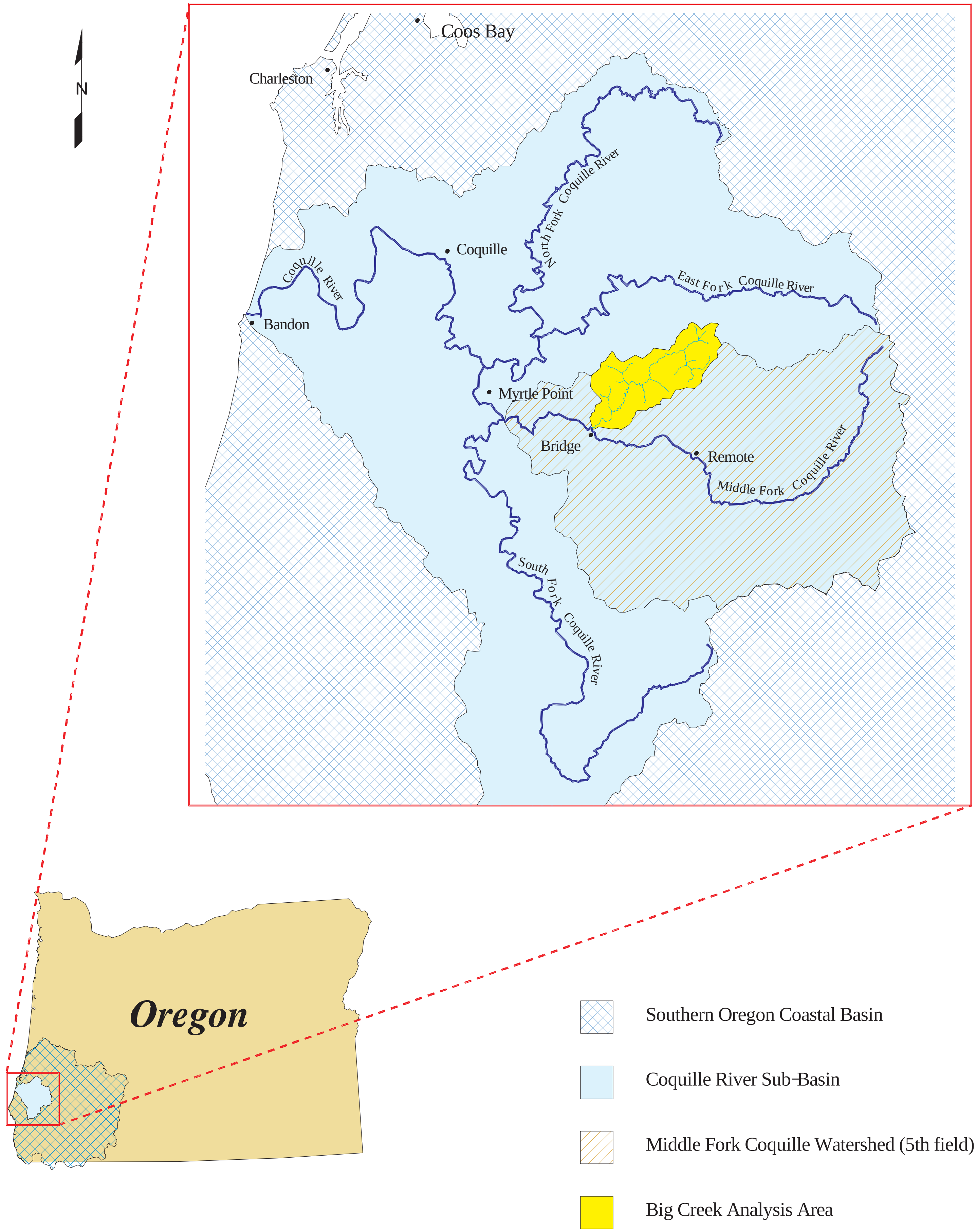
Introduction

This report is a first watershed analysis for the Big Creek subwatershed and is organized within reasonable conformity to the format described in the *Federal Guide for Watershed Analysis Ver. 2.2* (Guide). Prior analysis for this area include the Middle Fork Coquille Watershed Analysis (BLM 1994a). That analysis, however, focused on a general overview of the entire 5th field watershed and was an upgrade from a previous watershed *assessment*.

Watershed analysis is a major component of the ecosystem-based management strategy mapped out 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 (USDI 1994). The stated purpose of watershed analysis is to develop and document a scientifically-based understanding of the ecological structures, functions, processes, and interactions occurring within a watershed, and to identify desired trends, conditions, data gaps, and restoration opportunities. The information, recommendations and data gaps documented in a watershed analysis can be used to help plan land management activities that are appropriate for the analysis area, support the NEPA process, and direct future data collection efforts. Watershed analysis was designed as an iterative process, with reports being revised as additional information becomes available.

The interdisciplinary team members initially convened to identify issues and questions pertinent to the analysis area, then worked independently to write sections covering the analysis questions for their respective fields of expertise. The team reconvened to synthesize the information into a cohesive watershed analysis report.

Figure I−1 Watershed Hierarchy of the Big Creek Analysis Area



I. CHARACTERIZATION of the ANALYSIS AREA

LOCATION

The Big Creek analysis area is composed of the Big Creek subwatershed which lies within the Coquille River system. This subwatershed is one of the ten subwatersheds within the Middle Fork Coquille Analytical (fifth field) Watershed and comprises 8.4% of the Watershed (Figure I-1).

The Coquille River is the largest system in the South Coast River Basin, draining 1058 square miles from the Coast Range and Siskiyou mountains, westward to the Pacific Ocean. The Middle Fork Coquille River is the largest and most eastern with a drainage area of about 305 mi^2 and mainstem length of about 40 miles. The confluence of the Middle Fork Coquille River is with the South Fork Coquille near Myrtle Point, Oregon.

The analysis area is located about 28 miles southeast of Coos Bay, Oregon, near the town of Bridge and is 16,661 acres (26 sq. mi.) in size. (Figure I-2).

Big Creek, which traverses northeasterly through the analysis area is a 5th order stream and has a gentle gradient of less than 0.5 % for over half of its length. Big Creek is 5^{th} order for most of its length with 4th order tributary drainages. Drainage areas in descending order include Big, Brownson, Fall, Bear Pen, Axe, and Jones Creeks (Figure I-3).

OWNERSHIP and LAND USE ALLOCATIONS

Of the 16,661 total acres in the analysis area, the Myrtlewood Resource Area of the Coos Bay District - BLM manages 9,021 acres (54%). The Coquille Tribal Forest comprises 1047 acres (6%) and the remaining is 6,593 acres (40%) is privately owned.

All BLM lands are designated according to the categories set forth by the Record of Decision for the Coos Bay District Resource Management Plan (RMP) and the Record of Decision (ROD) for the *Supplemental Environmental Impact Statement on Management of Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl* (SEIS). The type and amount of each land use allocation is shown in Table I-1 and their respective location is shown on Figure I-4.

Figure I−2 Location Map of the Big Creek Analysis Area

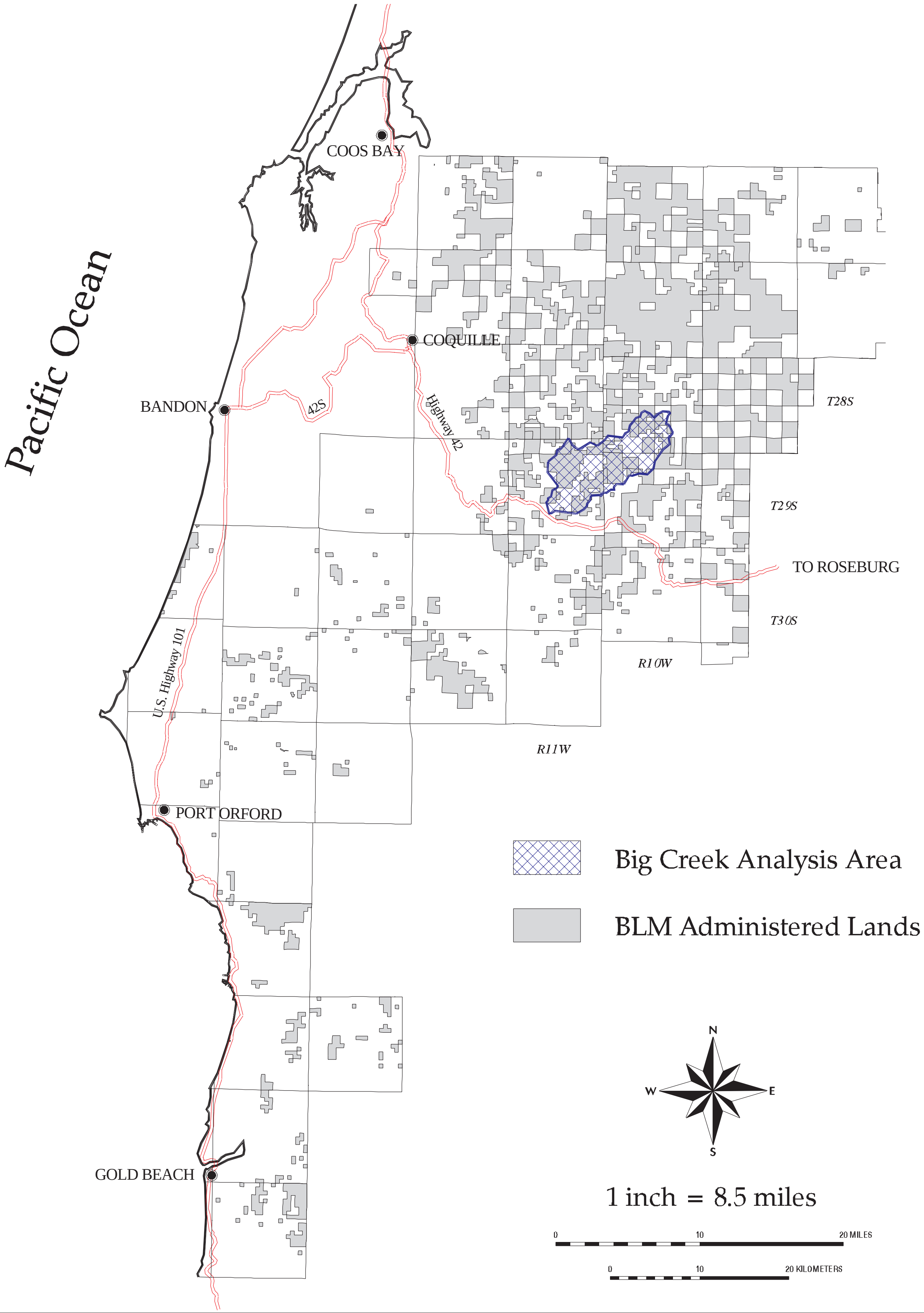


Figure I–3 Drainages within the Big Creek Analysis Area

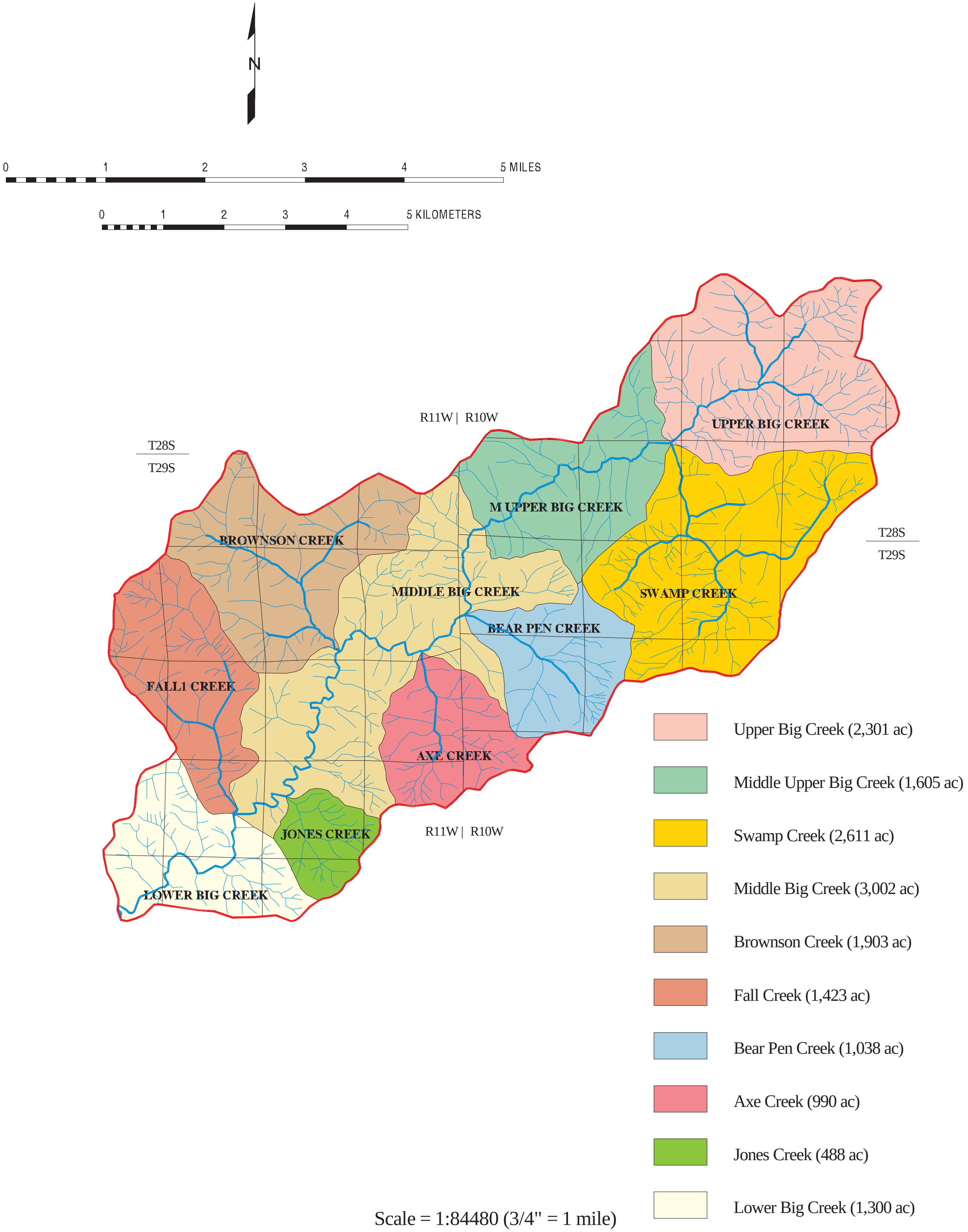
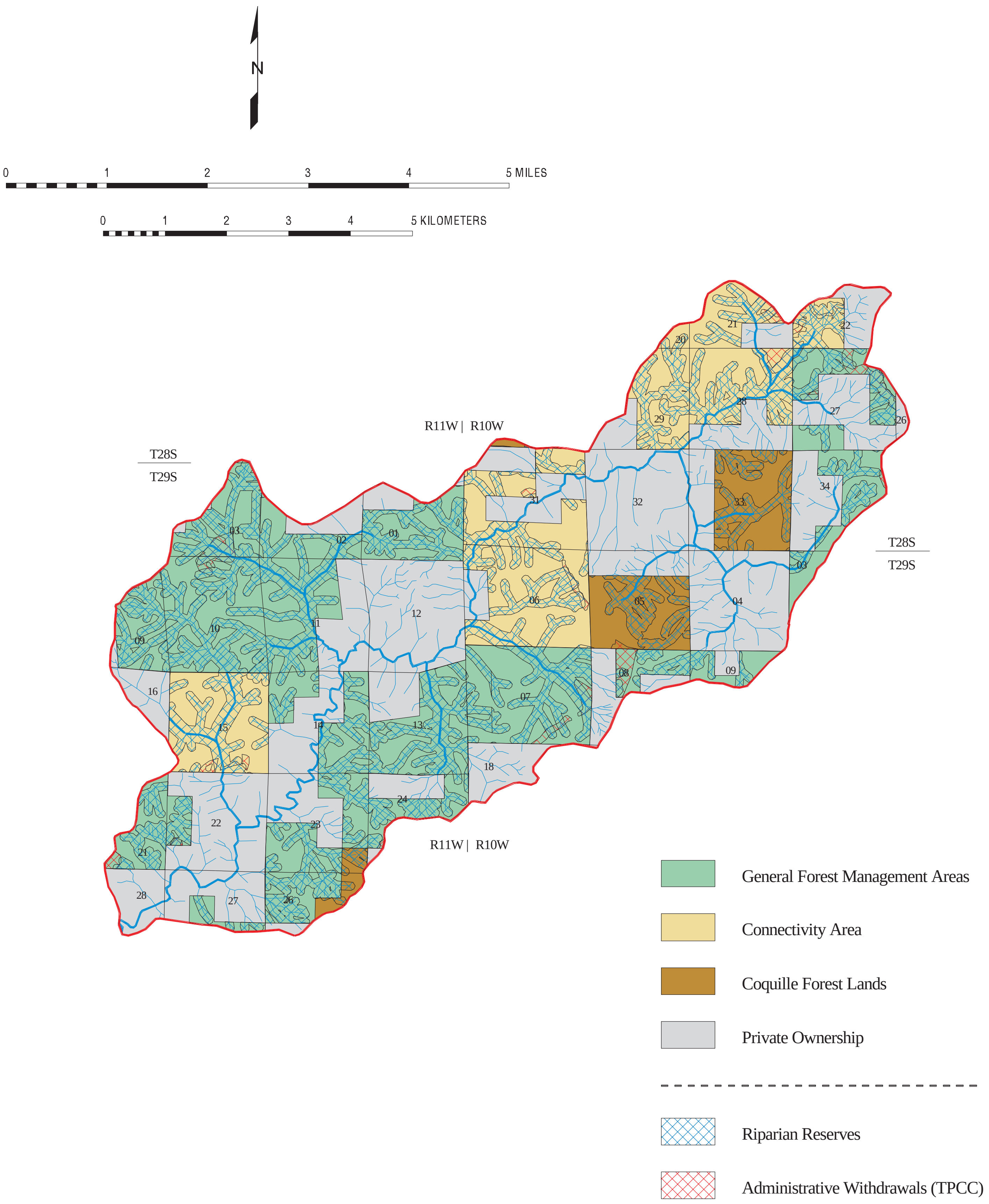


Figure I−4 Land Use Allocations on Federally Administered Lands



Scale = 1:84480 (3/4" = 1 mile)

Table I-1: Ownership and Land Use Allocations in Big Creek Subwatershed

Total Acres	16,661
Private	6,593
Coquille Tribal Forest	1,047
BLM	9,021
GFMA (General Forest Management Areas)	6,034
LSR/MMR (late-Successional Reserves)	0
Connectivity	2,987
Riparian Reserves-all land allocations (estimate)	5,038
Total Reserves[1]	5,275

[1] Includes TPCC withdrawn lands, and Riparian Reserves (GFMA only)

GEOLOGY

The Big Creek analysis area is comprised of formations characteristic of the Coast Range Physiographic and Klamath Mountain Physiographic Provinces (Figure I-5).

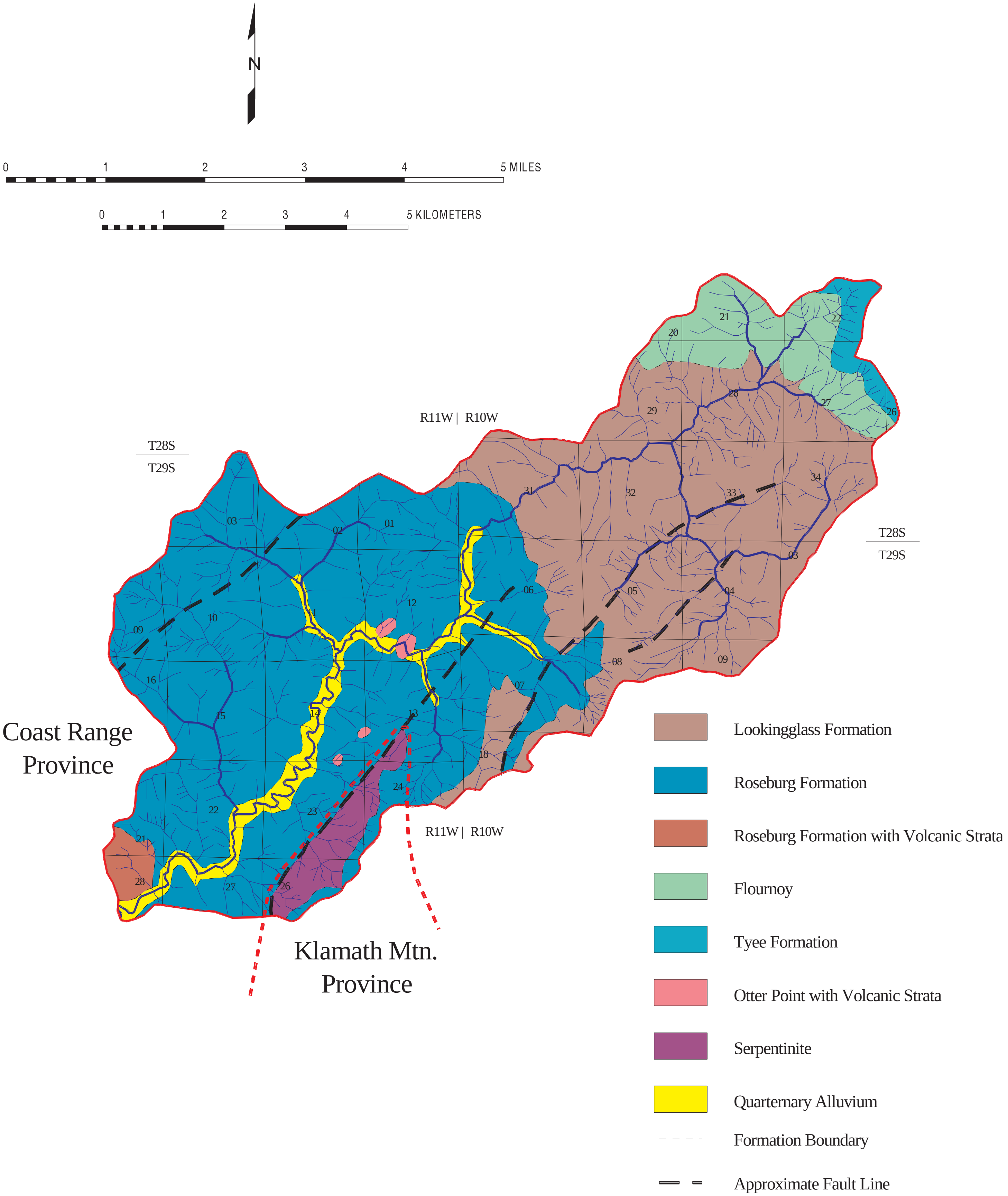
Geologists speculate that between 45 and 60 million years ago the Coast Range Physiographic Province was part of a large, partially enclosed basin called a geosyncline. Vast amounts of submarine basalt flows, breccias, and tufaceous sediments were deposited in this geosyncline during past volcanic activity and subsequent surface erosion during tetonic uplifting. These flows and deep water sediments constitute the Roseburg, Looking glass, Flournoy, and Tyee Formations.

The Klamath Mountain Physiographic Province borders the Coast Range Province on the south and extends into California as far south as San Francisco. It is the most geologically complex province in southwestern Oregon. It is comprised of very old (450 million yrs.) sedimentary and volcanic rocks, locally metamorphosed (altered by heat and pressure), with intrusions of granite and serpentine. The Jones Creek portion of the analysis area is comprised of the Otter Point formation and soils derived from serpentinite parent materials. This isolated portion of the drainage provide a unique character to the Big Creek drainage in regards to sediment type, vegetation characters and landscape stability.

There are six different geologic formations in addition to other deposits and outcroppings within the analysis area. They are from the oldest formation to the youngest: Otter Point, Roseburg, Lookingglass, Flournoy, Tyee Formations and the Quaternary alluvium. The underlying base rock is weakly resistant to erosion.

Four fault lines within the analysis area are predominately found lying in a Northeasterly and Southwesterly direction as are most in southwestern Oregon.

Figure I–5 Geologic Formations and Fault Lines



Scale = 1:84480 (3/4" = 1 mile)

Geologically, the drainage has a steep young portion on the Tyee and Flournoy formations.   The Looking glass formation is steep in those areas associated with fault lines or adjacent to other formations due to uplifting or resistance to lifting. The drainage is dominated by the Roseburg and Looking glass formations. These two tertiary aged formations have a higher siltstone and mudstone component in the parent material in addition to being composed of larger bedded materials (Townsend 1977, Beaulieu 1975, Burroughs 1976)

SOILS

According to the Soil Survey of Coos County, OR. (USDA 1989), there are fourteen different soil types on several different slope classes (Figure I-6). These soil types can be grouped together by similar properties to encompass four map units that cover the Big Creek drainage. The Preacher-Bohannon series and Digger-Preacher-Remote series that are deep to moderately deep, moderately steep to very steep, gravelly and loamy soils that formed in colluvium and residuum derived from sedimentary rock. The Serpentano-Digger series that has similar depth, slope steepness, texture, and is derived from metamorphic and sedimentary rock. The last series is the Umpcoos-Rock outcrop-Digger that is more shallow than deep, very steep, gravelly and loamy and formed in colluvium derived from sedimentary rock.

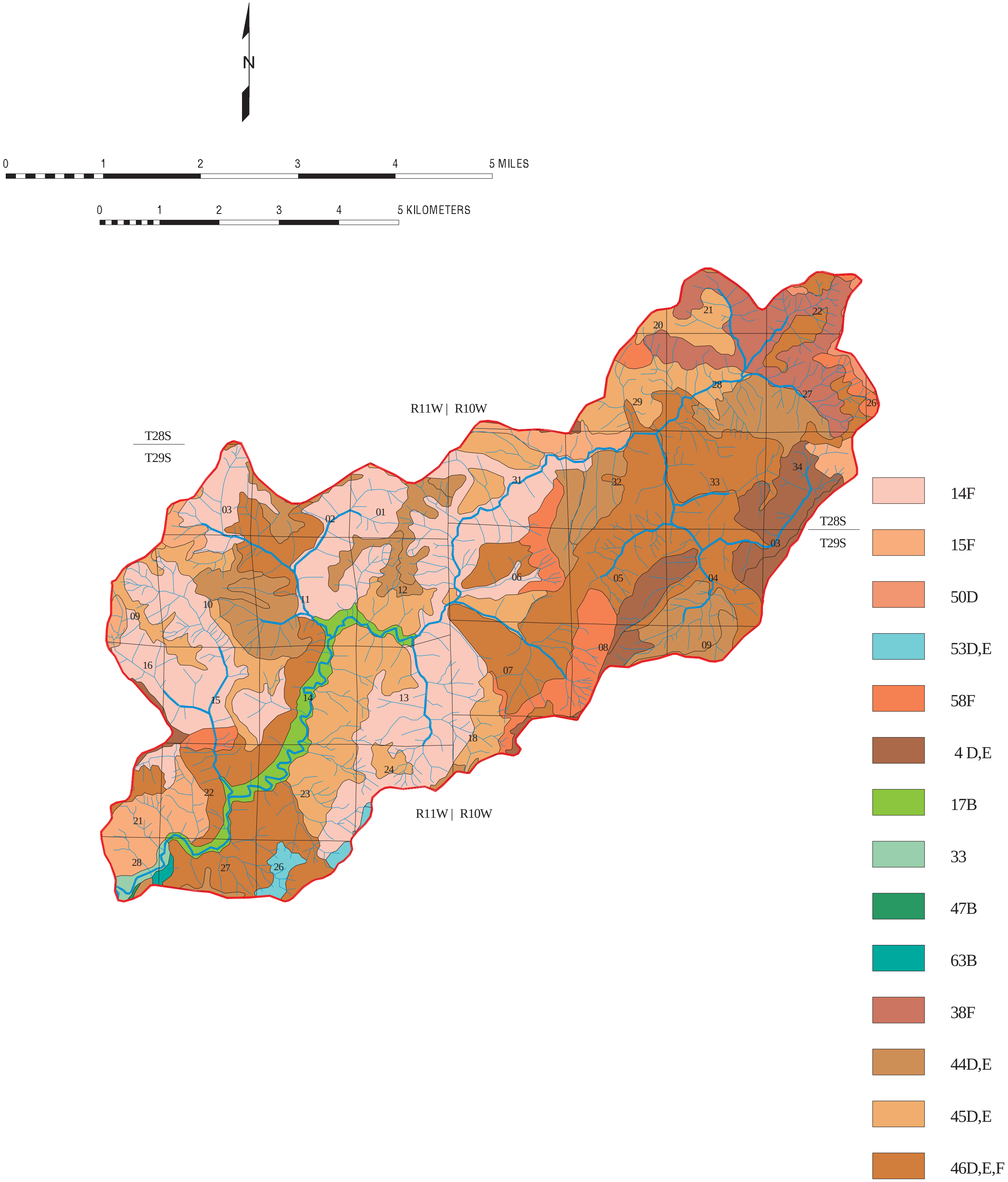
CLIMATE

Annual precipitation occurs mostly as rainfall, ranging from 55 inches in the low elevations and river valleys along the Middle Fork Coquille, to more than 70 inches in the upper areas of Big Creek near 2600 feet (OSU 1993). Precipitation varies strongly with elevation, with greater amounts in the higher portions of the drainage. Aspect and drainage orientation to prevailing winter Southwest winds also influence precipitation amounts. The analysis area seems to occupy a slight rain shadow behind the Siskiyou mountains from the Southwest trending winter storms, thus precipitation is lower than elsewhere in the Coast Range. Cool, moist air masses lifting over the Coast Range can produce snow over 1500-1800' elevations. These are intermittent snow packs, usually persisting on the ground for only a few weeks, and sometimes melting quickly with warm winds and rain. Extra water storage as snow water equivalent can elevate flood waters.

Approximately 90% of the average annual precipitation occurs between October and April, with 50% occurring during November-January. Although heavy rainfall occurs with winter storms, most of the precipitation is low intensity, and commonly occurs as "drizzle". Precipitation during the May through September summer months is only about 10% of the annual average, the dry season precipitation being 7 -8 inches (OSU 1982).

Maximum precipitation periods are responsible for high runoff, including flooding, watershed erosion, slides, and debris torrents - but occur on an infrequent basis. High precipitation with the melt of existing shallow snow packs can worsen flooding. Analysis from area NOAA Cooperative Weather Stations, damaging storms have a return frequency of 5 years or more, and could be expected to have daily precipitation of at least four inches. Cumulative precipitation of 9 inches or more in several days, has been correlated with a higher incidence of landslides and torrents (see Section III.1- Erosion Processes).

Figure I-6 Soils Map of the Big Creek Analysis Area



Scale = 1:84480 (3/4" = 1 mile)

Temperatures are generally quite mild with maximum temperatures seldom exceed the low 90's, nor fall much below freezing. Sustained hourly wind speeds on Signal Tree, a high point, about five miles East of the analysis area have not exceeded 48 mph in the last five years, with a gust speed of 72 mph (does not include the December 1995 storm). The prevailing wind direction is South/Southwest.

WATERSHED GEOMORPHOLOGY

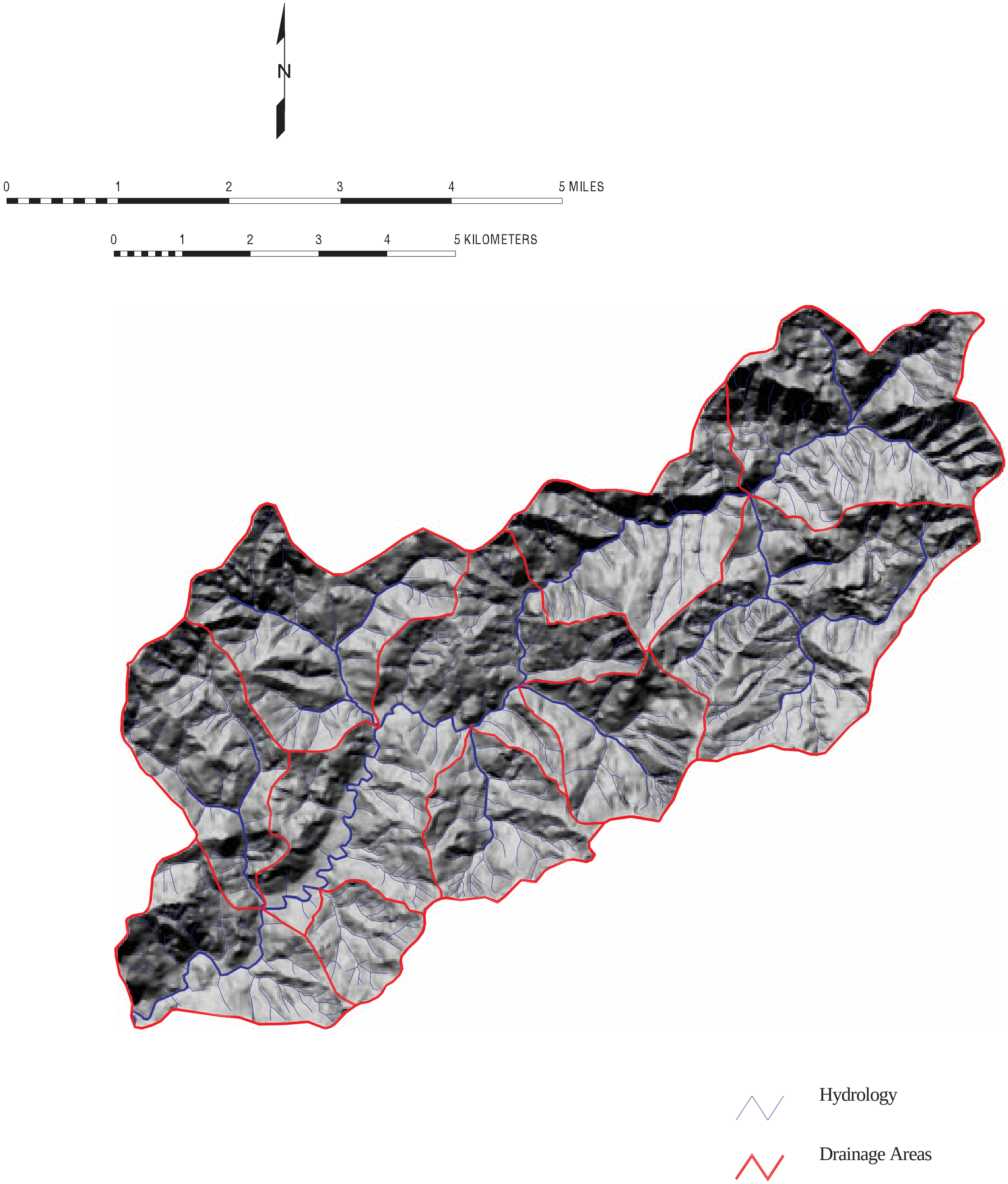
The Coast Range is a northeast-southwest trending anticline, dissected by perpendicular stream systems (Figure I-7). The drainage pattern is dendritic with a high drainage density of more than 7.2 mi/mi^2. About 186 miles of streams are found of which first and second order streams comprise 79% of the total drainage density (Table I-2). These are generally steep headwaters channels draining small catchments. Many of the first order streams and some of the second order streams become intermittent by late summer. The remaining 21% percent of the stream miles are 3rd order or greater have larger drainage areas and are almost always perennial.

Table I-2 Miles of Stream by Stream Order for the Big Creek Analysis Area.

Drainage	Miles of Stream by Stream Order[1]					
	1	2	3	4	5	Total
Lower Big Creek	7.9	3.8	1.4	<0.1	2.4	15.6
Middle Big Creek	17.1	6.3	2.7	<0.1	6.3	32.5
Middle Upper Big Creek	9.0	2.6	0.3	-	2.5	14.4
Swamp Creek	17.9	6.9	4.6	1.4	-	30.8
Upper Big Creek	18.0	6.2	2.7	0.8	1.2	28.9
Brownson Creek	12.9	3.5	2.6	0.9	-	19.9
Fall Creek	10.6	2.5	3.1	0.9	-	17.1
Bear Pen Creek	4.4	2.9	1.1	0.9	-	9.3
Axe Creek	6.5	3.3	0.8	1.2	<0.1	11.9
Jones Creek	3.6	1.4	0.9	0.2	-	6.1
Total (%)	**107.9** 58%	**39.4** 21%	**20.2** 11%	**6.5** 3%	**12.5** 7%	**186.5**
Drainage Density, mi/mi^2	**4.1**	**1.5**	**0.8**	**0.3**	**0.5**	**7.2**

[1] Relative position of streams, where all exterior links are order 1, and preceding downstream, the confluence of two like orders result in existing stream order +1. The junction of two different orders retains the higher order, and the main stream always has the highest order (Strahler 1957).

Figure I–7 'Hillshade' Representation of the Topography



(Topography 3–D effect is exaggerated 3x)

Scale = 1:84480 (3/4" = 1 mile)

Big Creek has very low gradient for a coastal stream. Contrarily, the tributary drainages consist of narrow canyons and much steeper channel gradients. Tributary streams drain rugged mountainous land forms, from near sea level to 2600 feet at the northeastern end of Big Creek and generally start below steeply sloping headwalls. Longitudinal profiles of streams are useful to compare morphology between stream reaches or from one stream to another. Bear Pen Creek and Jones Creek have the highest average gradients of 18% and 15.3 % respectively. These are high energy erosional streams with a high capacity to move water and sediment. Brownson, Axe, Fall, and the upper half of Big Creek are moderate to steep gradient streams. These are moderate to high energy erosional streams, with a moderate to high capacity to move water and sediment. However, all streams contain reaches of low gradient, which provide high habitat value. The lower portion of Big Creek is low gradient streams with average gradients of less than 1 %. These are low energy depositional streams.

HYDROLOGY

Forest hydrology is the study of the occurrence, movement, and distribution of water across forested watersheds, and how they are affected by soils, geology, land form, vegetation and climate. The principal driver of hydrology is precipitation as rain of which a high percentage ends up as runoff . Precipitation events interact with the land form, soils, geology, and vegetation. This interaction has an effect on hydrological characteristics such as, floods, frequent discharge, low flow, and distribution of flow.

Except for direct interception into streams, nearly all of the runoff occurs by infiltration into the soils and subsequent subsurface routing to streams due to the low water storage capacity of the shallow and coarse textured soils, and impermeable underlying bedrock that does not readily transmit water. Overland flow is seldom observed in the Coastal forests because infiltration capacities are in excess of 2 inches per hour, which is much higher than the most intense hourly storm likely to occur in this area (4 inches in 6 hours) (NOAA 1973). Surface flow can runoff from compacted sites, such as roads and landings, and can increase quickflow from rainstorms.

The stream network expands during storms, especially over several days to weeks, as more of the watershed soils become saturated, and live flow again reappears in low order intermittent channels. By examination of available precipitation and stream flow records, it is estimated that total runoff is about 65% of annual precipitation. The remaining losses include soil recharge, transpiration from the dense vegetation, and evaporation. Steeply inclined drainages, little groundwater storage, and steep stream gradients cause quick hydrograph response and flashy flow after the onset of rain. Stream hydrographs for an individual storm emphasize this short lag time with a steep rising curve, but a more moderate recession.

VEGETATION

Most of the Big Creek analysis area is comprised of the Port-Orford-cedar (*Chaemacyparis lawsoniana*) variant of the western hemlock (*Tsuga heterophylla*) zone (Franklin and Dryness 1973). An isolated area of White oak (*Quercus garryana)* woodland is found on BLM lands adjacent to the southern property line of Sec. 15, T.29 S., R.11 W.

Approximately 74% of the vegetation has been altered through logging or agricultural practices. These lands were generally reforested and are presently covered with Douglas-fir stands 60 years old or less and are of varying density. Furthermore, it is estimated that 99% of private lands have been harvested since the 1940s.

GIS data, describing forest age class, size, and density (Forest Operations Inventory, FOI), is available for BLM and Coquille Tribal lands. While age class information for older stands (>80 years or so) is often inaccurate and one age class may often encompass stands of varying ages and densities, FOI offers the best available picture of forest condition. FOI information for young stands, particularly those < 40 years old, is far more accurate. Data on private lands is interpreted from aerial photography and is less accurate. Forest age class are summarized in Table I-3 and their locations are mapped on Figure I-8.

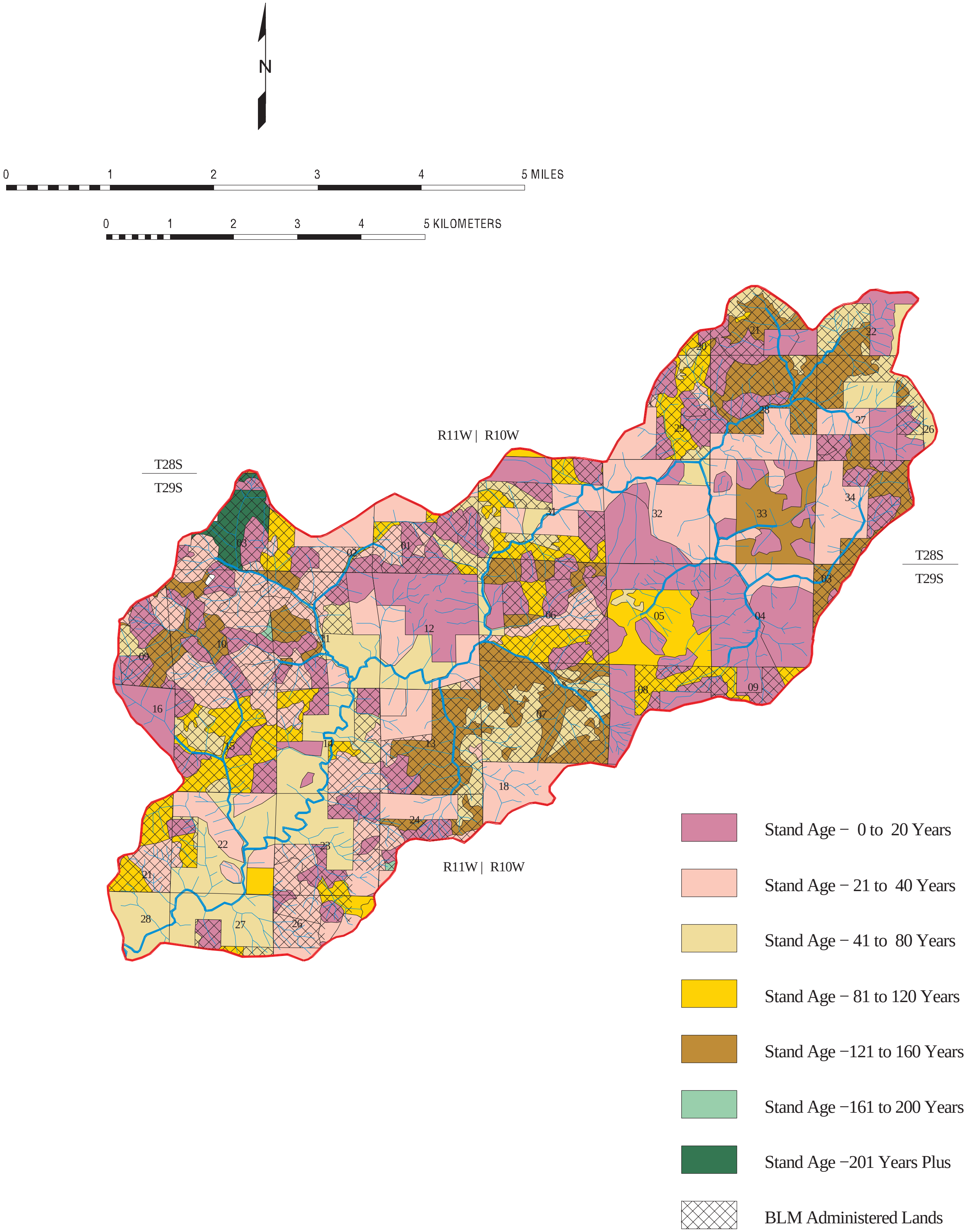
Table I-3. Age Class Distribution

	BLM Ownership (9,021 ac)		Coquille Forest (1,047 ac)		Private Ownership (6,593 ac)		TOTAL (16,661 ac)
Forest Age Class	Acres	% of BLM	Acres	% of CTF	Acres	% of PVT	% of Total
0 - 20	2447	27 %	308	29 %	2245	34 %	30%
21 - 40	1732	19 %	106	10 %	2527	38%	26 %
41 - 80	1183	13 %	16	< 1 %	1779	27 %	18 %
81 - 120	1368	15 %	339	32 %	43	< 1 %	10 %
121 - 160	2101	23 %	278	28 %	-	-	14 %
161 - 200	13	< 1 %	-		-	-	< 1 %
200 +	169	2 %	-		-	-	1 %
Totals	9,021	54 %	1,047	6 %	6,593	40 %	

WATER QUALITY

Big Creek from the mouth to the headwaters was listed on ODEQ's 303(d) list of water quality limited streams with regard to temperature during the summer. Streams are listed on the 303(d) list when monitoring data indicates stream reaches are not meeting State water quality standards. State water quality exceedances for dissolved oxygen for salmonid spawning and incubation during October-April and fecal coliform levels are suspected in the lower Big Creek, but monitoring to confirm this has not been conducted.

Figure I−8 Age Class Distribution



Scale = 1:84480 (3/4" = 1 mile)

SPECIES AND HABITATS

The location of the analysis area, land ownership patterns, and the land use allocations help define the ecological role of the analysis area in the larger landscape. Key ecological functions are: (1) to provide habitat and refugia for aquatic and late-successional species formerly widely distributed in the Middle Fork Coquille system, and (2) to provide population and genetic seeds for future re-colonization through developing connections to other or future habitats. Additional functions for terrestrial species include: (1) facilitating dispersal of wildlife between the LSRs to the north and south of the analysis area; (2) maintaining a forest matrix which retains important habitat features such as snags, down logs, and a complex forest structure conducive to wildlife movements; and (3) providing habitat for early and mid-successional species.

Terrestrial

The analysis area contains numerous ecologically and economically important wildlife species. (Appendix C, Table C-1) contains a list of all vertebrate wildlife species known or suspected to occur. There are 27 wildlife species or species groups of special management concern because they required further site-specific analysis under the regional planning efforts (USDI 1995), or because special local concern existed (Appendix C, Table C-2). These species of concern[1] rely on key habitats or habitat features such as complex forest structure, late-successional forests, snags and down logs, and rocky habitats and are further influenced by the pattern of these habitats on the landscape.

There are approximately 230 vascular plant species representing 70 plant families documented or likely to occur within the analysis area. Of these species, approximately 20% (43 species) are considered exotics, some of which are considered noxious weeds. Bryophytes, lichens, and fungi represent a large percentage of the vegetative diversity. Many of these species, have important ecological roles (such as nutrient cycling, soil stabilization, water retention, etc.) in forested ecosystems while having specific habitat requirements. Species numbers are unknown, but it is estimated that over 500 species probably occur in the analysis area, at least 29 of which are of special management concern and require further site-specific analysis under the regional planning efforts .

Riparian

Riparian areas are among the most heavily used habitats for most wildlife species occurring in the forest lands of western Oregon, because they provide requirements vital to these animals for some aspect of their lives; i.e., food, water and shelter. Brown, et al., (1985) found that of the 414 wildlife species analyzed (in western Oregon and Washington), 359 used riparian or wetland habitats. In addition, several species of concern occur in spring and seep habitats. Riparian areas are sometimes used as travel corridors, and may be used for species dispersal. These areas also provide nesting and perching sites, particularly for those species that use the aquatic invertebrate populations as a prey base.

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[1]The phrase "species of concern" is used to refer to the group of species for which special management concern exists in the analysis area (consistent with the use in WA Guide Ver 2.2) and is not to be confused with the species of concern list maintained by the U.S. Fish and Wildlife Service which is roughly analogous to the former Federal Candidate 2 species list.

The abundance and survival of aquatic organisms is dependent on riparian areas. Inputs from riparian areas provide the foundation for aquatic food webs. Aquatic invertebrates utilize riparian vegetation for mating and oviposition, and fallen riparian vegetation provides cover and habitat for stream fishes and amphibians.

Aquatic

The watershed provides habitat for a variety of native fish species (Table III.6-7) which use Big Creek and its tributaries for all or part of their life cycles. The most widespread species are the Salmonidae (salmon and trout). Other groups present in the watershed include Cottidae (sculpin), Cyprinidae (minnows and dace), Catastomidae (suckers), Petromyzontidae (lamprey), and Gasterosteidae (sticklebacks). Populations of exotic fishes (probably Cyprinids such as *Carassius* and *Gambusia*) may be present in privately-owned ponds, but are not covered in this analysis. The fishes of the Big Creek watershed play an integral role in aquatic and terrestrial food webs in Big Creek as well as help support important commercial and recreational fisheries.

Several species of amphibians use streams in the watershed for all or part of their life cycle. Amphibians, crustaceans and hundreds of other invertebrate species make up most of the biomass in streams in the watershed and are the functional building blocks of the aquatic ecosystem. In addition to providing the major food source which sustains stream fishes, the invertebrates contribute to the maintenance of aquatic and riparian food webs by processing vegetation and leaf litter, increasing the availability of nutrients to other organisms (Christensen 1996, Taylor 1996).

HUMAN USES

The Big Creek area has been the location of both prehistoric and historic cultural activities. The area is adjacent to the Middle fork Coquille which provided an important transportation link between the southern Oregon Coast and Camas Valley. Now, as well as in the past, the focus of human activity tends to concentrate along Big Creek with residences and agricultural uses. Timber production is the predominant use of the lands within the analysis area with dispersed recreation occurring on these lands.

II. ISSUES AND KEY QUESTIONS

ISSUES

Three main issues affecting management have initiated the need for and the focus of the watershed analysis in the Big Creek area. The first issue is to determine the overall condition of the watershed as it relates to; terrestrial plant and animal habitats, the components of the Aquatic Conservation Strategy, and population levels for species of concern.

The second issue is to determine which restoration opportunities could be enacted to improve water quality, aquatic habitat, vegetative communities, or wildlife habitat, or other opportunities. Recommended restoration activities would be brought forth into the 'Jobs-in-the-Woods' program or other funding opportunities and similarly evaluated for viability and environmental impacts (NEPA).

The third issue is to identify potential timber harvest areas within the GFMA land use designation that could contribute to the District's Probable Sale Quantity (PSQ) for fiscal years 1999 and 2000. The Coos Bay Resource Management Plan requires that potential harvest areas be identified through the watershed analysis process. Once identified, these areas are brought forth into the timber sale planning / NEPA process to verify the operational viability and assess the direct, indirect, and cumulative environmental impacts.

KEY QUESTIONS

The Guide recommends development of ‘key questions’ which address the main issues, focus on ecosystem elements as they relate to management actions, promote synthesis/interpretation of information, and are to be answered by the analysis. They are:

1. What immediate opportunities and needs for restoration exist in the analysis area?
2. Where could timber be harvested to help meet the District's commitment to PSQ,
3. What management activities are appropriate within Riparian Reserves and what criteria are appropriate for delineating final Riparian Reserves boundaries for intermittent streams?
4. What is the current condition of Connectivity blocks in and adjacent to the analysis area? How are they fulfilling the objectives of providing; connectivity between Late-Successional Reserves, dispersal/carryover of organisms, and early successional habitat.

ANALYSIS QUESTIONS

In addition, each section contains a series of analysis questions. These were developed by the team and are designed to become progressively more refined in order to answer the key questions. The Guide also contains a series of so called ‘core questions’ to be addressed. Answers to these core questions are contained within the team’s analysis questions or were not found to be relevant to this analysis.

III.1 CORE TOPIC - EROSION PROCESSES

EROSION PROCESSES

Analysis Questions:

What are the dominant historical and current erosional processes within the watershed (e.g., surface erosion, mass wasting)? Where have they occurred and how likely are they to occur?

What are the rates of landsliding and surface erosion within the analysis area?

How and where have management activities played a role in producing landslides? How have they affected sediment routing in the analysis area?

What are the influences and relationships between erosion processes and other ecosystem processes (e.g., vegetation, woody debris recruitment, aquatic habitat, etc.)? How have management activities affected these relationships?

What are the management objectives for erosional processes and sediment within the watershed?

Erosion is a process that dislodges and transports soil particles in wind and/or water. Erosional processes common in the analysis area include mass wasting (landslides), rotational slumps, channel incision, stream-bank failures, and surface erosion. Mass wasting is the most common process and accounts for a substantial amount of sediment delivery downslope and to stream channels. Three types of mass wasting were noted during analysis of erosion processes in Big Creek: debris torrents, debris avalanches, and shallow-rapid debris failures. A debris torrent is the rapid movement of large amounts of soil and woody debris, under the influence of water, down a stream channel. The torrent usually consists of a liquid flowing mass that can travel considerable distances downstream. A debris avalanche often results from the under-mining of the toe of a slope, or from over-steepening of a slope past the natural angle of repose. The avalanche usually consists of a mass of soil, moving downhill under the influence of gravity. Shallow-rapid debris failures are slides which move the top few feet of soil short distances downslope, contributing fine sediments to stream channels if not filtered out. For all types of mass wasting, potential for sediment delivery to stream channel is dependent upon the nearness of the failure to a stream channel and the length of the slide's downhill run.

REFERENCE CONDITION

All types of erosional processes were present before human influences occurred in the analysis area. Natural events, such as fire and floods, probably produced large quantities of sandy and clayey sediments from exposed surfaces. It is assumed that the historic rate of surface erosion within the subwatershed alternated between periods of high and low based on the occurrence of episodic events (i.e., fire, floods) spread over a long time-span. No historic rates can be determined for events such as landslides, although researchers speculate that they were probably infrequent (Ketcheson 1978).

Analysis of reference condition with respect to erosional processes and rates was conducted using aerial photos from 1943 to the present to determine the distribution and prevalence of types of erosion in the watershed.

Mass Wasting

No evidence exists that will support an estimate of the historic rate of magnitude or mass wasting processes in the Big Creek watershed. It is reasonable to assume that certain erosion processes were more common in some parts of the drainage than others based on topography and underlying geology. For example, aerial photo analysis indicates that the northern part of the analysis area (which is geologically younger and steeper) appears to produce more shallow-rapid debris slides than elsewhere in the drainage.

Surface Erosion

No historic surface erosion rates are known or can be developed for the watershed. Typically, the rate and magnitude of erosion is influenced by the presence and composition of vegetation. We may therefore predict that events within the watershed that changed the distribution and composition of vegetation (such as fire and large avalanches) produced changes in erosion rates. The analysis area is known to have had large fires in the upper portion of the drainage in the 1860s and 1930s.

CURRENT CONDITION

Types of Erosion

Mass Wasting/Landslides

The type and number of landslides across the drainage were determined based on analysis of aerial photos (photo years 1943, 1976, 1992). For each occurrence, underlying soil-type and land-management activity thought to precipitate the slide were identified. It should be noted that landslide inventory from aerial photographs tends to underestimate the number of landslides in undisturbed forests because shadows cast by steep, narrow ridges, and tall, dense forest vegetation makes failure within forested areas difficult to identify (Skaugset 1992). It is also difficult to distinguish natural slides from those caused by a harvest activity if the slide occurs on land that is sufficiently vegetation. For this analysis, slides found on land vegetated for 10-15 years were considered a natural slide and not a function of a management activity.

Aerial photo interpretation determined that 196 slides occurred between photo years 1943 and 1992. Most of these slides were shallow-rapid debris failures and debris avalanches on steep (>50%) slopes. These debris-torrent failures were associated with steep slopes and ephemeral channels, while debris avalanches were most often correlated with management activities such as timber harvest and road construction (see further discussion below).

The second most common type of failures were slumps and associated earthflows, which occurred on deeper, clayey soils. Rotational slumps and earth-creep soil movement were evident, particularly in Jones Creek (the southeastern end of the drainage). Shallow-rapid slides were also observed in the headwaters of the Fall, Brownson, and Axe Creek drainages.

Almost all slides occurring in this period delivered sediments to the stream channel, but no estimates for volume delivered were determined during this analysis. Based on the size of exposed area, 2/3rds of all slides occurring between 1976 and 1992 exposed areas greater than 1000 yds^2 (.2 acres). The remaining 1/3 of the slides covered less than 1000 yds^2.

Surface Erosion

Typically, surface erosion in a forested environment is not a major contributor of sediment at the common erosion rate of less than 0.1 ton/ac/yr. Soil erosion rates for the Big Creek subwatershed were modeled using the Revised Soil Loss Equation[2]. According to the model, the watershed can be expected a similar rate of 0.01 to 0.10 tons/ac/yr from most of the land surfaces, once vegetation reaches 20 years of age (Fig III 1-1). However, higher rates (up to 8 to 10 tons/ac/yr) may occur when vegetation is removed from extremely steep slopes, but subsequently drops to 2 to 4 tons/ac/yr 3 to 5 years later, following revegetation of the exposed ground.

In managed watersheds such as Big Creek, surface erosion occurs when there is disturbance to the ground and vegetation is removed or when there is high volumes of traffic on dirt or gravel spur roads. However, there must be water available for conveyance of soil to the stream as either overland flow or as uncontrolled flow of water across road surfaces, in ditches and around culverts

Natural and Anthropogenic Factors Contributing to Erosion in the Big Creek Watershed

Before attempting to determine the effects (if any) of management activities on erosional processes, it is important to first identify the natural factors causing occurrences (total numbers) or rates (i.e. number per year) of landslides.

Natural Rates of Landsliding and Surface Erosion

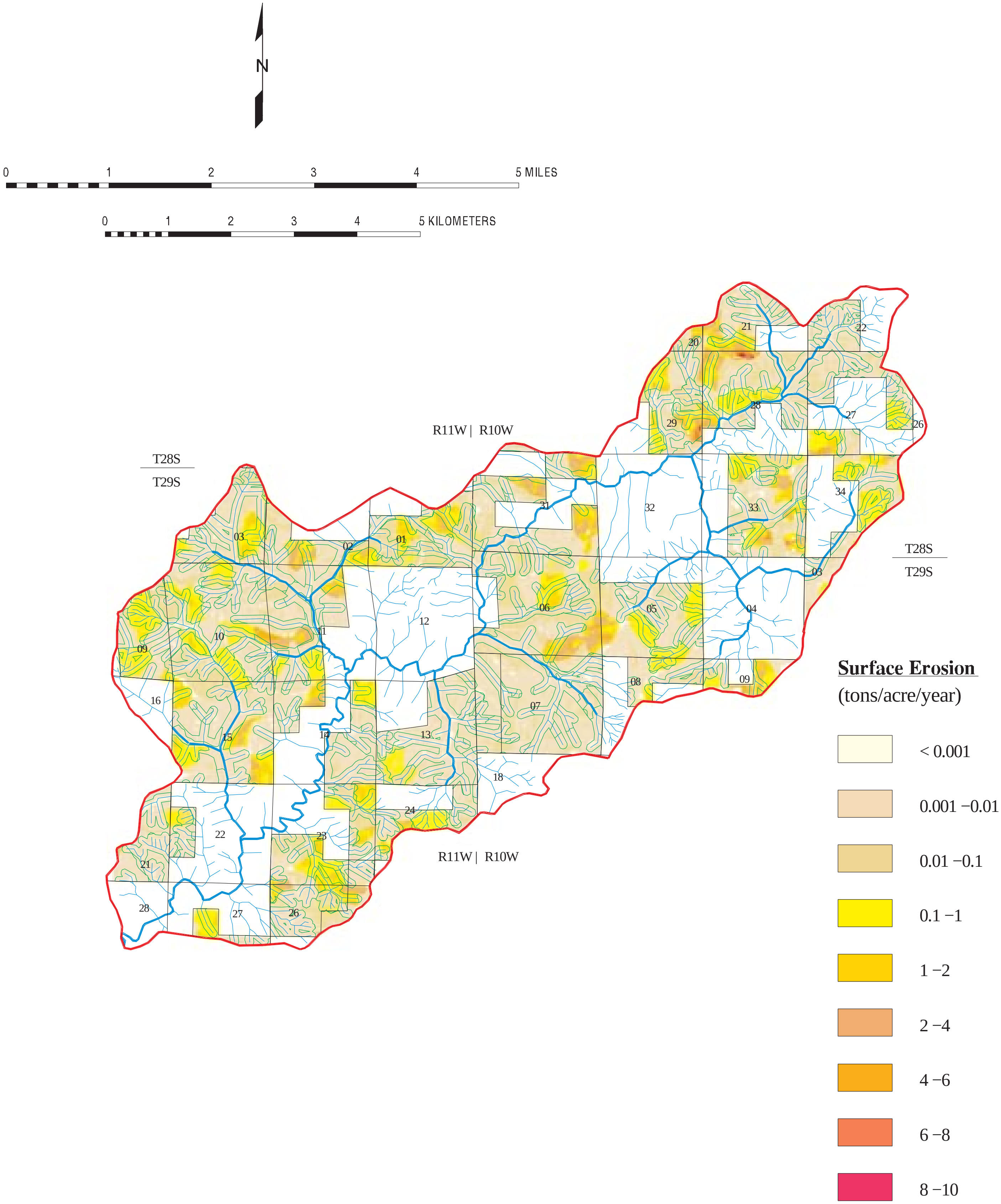
According to aerial photo analysis, the type and number of landslides in the Big Creek subwatershed appears to be correlated with underlying geology, sensitivity of land-forms and topographic-types, soil type, and BLM land-type designations.

Geology: In the analysis area, failure events appear to be more common in certain lithographies. For example, the Jones Creek drainage appears to be prone to slow earth-creep and slump-bench failures. This is due, in part, to the fact that the Jones Creek area is relatively old (nearly 9 times older than the rest of the analysis area) and the soil has a very high clay content. The large debris torrent in the lower portion of the Bear Pen Creek drainage and the rotational slump in the upper portion of the Jones Creek drainage are characteristic of the underlying geologies in those drainages. In contrast, the northern area (consisting of the geologically younger and steeper Tyee and Flournoy formations) produces more shallow-rapid slides than elsewhere in the drainage.

A small island of the Otter Point formation containing high clay content exists in the southern portion of the drainage (Figure I-5). Although slopes are not steep in this area, evidence of earth creep in 30 to 40 year old stands of trees and encroachment of cut-slopes on road surfaces indicated there is risk of land failure in this area.

[2] Values for rainfall amount, percent of bare soil, and canopy height were set at highest levels possible for the area ("worst case scenario). The model may therefore not represent actual conditions after disturbance.

Figure III.1−1 Surface Erosion modeled with MSLE



Scale = 1:84480 (3/4" = 1 mile)

Table III.1-1 summarizes the relationship between geological formation and landside frequency.

Table III. 1-1 Rate of Landslides by Geological Formation for all Photo Years

	Roseburg	Looking glass	Flournoy	Tyee	Roseburg w/volcanics	Serpentine	Quaternary Alluvium
Formation Acres	8146	5824	1057	255	173	421	729
Total Slides	103	59	20	6	3	4	1
Percent of Landbase	48.9	35	6.3	1.5	1	2.5	4.4
Percent of slides	52.6	30.1	10.2	3.1	1.5	2	0.5
Slides/100 acs.	1.3	1	1.9	2.4	1.8	1	0.1

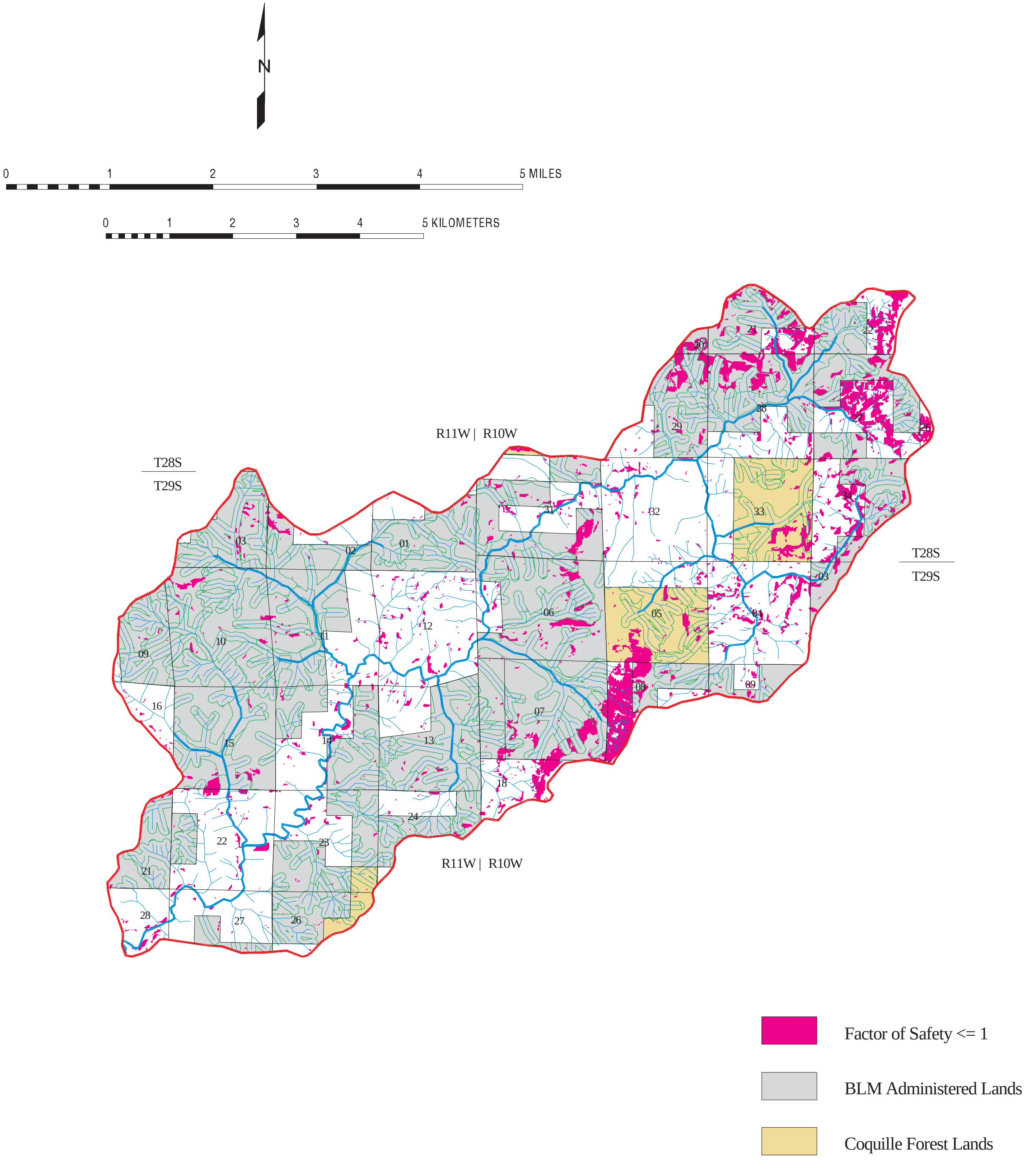
Sensitive Landforms and Topography: Land-form and topography are partly the product of underlying geology. Like sensitive rock formations, certain landforms and topography are more prone to failure events than others. Critical and sensitive land forms in the analysis area were identified based on land stability and the natural or background tendency (i.e., not caused by management) towards erosion. The Infinite Slope Equation (I.S.E.)[3] was used to model a natural tendency towards mass movement as a Factor of Safety.

Results of the analysis indicates that natural landslide failures are predicted in draws and midslope areas where water concentrates and topography is steep- exceeding 65% (Figure III.1-2) These predicted failures correlate well with slope analysis (Figure III.1-3). Steep areas are located in the northern end of the analysis area. Other areas steep enough to initiate debris avalanches are an uplifted portion of the Lookingglass formation (a ridge primarily located at the joining of Sections 7 and 8 of T.29 S., R.10 W. and extending into Section 5 and the eastern half of Section 6 extending up to the SE 1/4, SE 1/4 of Section 31).

As indicated earlier, photo analysis revealed a positive correlation between predicted areas of failure (steep topography) and numbers of actual slides. The I.S.E. model predicted more unstable areas in less-steep portions of the watershed (the Lookingglass formation) than actually occurred. The discrepancy between model predictions and number of slides experienced may be partially explained by drought conditions in the watershed during critical years following harvest.

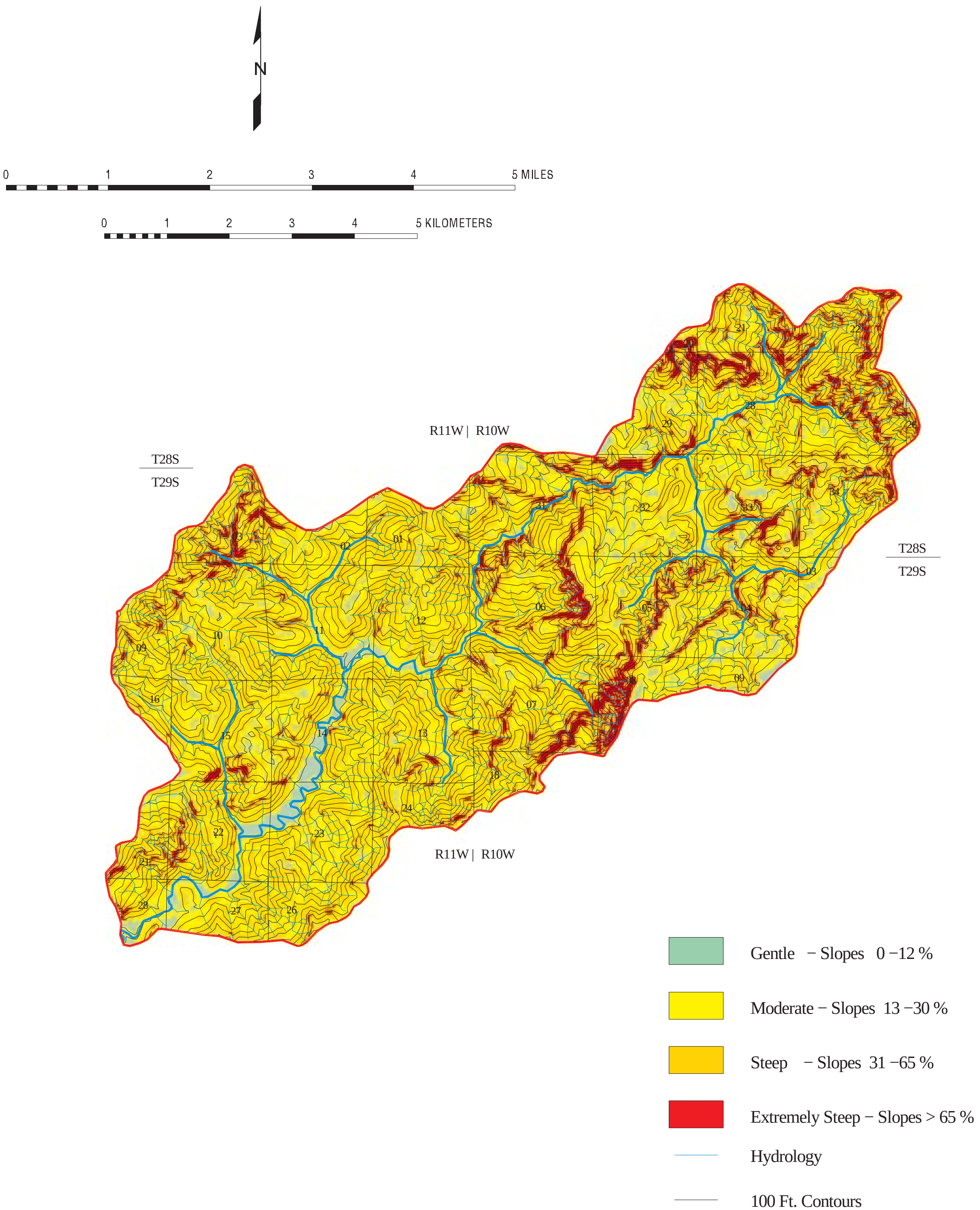
[3]The following conditions and assumptions used during modeling with the Infinite Slope Equation:
1. A predicted Factor of Safety less than 1.0 was used to identify areas predicted to fail under a set of "worst cases."
2. The conditions assumed maximize the forces producing slides and minimizes forces adding resistance to slides.
3. To minimize retention forces and simplify the equation, no residual forest for all lands after harvest was assumed (even through live green tree retention is required on BLM-administered lands).
4. The full width of Riparian Reserves are forested as per the Northwest Forest Plan.

Figure III.1−2 Mass wasting modeled with ISE



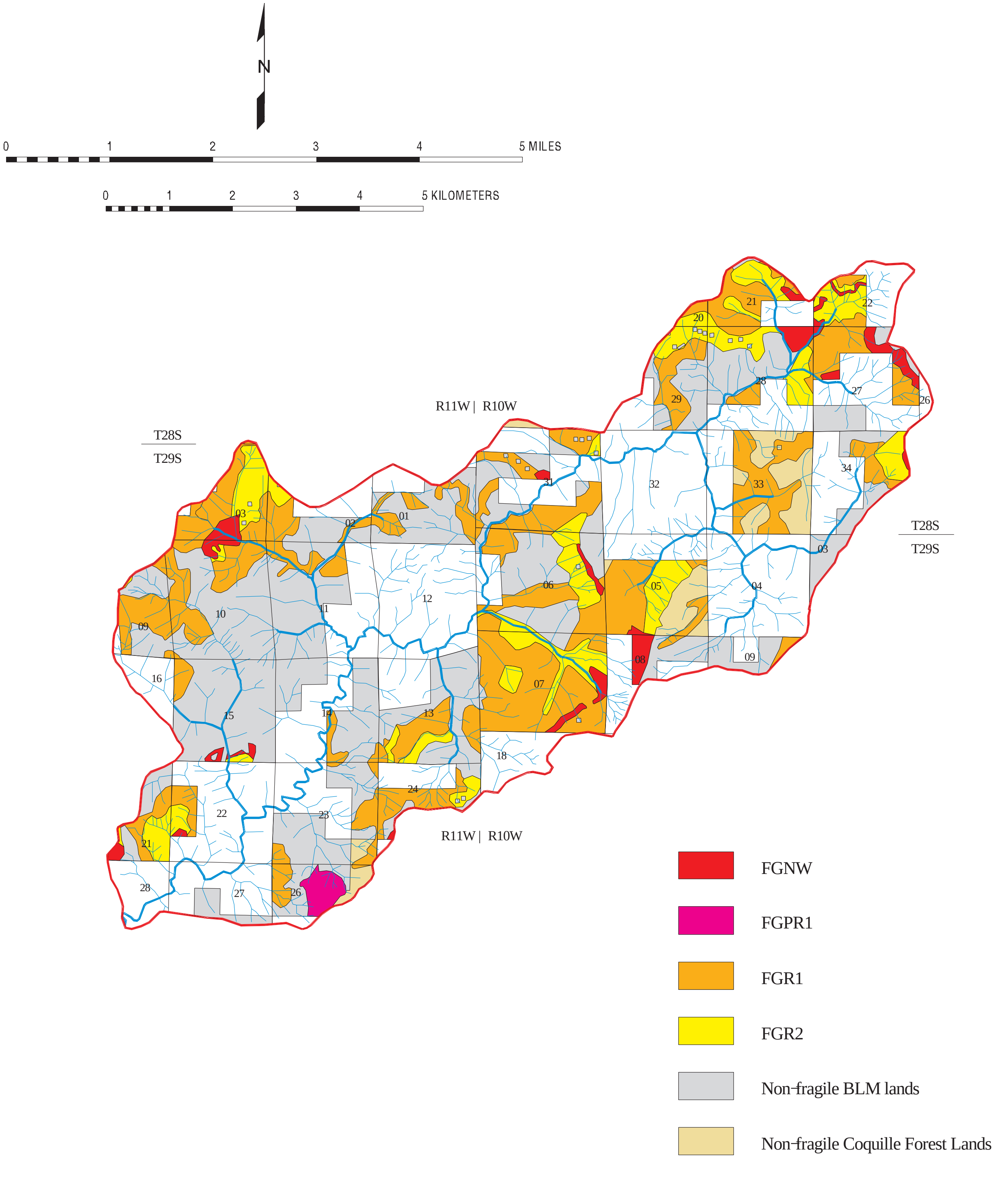
Scale = 1:84480 (3/4" = 1 mile)

Figure III.1−3 Slope Hazard Classes



Scale = 1:84480 (3/4" = 1 mile)

Figure I−4 TPCC Fragile and Withdrawn Areas on Federally Administered Lands



Scale = 1:84480 (3/4" = 1 mile)

Designated Land-type and Tendency towards Failure: Analysis using the I.S.E. model revealed a positive correlation between predicted areas of failure and land type (i.e., FGNW, FGR2, etc.) This model suggested that some TPCC areas (Figure III.1-4) have higher incidence of landslides.

Landslides and Soil-Types: Landslides were found to occur more frequently on five soil-types (14F, 15F, 46F, 38F, and 58F) (Figures III.1-5 and Table III.1-2). Although these soil types make up only 58% of the Big Creek subwatershed, nearly 83% of all failures occurred on these soil types. In particular, soil types 15F, 38F, and 58F were particularly sensitive to landsliding, with slide rates four to thirty-four times what would be expected based on the number of slides per 100 acres of the particular soil type.

Fig III. 1-5 Landslides Observed on Most Prone Soil Types by Management Activity

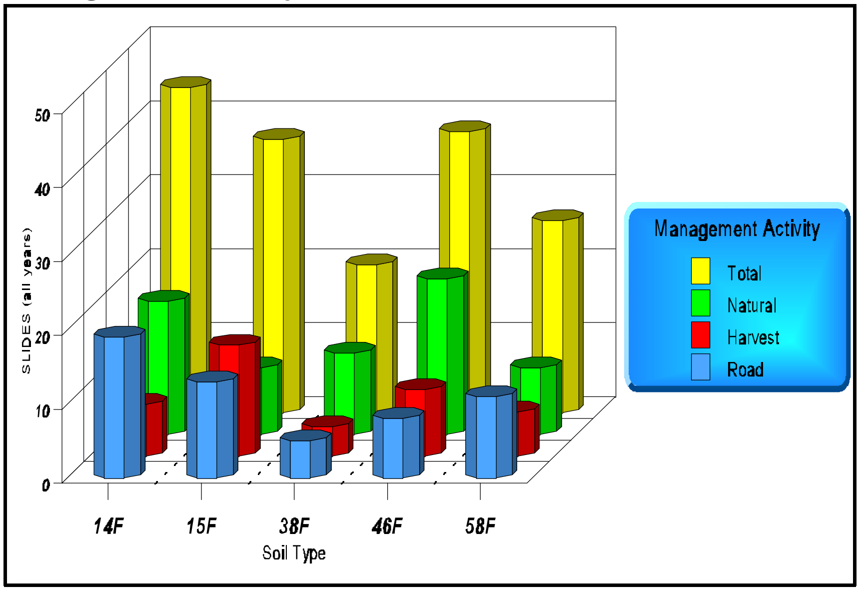


Table III. 1-2 Comparison of Landslides by Soil Type

Soil Type	Percent of Land Base	Percent of Slides	Number of Slides per 100 acs.
14F	23.7	22	1.09
15F	5.1	19	4.34
46F	19.2	19	1.16
58F	4.6	13	34.07
38F	5.1	10	23.31

<u>Management Activities and Mass Wasting</u>

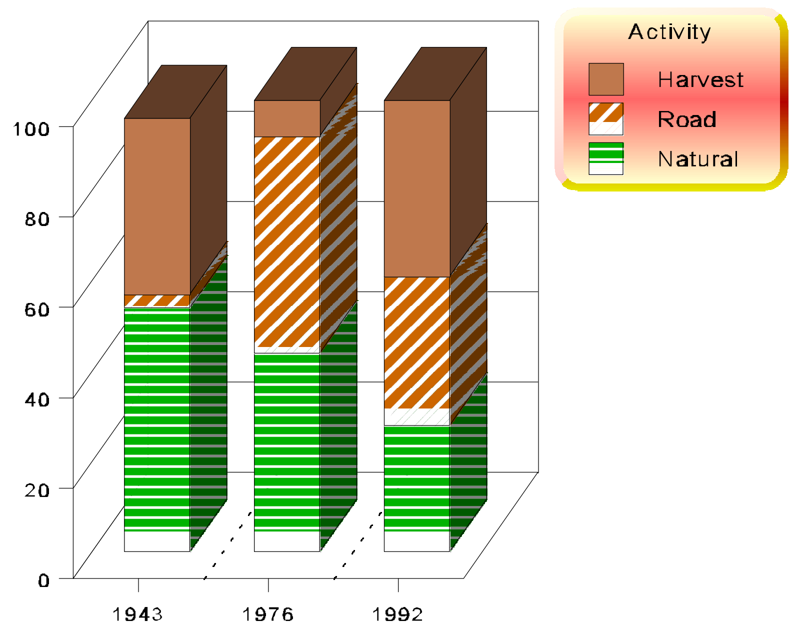
Fire and Harvest: According to aerial photo analysis, natural slides made-up the largest portion of all slides. Accuracy of this conclusion, however, is suspect because of the difficulty in separating fire-caused slides from harvest-related events. For example, if one assumes an error rate of 10% in distinguishing between harvest and fire-related slides, the two activity-types would be approximately equal in producing slides.

Although the number of failures related to other factors (such as roads) increased in the 1970s, the number of harvest-related failures did not; in fact, harvest-related failures showed a conspicuous drop (to about 1/3 of other years) in the mid-1970s. This is unexpected because harvesting levels in the 1960s and 70s were similar to previous decades. A possible explanation is that harvest *intensity* was reduced in the 1970s (i.e., relying on salvage rather than high-intensity, clear-cut harvest) while harvest *levels* continued unabated.

Roads: The number of road-related failures is second in total number of slides. The increase in the number of road-related failures in the late 1960s and early 1970s is noteworthy because of the number of road improvements that were made during this period. These roads were built with techniques that allowed much sidecasting and partial bench locations . A noticeable reduction in landslides related to road failures was also observed on 1992 photos, but it is not known if this is the result of improved construction and maintenance techniques or the result of drought.

The percentage of total slides related to management activity in a given photo year is illustrated in Figure III. 1-6. It is interesting that 1943 contained the lowest portion of management-related slides while in 1992, management-related failures made up a majority of the total

Figure III.1-6 **Percent of Landslides by Management Activity**



Soil-types: Stratification of landslides by soil type (Figure III 1-7) and management activity (Figure III.1-8) suggest that, with the possible exception of road-building, management activities do not necessarily increase the susceptibility of certain soil-types to landslides .

Figure III. 1-7   Landslides Classified by Soil Type

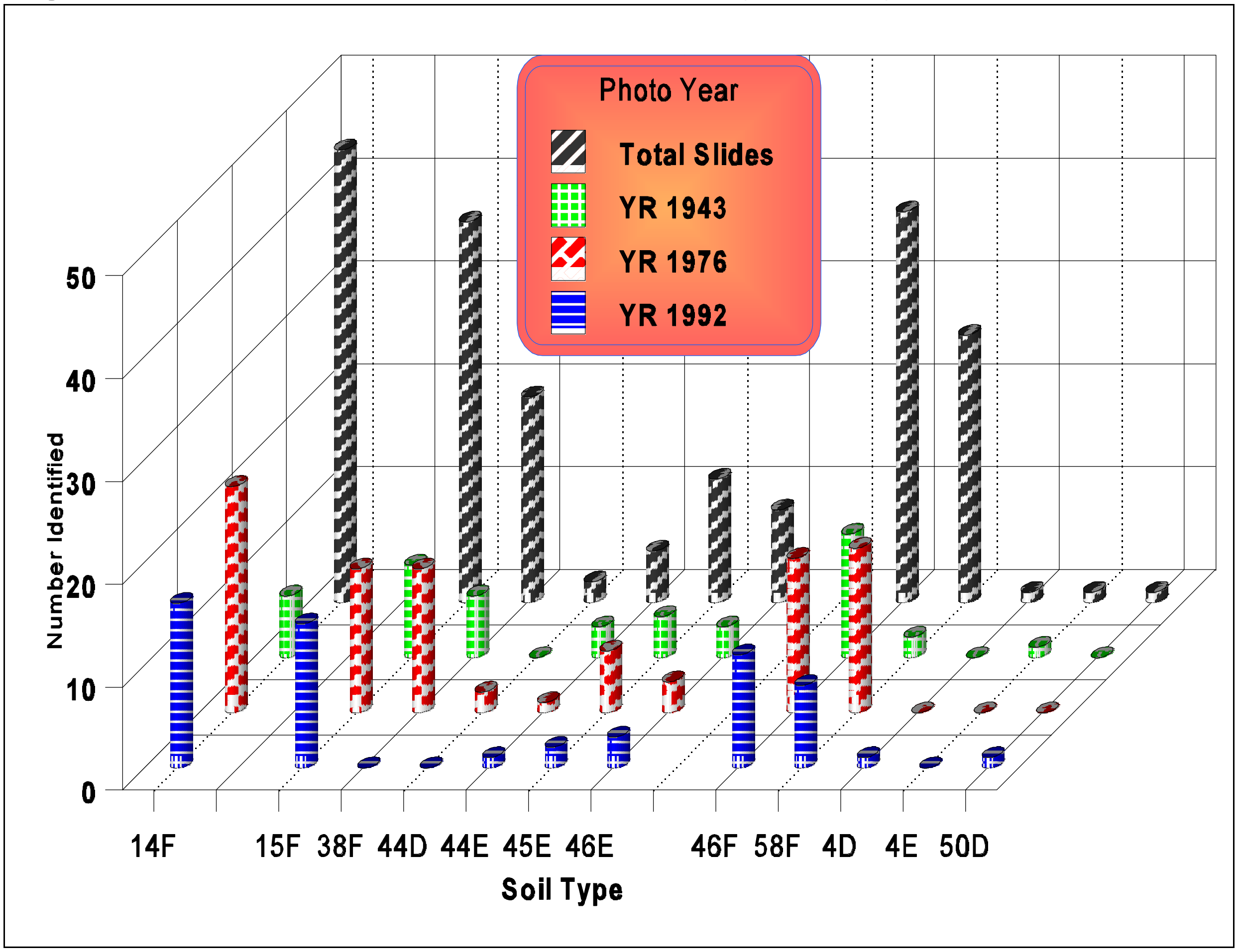
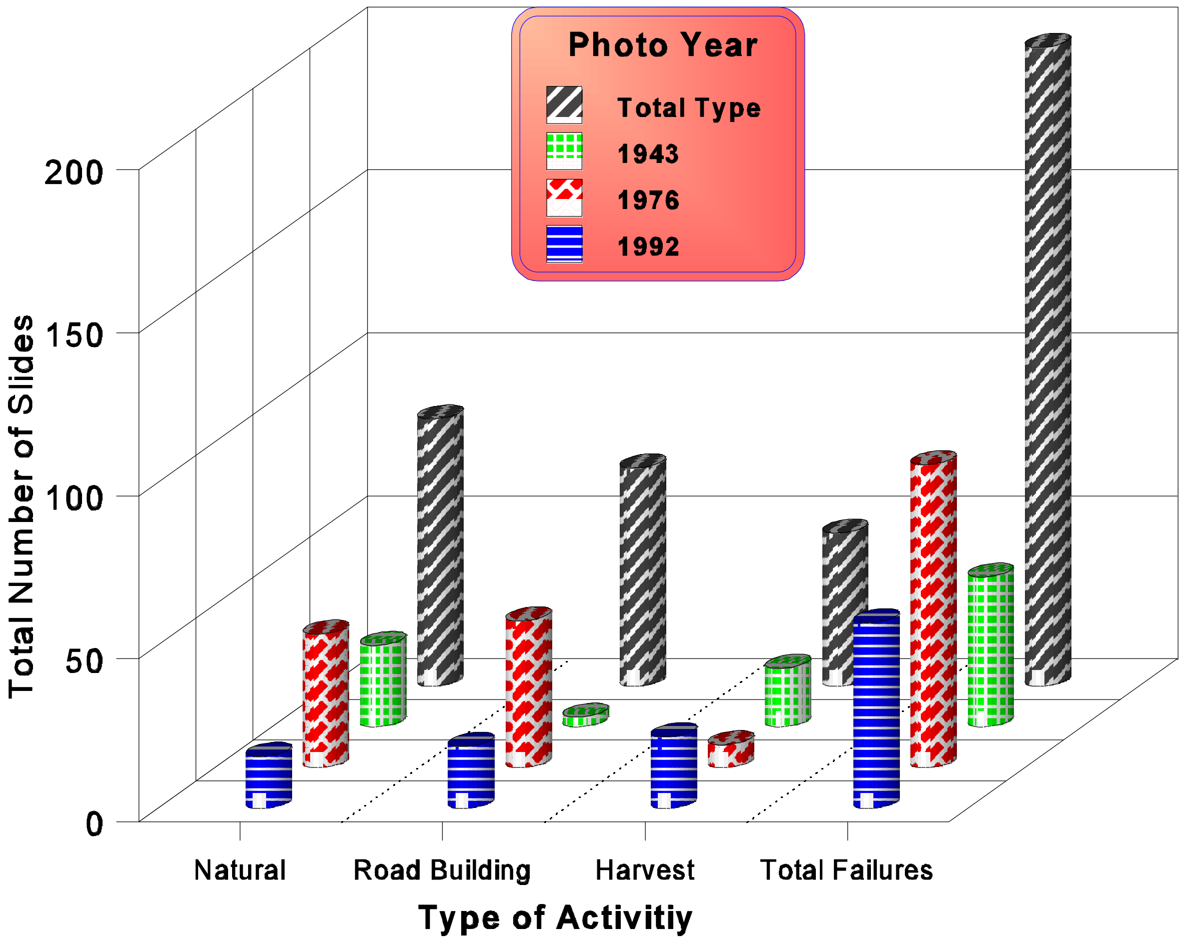


Figure III. 1-8   Landslides Classified by Management Activity



Erosion Rates and Management Activities

<u>Erosion and Management Activities</u>

It is apparent that deteriorated, poorly located or poorly installed culverts (not on stream grade or disconnected from the channel), are contributing sediment to stream channels. Culverts along the Big Creek Mainline Road were inventoried and several found to be rusted through and replaced under the 1996 "Job- in-the-Woods" program. Culverts were randomly surveyed in November 1996 by members of the analysis team. Most of these culverts were considered in fair to poor shape with numerous rusted through or deteriorated to a point where they will failure in the near future (approx. 5 years). Culverts which had the most advanced deterioration were located along the older roads (cira 1970) and along the lower mainstem transportation systems. Culverts and natural-surfaced roads on private lands in T28S, R10W, Secs. 32 and 33, and in T29S, R10W, Secs. 4 and 5 were severely deteriorated. Grade culverts, which carry storm runoff from the road surface and group water intercepted from cut banks, were not similarly affected. All soils in the analysis are corrosive to uncoated steel. This factor, combined with the age of many culverts in the subwatershed, may explain their poor condition.

SYNTHESIS & INTERPRETATION

Mass wasting

Effective management of erosional processes requires an understanding of what processes, and levels of those processes are natural to the area. Debris torrents, avalanches, and other types of erosion were present in the analysis area prior to human influences. These events were infrequent, but contributed many important structural components to the lower river system. For example, landslides carried large wood and boulders, providing key structural components that build lasting debris dams on lower-gradient stream segments. These structures subsequently created habitat for aquatic organisms, filtered sediments, and provided long-term storage of water for later release in the summer.

Not all types of erosional processes have the potential to produce ecological benefits to riparian and stream ecosystems. For example, other natural processes such as surface erosion from non-vegetated areas, rotational slumps, and earth-creep soil movements (such as those evident in Jones Creek) deliver pulses of fine sediment downslope without the quantities of large wood and boulders that are generally delivered from the debris slides.

Although mass wasting events such as landslides and debris torrents contributed important structural components to stream and riparian ecosystems, these events probably also contributed a substantial amount of fine particles to streams. Excess sedimentation and turbidity in stream channels reduce habitat quality for aquatic biota, can smother benthic biota, cause widespread mortality to fish eggs and alevins, and cause physiological distress for fishes. Fishes in the Pacific Northwest have evolved behavioral and physiological responses to sediment pulses such as those historically contributed by landslides and debris torrents, and to long-term, low-level inputs such as those contributed by erosion from exposed surfaces. However, when management activities, such as timber harvest and road-building, accelerate the rate and increase the magnitude of these events, the amount of sediment contributed to stream channels can overwhelm the behavioral and physiological capacity of aquatic biota to compensate, resulting in reduced production and survival.

Without actually conducting sediment sampling throughout the drainage to determine if fine sediment level is above normal, this analysis uses the data gathered in the lower reaches of various drainages (see Section III.4 Water Quality) to infer that high levels of fine sediment is being delivered to the streams. This level may be normal for the geology and stream network but without a long term sediment sampling regime this data gap exists.

Effective management of erosional processes as well as fish and wildlife resources in a watershed requires an evaluation of the effects of these management activities on the rate and magnitude of soil movement events. Increases in the rate and magnitude of erosion have implications for soil and forest productivity and survival of biota. In the analysis area, it is apparent that management activities such as road-building and timber harvest have probably influenced the rate and magnitude of these natural processes; however, using available data, it is difficult to define the *level* of influence, or to describe the cumulative effects of management contributions of sediments to streams.

No clear pattern emerges that reflects a landscape-level response to management activities.

Between 1943 and 1992, there were 196 slides, with the largest portion coming from natural and road-related activities. As management intensity increased on the landscape, so did the number of slides (as evidenced by a two-fold increase in 1976). However, only slight increases over previous levels were seen in 1992, even though the proportion of the drainage exposed to management disturbance continued to increase.

Additionally, while management practices (particularly roads) were probably responsible for some of the slides observed in the 1976 photos, many of the slides occurring during those years could also be a reflection of the amount of water delivered. During the years from 1943 to 1976, the watershed experienced a large flood in 1964 as well as above-average wet periods in 1955, 1971, and 1974. Furthermore, depressed annual rainfall during the 1980s may have contributed to the increase in soil stability by limiting the amount of slippage from water, thus reducing the number of slides prior to the 1992 photos could have been influenced by factors other than management practices.

It is clear from the analysis described above that road-building activities disturb the ground and produce slides. It is also clear that the overwhelming majority of all slides originating from roads delivered sediment to stream channels in the analysis area. However, the rate at which this occurred depended largely on location, method of construction, and subsequent weather patterns.

Surface Erosion

Surface erosion from ground-disturbing activities appears to be under control by vegetation which grows back in on the site following harvest and burning.

Roads within the drainage were surveyed by members of the analysis team. Gravel and bituminous surfaced roads are in good shape with only few that require additional drainage or repair of surface conditions to further minimize sedimentation. Overall, little sediment is occurring from this source. The dirt spur roads show signs of past and present delivery into the stream system, but much of the sediment is being filtered prior to water reaching the stream.

Although sediment delivery from surface erosion has not been quantified for the watershed, it should not be assumed that an elevated rate is occurring primarily as a result of management.

Trends

The trend within this analysis area is that it will continue to receive pulses of fine sediment as lands are harvested. However, the rate of onsite soil loss should be less than from previously managed areas as there will be less new road construction, roads will be located with long term stability in mind, harvesting disturbance from ground-based systems will be reduced, and improved site preparation techniques will be employed. Existing BLM-controlled roads that have been degraded will be improved or possibly be closed to traffic reducing sediment production. Sediment routing and levels will return to near historic conditions as culverts are restored and roads are erosion-proofed. On BLM-administered lands, the rate of surface erosion in harvest units will decrease through the establishment of Riparian Reserves, less-intensive harvesting levels, and lower open road densities.

It is expected that federal administered (GFMA) lands will be managed with a minimum 60 year rotation, while private lands will be managed under a short (35-50 year) timber harvest rotation. Connectivity lands will be managed to contain a mix of ages, with approximately 1/3 of these lands in seral, mid-seral and old-growth stages. Riparian Reserves and LSR's have no specified rotation age, but will be managed for function of long-term, old-growth ecosystems. It is assumed that lands obtained by the Coquille Tribe will be managed under the same constraints as GFMA lands with Riparian Reserves, as stated in the NFP . For this analysis, it is assumed these lands will be harvested under the NFP, but to what extent is currently unknown.

Howerer, the lower harvest levels under the NFP/RMP should reduce the frequency of harvest-related slides as well as mitigate the effects of a slide on stream channels should they occur. It is difficult to precisely predict the effects of NFP practices on the occurrence of harvest related slides since initiation of these events is dependant on a complex set of conditions that need to be met in a precise time frame. Although the establishment of Riparian Reserve areas may not affect the rate or magnitude of slides occurring on mid-slopes, sediments occurring from those slides will be filtered out by the Riparian Reserve vegetation prior to entering the stream, thus lessening effects on stream channels and aquatic biota.

Road-related failures will continue in the future as older portions of the watershed road system fail. However, because newly constructed roads and improved old roads are expected to fail less, the frequency of slides should drop as the majority of the transportation system in the watershed undergoes improvements.

<u>Management Objective</u>
The management objective for BLM-administered roads and lands is to return to historic timing and types of landslides, delivery and routing of woody material and sediment in stream channels. It is also desirable to minimize the effects of management activities on the rates of surface erosion and fine sediment delivery to streams. This can be accomplished by striving to meeting the Aquatic Conservation Strategy during management activities. A reduction in the rate of road-related failures and harvest failures should be strived for on both the private and Federally administered lands within the watershed.

SOIL PRODUCTIVITY

<u>Analysis Questions</u>:

What is the overall status of soil productivity within the watershed?

Has soil productivity suffered a loss through past management practices?

What soil components are most prone to degradation and result in lower site productivity?

What level of compaction due to roads and other management activities exists within the watershed?

Is compaction of the watershed hindering soil or plant functions in the watershed?

What are the influences and relationships between soil productivity and other ecosystem processes (e.g., vegetation, woody debris recruitment, aquatic habitat, etc.)? How have management activities affected these relationships?

What is the management objective for soil productivity within the analysis area?

"Productivity" is the capacity of the soil to sustain the ecological processes of the site and produce a given product (usually plants)without sustaining a long-term decline in production levels. The physical and biological properties found in the soil environment, together with the processes that link them to a growing plant, define soil productivity.

REFERENCE CONDITION

There is no reference condition for soil productivity that can be defined in absolute values. In general, the productive capacity a site is dependent on five factors: infiltration rate, moisture holding capacity, base nutrient levels, organic matter levels, and activity levels of related organisms. Coastal forest ecosystems are characterized by their high capacity to store nutrients, rapid infiltration rates, and low bulk soil density. These qualities distinguish coastal mountain forests from many other forested slopes throughout the world.

CURRENT CONDITION

<u>Soil Productivity</u>
A soils "site index" is an indicator that incorporates many of the variables which characterize soil, resulting in a measure of relative productivity. According to analysis of site index classes, index classes 2 and 3 dominate in the Big Creek subwatershed. Index class 4 is present on the rocky and shallower soils such as 15F, 38F, and 58F. In general, this watershed is highly productive, is closely linked to processes that provide nutrients, and is resilient to management activities.

Baseline or natural productivity (as defined by the Soil Index) may be increased by the introduction of additional nutrients into soil (i.e., fertilizers, nitrogen fixation by plants and micro-organisms such as fungi and lichens, or nutrients contained within precipitation). In the analysis area, both private timber companies and the Bureau of Land Management have applied nitrogen fertilizer to portions of the watershed as part of intensive silvicultural management activities.

Nitrogen-fixing native plants such as *Ceanothus* and red alder, along with lichens and micro-organisms, help accumulate nitrogen in adjacent soils, subsequently helping to maintain or increase local productivity. Additionally, there are exotic species present in the watershed which also fix nitrogen, including Scotch and French broom. The distribution and abundance of *Ceanothus* and red alder has been reduced in some areas through maintenance contracts and herbicide spraying, reducing the amount of time which nitrogen fixation could have occurred there. Since Scotch and French brooms are considered noxious weeds, they are not encouraged to grow on any lands.

Nutrients may be removed from soils during removal of tree boles and burning. Soil productivity in the subwatershed has probably not been reduced as a result of these activities with the exception of areas with shallow soils and rocky outcrops such as Upper Big, Swamp, and Bear Pen Creek drainages. In these areas, fires burned hot enough to completely consume organic matter in the soils, and productivity has subsequently been reduced.

Harvest and burning may affect soil productivity *directly* through the removal of nutrients; however, these activities may also *indirectly* reduce productivity by affecting other processes (such as microbial activities or reduction of infiltration rates) contributing to overall soil productivity. For example, yarding and road-building compact soils, reducing the infiltration capacity, causing overland flow and the subsequent removal of nutrients. The degree to which management activities such as harvesting, burning, and herbicide applications have affected these processes is unknown.

Certain shallow soil-types are more susceptible to nutrient degradation resulting from management activities. In the Big Creek subwatershed, these are the Digger-Preacher-Umpcoos (14F), Digger-Umpcoos-Rock outcrop (15F), Milbury-Bohannon-Umpcoos (38F), and the Umpcoos-Rock outcrop (58F). All of these are noted in the Coos County Soil Survey as having 10-20 inches of soil above bedrock in one or more of the soil types. These soil groupings make up 39% of the analysis area, but the area covered by these very shallow soils only covers a little under 10% of the watershed. Rock outcrop and Umpcoos soil types normally are found on the narrow ridges, steep side slopes or convex side slopes adjacent to rock outcroppings. These soil types are rated soil class 4, or are not rated, and do not commonly grow commercial tree species.

<u>Soil Compaction</u>

Roads and skid-trails: It is possible to indirectly measure the level of compaction within the drainage due to yarding from past monitoring reports and a calculation of road-miles in the watershed transportation system. The roads and identified equipment trails, present in the GIS data base, represent 202 acres of the 16,661 acres in the analysis area. This calculates to an average level of compaction of 1.21%. (Road length was converted to acres using an assumed width of 14 feet for all surfaces and only those roads and cat trails identified from the GIS database were used in the calculation.)

Lands taken out of production for the purpose of roads are not expected to grow plants and are not considered when calculating the productivity of the watershed. No systematic survey of the analysis area was conducted to determine the level of recovery of the compacted skid trails. However, a field review of the past entry areas showed the skid trails to be in various states of recovery. Skid trail construction usually removes the top soil so that many skid trails may never fully recover to the unroaded condition.

Timber harvest: The level of compaction due to harvest within the analytical area has not been measured. Based on an aerial photo review from 1943 to 1992, harvest activity and subsequent compaction has been more extensive on private than on BLM-administered lands.

Harvest on private lands generally employs extensive use of ground based yarding systems, -a type of activity that is still evident within the drainage today. Lands harvested using ground-based systems (which can lead to compaction rates of up to 30% of area harvested) were generally found on slopes below 40%. As a general rule, Hi-lead cable systems were employed on slopes greater than 40% or where ground-based systems needed excessive skid trails. These Hi-lead cable systems have been found to increase the level of compaction from 3% of the harvested unit to 12%. Private lands comprise nearly 40% of the total drainage. Due to the location of these lands on steeper slopes the harvest system most often employed was the cable system that provides better protection of the soil resources. Because private lands are a mixed mosaic of ground and cable systems, many times on the same piece of ground, and much of these lands are now covered by 20 to 40-year-old timber, it is difficult to place a level of compaction due to harvesting on these lands in this watershed analysis. However, based on the aerial photo analysis conducted during the landslide inventory process the level of compaction would be approaching the 12% level as an estimate.

On BLM-administered land, entry with ground-based systems in the 1943 photos occurs in the northern portion of the watershed (in response to the 1936 Brewster-Sandy fire). Roads were constructed with equipment of the time and crossed some of the steepest slopes in the watershed in an effort to salvage the timber. Since that time, most of the BLM lands have been harvested using cable systems. Past monitoring of harvest units on BLM administered lands in the watershed for compaction and soil disturbance has not identified a level of compaction that exceeds 5%, well below the 12% level established in the monitoring process (USDI Handbook 1734-1).

SYNTHESIS & INTERPRETATION

Integrity of soil is vital not only for maintaining plant and timber production but also for maintaining inputs of elements important to habitat for terrestrial and aquatic biota Management activities which affect the ability of the land to re-vegetate after disturbance not only diminish the ability of the land to produce products but have implications for survival and abundance of terrestrial and aquatic flora and fauna. Losses in soil productivity ultimately reduces the level of inputs of large wood, an important habitat component in aquatic and terrestrial ecosystems. Management activities which reduce the soil's ability to re-vegetate after disturbance result in surface erosion, inputs of sediments into streams, and ultimately, reductions in water quality.

The factors contributing to creating and maintaining soil productivity are:(infiltration rate, moisture holding capacity, base nutrient levels, organic matter content, and level of biological activity of micro-organisms within the soil). The two soil components that are most prone to degradation by management activities are soil bulk density and organic matter content.

Certain harvest conditions (poor log suspension during inhaul, wet soil conditions or poor operator) may particularly affect soil bulk density and organic matter content by reducing air space between soil particles or eliminating the upper portion of the soil. This type of harvesting is common where ground-based systems are used to remove trees or where broadcast burning is poorly controlled and fire intensity/duration are high enough to remove the organic layer. In situations such as these, where timber is removed without regard for maintaining the normally high infiltration rates, and where widespread removal of organic matter from the upper horizon occurs, there can be substantial reductions in soil productivity.

The introduction of road systems and the various methods to remove timber from this watershed have increased the level of compaction above natural levels. However, some of these early trails have been re-vegetated for a length of time sufficient to reduce or remove influences on surface runoff or growth rates. Furthermore, increases in stream networks as a result of road surfaces do not appear to be a major factor due to the low percentage (1.21%) of the land in the roaded state (although no formal inventory to determine stream network extension has been conducted). Areas compacted more recently, however, continue to affect runoff and plant growth, and are of particular management concern; however, given our present level of knowledge, there is no reason to suspect widespread reductions in that any soil or plant functions in the Big Creek subwatershed. There may be some local influence on private land.

Trends

On private lands, the use of ground-based systems for harvest is being replaced by the use of low ground-pressure mechanical harvesting methods which substantially lowers disturbance to soils when compared to ground-based systems. The level of compaction imposed on the land by low ground-pressure systems is still unknown; however, because of the added ability of low ground-pressure systems to operate on slash (reducing compaction to soil) combined with reliance of previously-constructed road and trails, levels of compaction are thought to be comparable to cable systems.

On BLM administered lands, the trend will be towards fewer permanent roads open to traffic. Harvesting will be conducted with the “build, use, and close” policy as a means of reducing road densities and lowering maintenance costs. The TMO process used in this watershed analysis recommended many closures and improvements that will lessen the level of compaction over time and reduce sediment delivery in the near future.

In general, soil productivity has not been substantially reduced on either private or public lands by past management practices. Typically, soil is fairly resilient. This level of basic resiliency, combined with the naturally high nutrient levels of the soils in the Coast Range, the abundance of nitrogen-fixing vegetation, and fast re-vegetation rates (which helps hold soils in place) helps minimize soil degradation. It is important to note that, despite the resiliency of Coast Range soils, degradation from management activities on a continual basis can, in time, reduce soil productivity. For example, soil productivity modeling for the RMP, demonstrated that removal of timber on less than a 40 year rotation, would ultimately result in loss of soil productivity. On private lands where rotations may be less than 40 years, there may ultimately be productivity losses; however, on public lands, the NFP and RMP do not allow such short rotations and set large areas of Reserves that will be managed for old-growth habitat.

Continued high productivity of the soil is vital for maintaining elements important to habitat for terrestrial and aquatic biota, such as the key large woody material and shade. The ability of the land to re-vegetate after disturbance will lengthen and allow the process of surface erosion to become more important in producing fine sediment in the stream systems. Water quality and quantity could be reduced if components of soil productivity are reduced. Other plant and tree species become better at occupying some soils and although diversity would increase the ability to provide wood products would decrease.

Management Objective

For any soil, the maintenance of soil productivity requires that forest-management activities minimize the withdrawals of soil resources (remove Nitrogen) and the timely replenishment of those resources. Four actions should be optimized when striving to maintain soil productivity. 1) Minimize disturbance severity (i.e., intense burn, soil compaction or erosion), 2) retain organic matter, 3) re-vegetate with indigenous species and associated soil organisms, 4) recognize shallow soils as those most susceptible to productivity losses.

The level of compaction on BLM administered lands set forth in the RMP is not to exceed 12% of the land. This excludes roads and is confined to the operable land surface. An increase over that percentage will affect the ability of the land to produce timber at the prior calculated rate and is unacceptable.

III.2 CORE TOPIC - HYDROLOGY

Analysis Questions:

What are the dominant hydrologic characteristics and other notable hydrological features and processes in the watershed? (refer to Section 1 - Characterization)

What are the historical hydrological characteristics (e.g., peak flows, minimum flows) and features in the watershed?

What are the current conditions and trends of the dominant hydrologic characteristics and features prevalent in the watershed?

What are the natural and human causes of change between historical and current hydrologic conditions?

How have natural and human caused changes in water quantity and timing of flows affected water quality?

How much surface water is being used for out of stream uses, and where are points of diversion (including domestic sources)? What effect does this have on available summer flow?

What are the influences and relationships between hydrologic processes and other ecosystem processes (e.g., sediment delivery)?

What is the management objective for the hydrologic processes in the watershed?

Watershed hydrology includes floods, distribution of flows, annual yield, and minimum flows. A general overview of the analysis area's hydrology and watershed characteristics is contained in Section I, Characterization.

REFERENCE CONDITION

There is insufficient monitoring data to establish a comparison between current and historic hydrology and changes from land management.

CURRENT CONDITION

Peak Flows

Runoff is described as instantaneous peak flow in cubic feet per second (cfs), calculated from a flood frequency curve or estimated by other methods. Annual peakflow for a given drainage is highly variable from year to year. A frequency analysis establishes a relationship between the magnitude of the flood and its return period.

There are no precipitation or runoff gaging stations in the Big Creek analysis area. Bankfull and extreme over bank floodflows were estimated using several methods. Results are summarized in Table III.2-1.   Descriptions of historic floods, in the region with a 20-year return frequency or greater, are shown in Appendix B-3:Floods.

Table III.2-1   Estimated Bankfull (2-year) and Extreme (100-year) Flows.

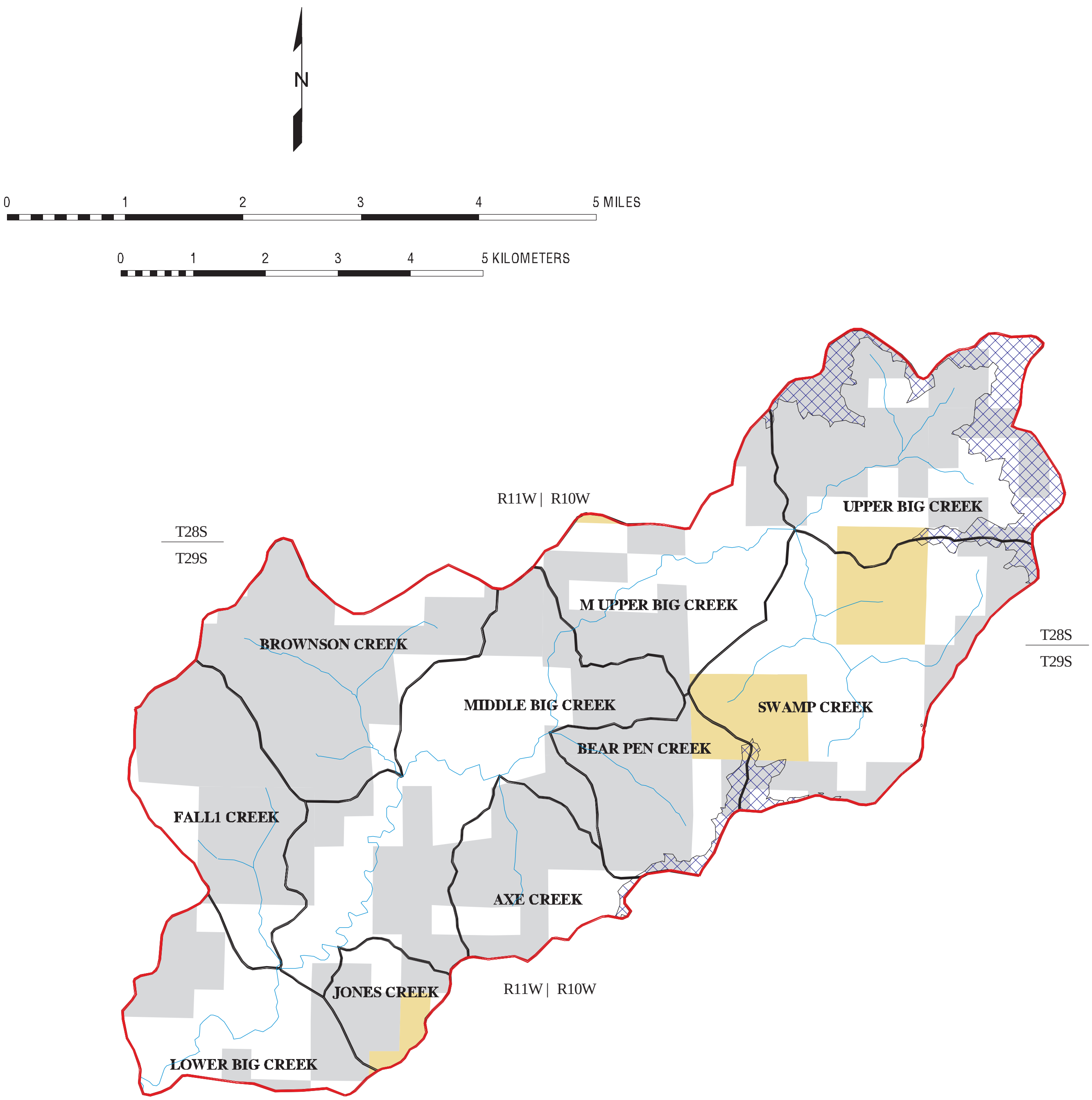
Method*	2 Year Flow (Bankfull) Estimate (cfs)	100 Year Flow Estimate (cfs)
Channel Geometry**	1100	3080
Basin Characteristics*** Regression with USGS Coastal Gaging Stations	1480	3530

*	Estimated flows are for the entire watershed (26.03 mi^2).
**	Grant 1992
***	Harris & Hubbard 1979

Precipitation as snow can accumulate in the higher elevations of the Big Creek watershed (above 1800 feet), but usually is transient and only persist a few days to weeks each winter (Figure III.2-1). Weather conditions including warm winds and rain can cause rapid melting of the stored water equivalent as snow pack. Snow will accumulate and melt faster in openings than the surrounding forest. This process can increase peak flows, depending on drainage factors and vegetative age and condition. Upper Big Creek, Swamp Creek and Bear Pen Creek are the most susceptible to this phenomenon as about 32%, 5%, and 9% of these drainages can retain snow for short periods. Long time residents remember that the flood of 1955 caused considerable flooding along Big Creek, when snow melted in the uplands.

Interviews with local residents suggest that 1955, 1964, and 1971 were the worst flood years in the recent past. The residents also remember that the flood of 1971 destroyed the bridge on Big Creek, just above Fall Creek. The November 1996 storm did not produce substantial flooding in the Big Creek watershed. This event ranks as a 50 year flood at the nearest South Fork Coquille USGS gaging station, (refer to Appendix B-3), but did not express similar effects along Big Creek. An explanation for this could be that the analysis area is located further to the east and in a slight rain shadow from the Siskiyou Mountains. This shields the area from storms orientated from the Southwest.

Figure III.2−1 Intermittent Snowzone Areas (Elevations above 1800')



Transient Snow Zone	
Upper Big Creek	744 ac
Swamp Creek	140 ac
Middle Upper Big Creek	5 ac
Bear Pen Creek	94 ac
Axe Creek	17 ac

Areas above 1800' elevation

BLM administered lands

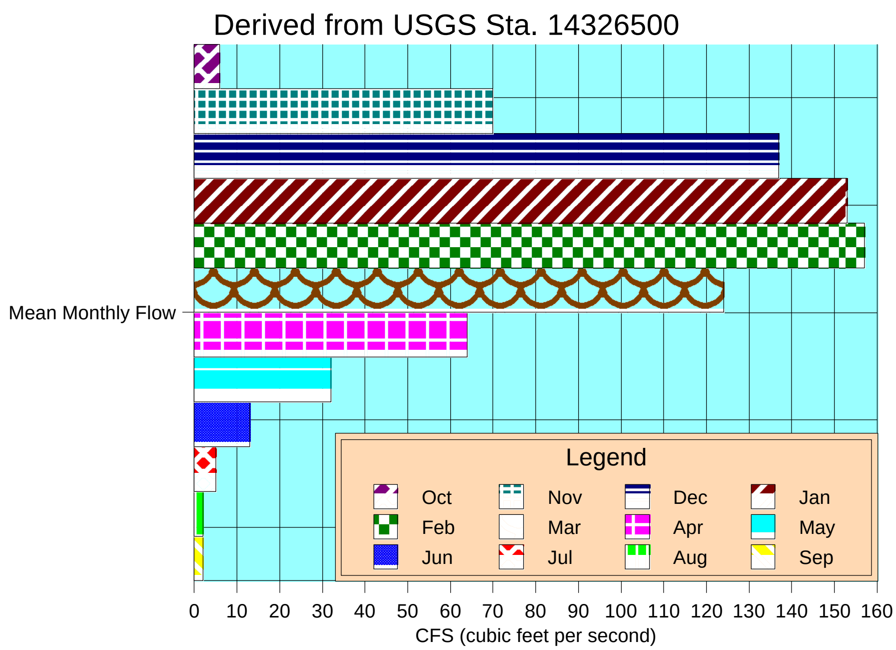
Coquille Forest Lands

Scale = 1:84480 (3/4" = 1 mile)

Annual Flow and Yield

Figure III.2-2 shows that approximately 60% of the annual runoff occurs between December through February, with January being the highest month. June through October contribute only 4% of the annual runoff and results in very low stream flows. This annual runoff distribution very closely follows the precipitation pattern.

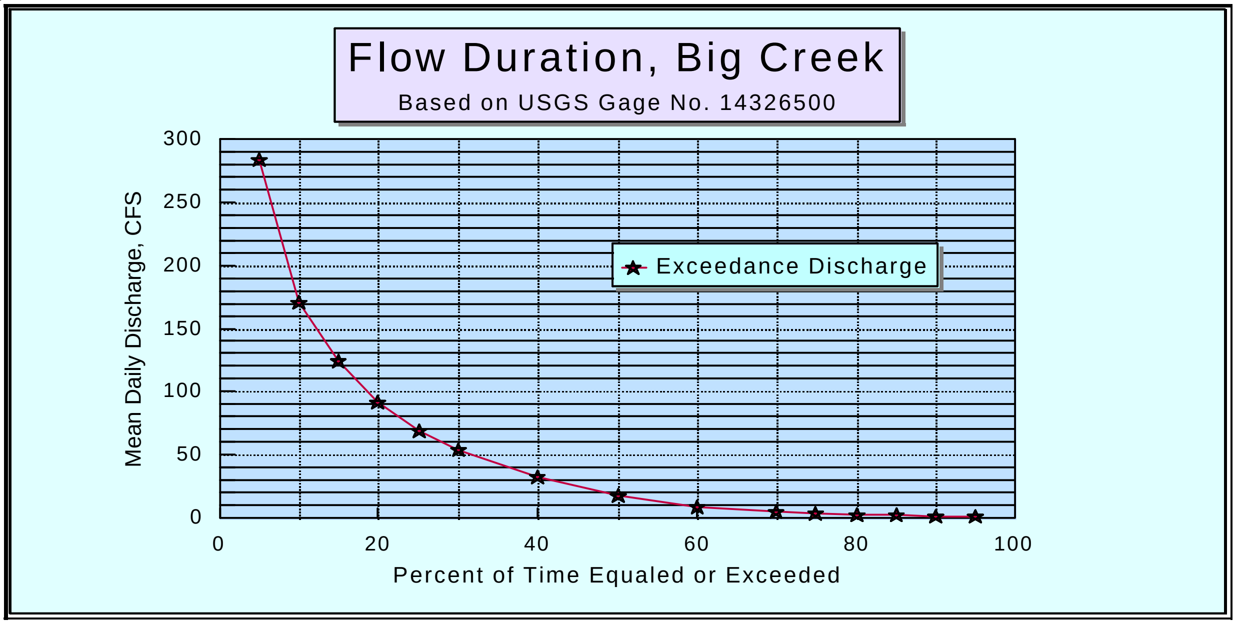
Figure III.2-2 Mean Monthly Flow for the Big Creek Analysis Area



Flow Distribution

Figure III.2-3 shows how flow is distributed throughout the year in terms of flow duration. Large to extreme flows occur less than 5% of the time, moderate flows occur 45% of the time, and low flows occur 50% of the time. Channel formation processes are caused by flows which fill the channel to bankfull or beyond, while channel dimensions are maintained by the frequent flows (flows less than bankfull).

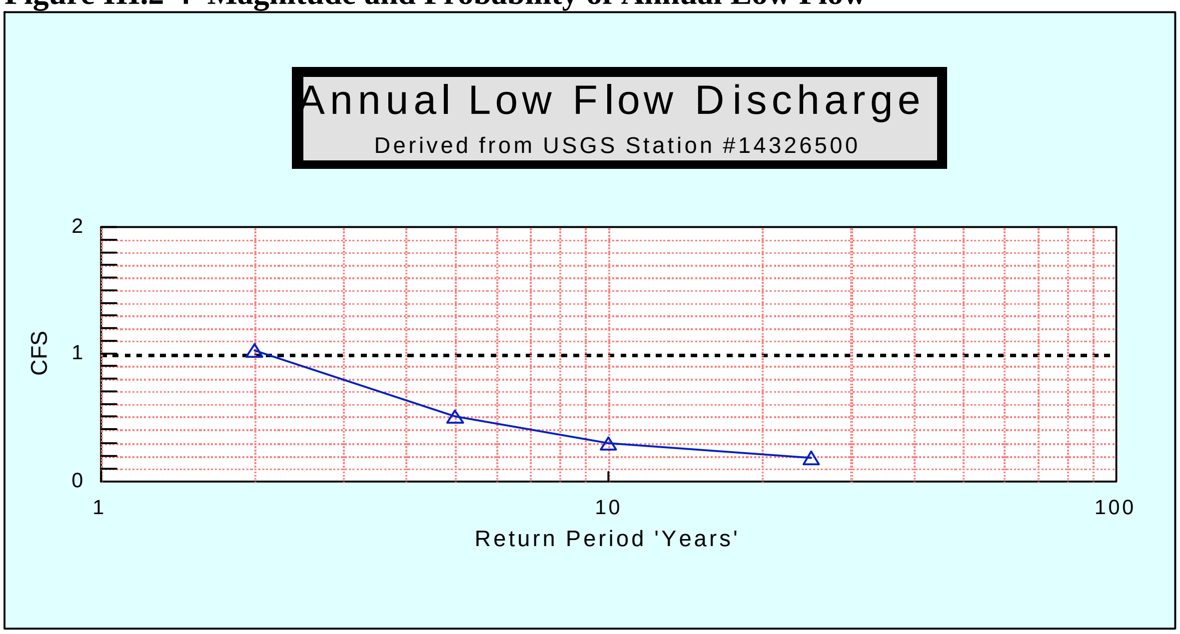
Figure III.2-3 Daily Flow Duration for the Big Creek Analysis Area



<u>Minimum Flow</u>

Because rain is infrequent in the summer, stream flows become extremely low in mid August-October along Big Creek and other tributary streams. Figure III.2-4 shows the magnitude and frequency of low flow in the Big Creek watershed (It should be kept in mind that these are estimates of the lowest live flows in Big Creek for a consecutive seven day period for the indicated return period or years. This estimate does not consider live flow which becomes subterranean further down the channel). The average 7-day low flow is about 0.04 cfs/mi^2 for a two year recurrence interval and <0.046 cfs/mi^2 for consecutive periods of up to 30 days. These values are nearly one half the amount of other Coast Range streams.

Figure III.2-4 Magnitude and Probability of Annual Low Flow



Information from the USGS stream flow gage 14325000, near Powers OR. indicates that significant 7-consecutive-day low flows occurred between September-October in 1931, 1933, 1939, 1974, 1987, 1991, 1992 and 1994. It may be interpreted that low flows also occurred within the analysis area during these years. The return period for these 7 day low flows are 20 years or greater. The low flows in 1933, 1991, 1992 and 1994 were 100 year events (Wellman et al. 1993). During these periods, there was essentially no live flow.

Many of the "headwater" first order streams are formed on coarse textured high permeability soils and dry up as the summer progresses (Figure III.8-1, shows a representation of these intermittent streams). Streams which originate from seeps and drain fine textured, deep, high porosity soils types have a very low, constant flow, but may have "dry spots" in the channel in later summer. Higher order channels may have pools in late summer, but little live flow. During the summer/fall period, live stream flows are so low they are measured in gallons per minute. Stream flows may actually increase slightly at night, because evapotranspiration demand is at its lowest point.

Water Uses

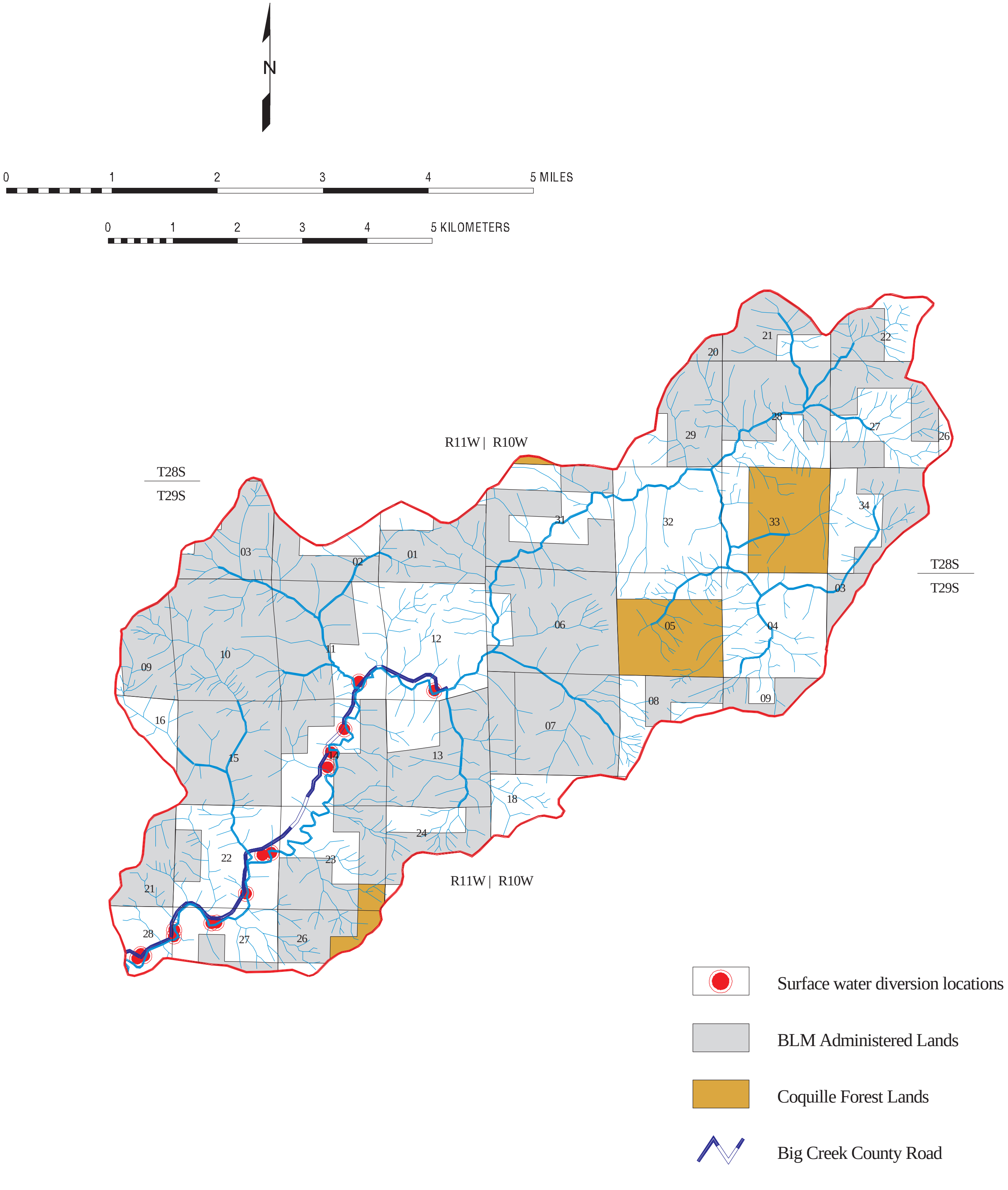
Drainages in the analysis area supply drinking, domestic, and irrigation water to local residents living along the rural forest interface. In addition, numerous wildlife and plant species are dependent upon the drainages for both drinking water and habitat.

The removal of water from Big Creek for consumptive uses is permitted by the State of Oregon and totals 0.648 cfs (Oregon Water Resources Department WRIS System, 1997). The actual consumption is not metered and is therefore unknown. A representative of the Coos Bay Water Board stated that for average rural residential user, the consumption was 350 gal/day/household. There are 22 occupied residences in the analysis area. Of these; nine use surface water from Big Creek or springs, seven have wells, and six residences could not be contacted to determine where they receive their drinking water. Figure III.2-5 shows the present locations of surface water diversions for domestic water supplies along Big Creek.

Water quality data of drinking water specific to Big Creek is not available at present. Water quality testing is not required by state or federal laws because any one water system does not supply more than three households. This was verified by representatives from the Oregon ODEQ, Oregon Health Division, and Coos County Health Dept. Many of the surface-water withdrawal systems include a catch basin and/or settling tank to reduce particulates; some systems have neither. Only two residences reported having water treatment system; one using an ultraviolet light, and the other a carbon filtration system. It should be noted that a few residents cited occasional periods when their tap water was discolored by sediment.

ODFW has applied to the Oregon Water Resources Department for various minimum instream flows on Big Creek (ODFW 1992). Application #72525 has a summer minimum flow of 105 cfs and is located between rivermile 0.0 and 7.8 on Big Creek, with a priority date of 6/30/92.

Figure III.2−5 Surface Water Diversions for Domestic Water Supplies



Scale = 1:84480 (3/4" = 1 mile)

This application would greatly exceed the amount of available water during the dry period. Other streams in the analysis area do not have any instream minimum flow protection pending, but are at low risk for water withdrawals or flow modification.

A reservoir water source option has been identified on the Big Creek located in T.29 S.,R.11 W. Sec.12 (CH2MHill 1993). A new dam and reservoir would be constructed on the mainstream of Big Creek. The water would be diverted, treated and piped to demand centers. This option is considered fatally flawed because anadromous fish runs exist in this section of the river and ODFW highly opposes its construction.

SYNTHESES AND INTERPRETATION

Extreme and Frequent Flows

Little evidence exists to determine whether forest management activities have had an effect on the infrequent peak flows in the precipitation dominated Coast Range. Watershed studies in the northwest have shown that following road building and timber cutting, peak flows may increase, decrease or remain unchanged. The magnitude of the change varies from a 36% decrease to 200% increase and depends on specific watersheds and storm factors (Reiter et. al. 1995). Harvest in the Upper Big Creek drainage may increase peak flows if enough area in the intermittent snow accumulation zone is less than 40 years old.

Extreme flood flows (greater than a 20-year return frequency), measured at the South Fork Coquille USGS gaging station, have occurred in 1934, 1955, 1964, 1971, and 1974, and 1996. Because the analysis area may lie within a rain shadow, the magnitude of these extreme flows is probably less in the Big Creek watershed. The South Fork Coquille extreme floods were the result of natural weather patterns and flashy watershed response. Forest management has had little to do with significantly increasing the magnitude of these events.

Minor increases in the amount of daily flow in the spring and fall may result following harvest activities. This is a result of the younger vegetation transpiring less water and allowing more water to route to the stream channel. This increase is usually considerably less in magnitude than the frequent flows (those flows that occur several times each winter, but are less than the annual high flow) and has little effect on overall flow.

The importance of these types of flows to the stream channel is that frequent flows (those high discharges that return several times each winter season) and the bankfull flow (return period of 1.5-2 years that fills the active channel) are responsible for maintaining channel dimensions and moving most of the sediment load. Major channel adjustments have resulted from infrequent extreme flood flows.

Annual Yield

The amount of increased annual runoff in the analysis area is not known, but suspected to be in the range of 10-20%. Annual yield typically increases as a result of the effects of forest harvest and road building, as shown by studies in the coast range (Ziemer et. al. 1996). This increase is a result of reductions in evapotranspiration following the removal of coastal forest vegetation. The current vegetative condition shows 30% of the analysis area is less than 15 years of age and 42%

less than 25 years of age. These are hydrologically immature timber stands, which use water at less than potential transpiration rates. As more acres of forest vegetation reach hydrologic maturity (±40 years old), this increased yield will decline.

However, because of increased evaporation and soil detention storage on cleared land, not all of this additional water is available for runoff. Compacted surfaces including roads, landings and skid trails can permanently increase runoff and yield and advance timing.

Timing of Flows

Forest management can have an effect on the timing of flows. Flows appear to occur earlier in the fall than in the past. Reduced transpiration from hydrologically immature trees results in increased soil moisture content. As the fall rains occur, less precipitation is needed to saturate these soils and the excess water enters the stream system either through primarily subsurface flow. This results in a rise in streams levels earlier in the year than under undisturbed conditions.

The response time of streams to storms have always been "flashy" because of limited soil and groundwater storage. It is thought that roads and clearcuts in a watershed act positively in advancing timing for a particular storm (Jones et. al. 1996). Roads and ditchlines may be acting as extensions of the stream network and channel the precipitation directly into the stream system. Midslope roads could be intercepting subsurface flow moving in a downslope direction. These factors result in a quicker rise of the stream flow followed by a quicker drop than may have happened in the past. Runoff from compacted areas can also advance this timing in the tributary streams, however, compaction in the analysis area is thought to be low (refer to Section III.1-subsection Soil Productivity).

Minimum Flows

Low Flows have undoubtedly been increased by regeneration cutting in the watershed. However species conversion to hardwoods that are more efficient at transpiring water during the summer and changes in stream channel condition may have diminished these increases. The removal of beaver dams and pools created by log jams also reduced water volume during low flows. Beaver dams and log jam pools release water slowly over the summer and probably supply cooler water due to thermal stratification in the deeper pools. Management activities that change riparian areas from conifer to hardwood could have some effect on reducing low flows, because of increases in the transpiration rate.

Summer flows are a result of subsurface flow being released during the late spring/summer and is primarily dependant upon soil types, soil depths and porosity. Many soil types in the watershed are shallow and coarse textured and do not retain much water. The bedrock geology in the watershed does not favor ground water accumulation.

The reader is referred to Section III.3-Stream Channel for a more in depth look at low flow and stream channel processes.

Trends

Annual yield will decrease and the frequent flows may decrease as young timber stands in the analysis area age and become more efficient at transpiring water. Extreme peak and minimum flows are dependant on climatic patterns.

Management Objective

The management objective for the analysis area is to: A) continue with forest management and other activities in such a way as to minimize the risk of increasing peak flows or altering timing of runoff, B) encourage activities that will retain or increase flows and pool volume during the 'low-flow' summer months, and C) provide uninterrupted supplies of high quality water at the boundaries of BLM administered lands to domestic and other water uses.

III.3 CORE TOPIC - STREAM CHANNEL

Analysis Questions:

What are the basic morphological characteristics and processes in the analysis area drainages? (refer to Section 1- Characterization)

What were the historical morphological characteristics and processes in the analysis area drainages?

What are the current conditions and trends of stream channel types and sediment transport and deposition processes prevalent in the analysis area drainages?

What are the natural and human causes of change between historical and current channel conditions?

What effect have changes in channel morphology and riparian vegetation had on summer low flows?

What are the influences and relationships between channel conditions and other ecosystem processes in the watershed?

What is the management objective for stream channel types in the analysis area drainages?

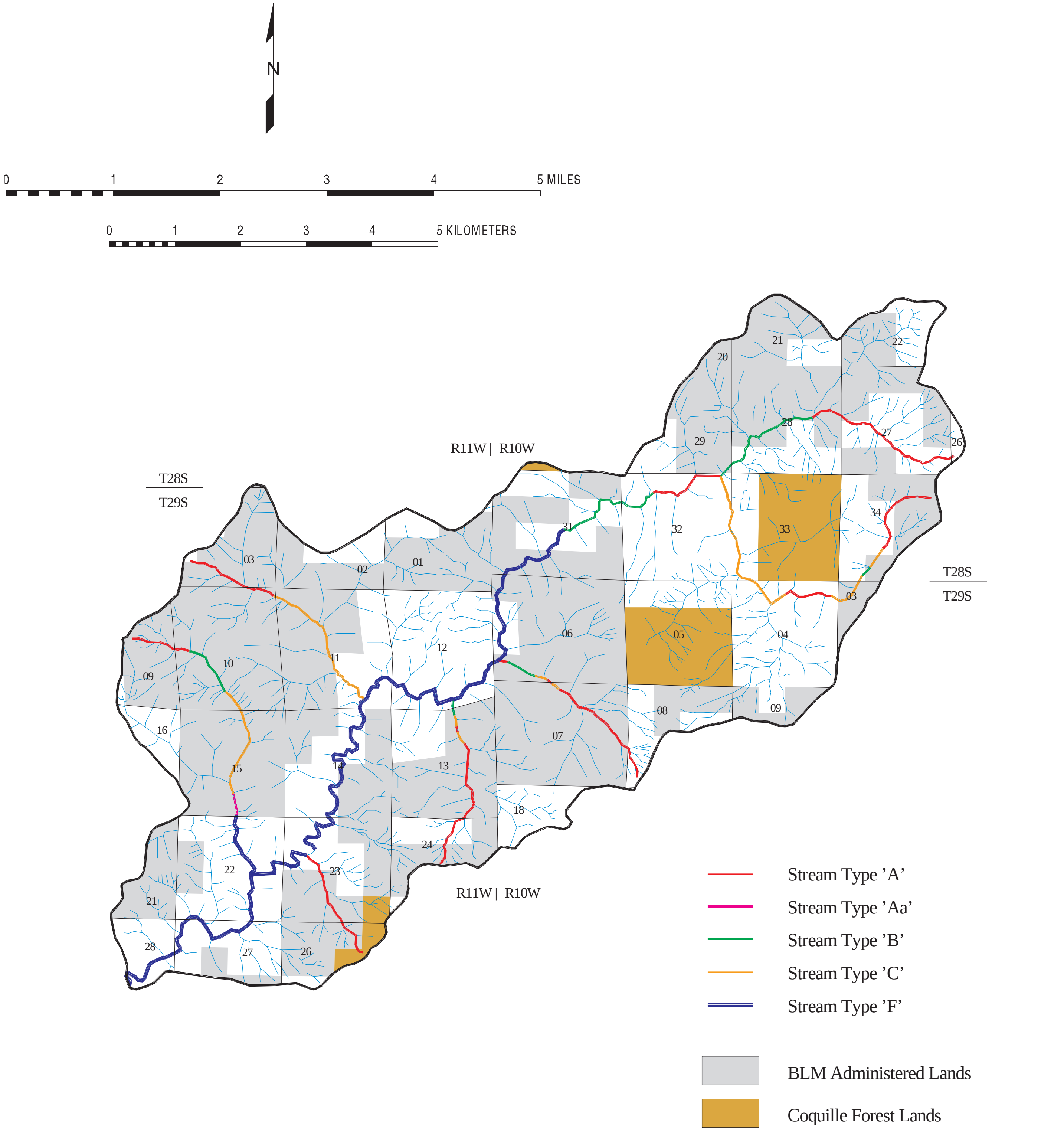
Stream types can best be described by stream channel similarities and differences. Rosgen classification system was used as a basis for comparisons (Rosgen, 1994). The letter designation in Rosgen's classification system identifies the channel gradient and other general hydraulic relationships. The number designation refers to the substrate type. Table A-1, Appendix A shows a brief outline of this classification system and hydraulic relationships, for stream types found in the analysis area. Figure III.3-1 shows generalized Rosgen Stream Types for the Big Creek analysis area.

REFERENCE CONDITION

High Gradient Channels, Rosgen A Stream types
These high gradient (4-10%+) stream channels are usually first and second order streams. Streams in unmanaged timber stands are still representative of the historic condition.

Moderate Gradient Channels, Rosgen B Stream types
These moderate gradient (2-4%) transitional stream channels are usually 3rd order streams. Few reference areas remain in the analysis area. This channel type contained steps formed by Large Woody Debris (LWD) that are critical to maintain stream energy dissipation and prevent lateral adjustment and bankcutting. Embedded LWD spanning the channel creates low velocity flats onto which sediments are deposited for long term storage.

Figure III.3−1 ROSGEN Stream Channel Types



Most 1st and 2nd order streams were also considered to be Type 'A' streams.
(* See classification system in Table A−1 of Appendix A)

Scale = 1:84480 (3/4" = 1 mile)

Low Gradient Channels, Rosgen C Stream types
These low gradient (<2%) stream channels are usually 4th order and greater streams. The probable historic condition for these channel types included streams that were narrow, unconfined by the stream bank at flood stage, and used the floodplains during floods. Their stream banks were stabilized by root masses including myrtle, maple, cedar and other tree species. Greater numbers of downed LWD were in these channel types, but the living trees provided bank stability and were more important than the influence of log steps. These channels dissipate energy by meandering and flowing over roughness elements along the banks and streambed.

Beaver dams and high densities of LWD in log jams are thought to have contributed a larger role in maintaining pools and storage of water in the channel. This water would slowly be released during the summer low flow period.

CURRENT CONDITION

High Gradient Channels, Rosgen A Stream types
These are steep, V shaped, erosional, straight channels which lack a floodplain. Many are confined by bedrock channels and steep banks. About 147 miles (79%) of all channels in the analysis area fit this type. The main process affecting these channels are infrequent landsliding and debris torrents. Review of past aerial photography indicates that although incidences of debris avalanches and debris slides into channels have increased from forest management, rapid movement down first and second order channels by torrenting has probably not been accelerated, except in the Upper Big Creek drainage (see Section III.1-Erosion Processes).

The analysis area has many type A first order channels on bedrock (A1). These stream types are associated with soil mapping units 14F, 15F, 46D, 46E, 46F and 58F. A1 channels on these soils are often intermittent, because the catchment areas are small (20-60 acres), soils are shallow with high water infiltration (2-6"/hr.), and bedrock is basically impermeable to water. Figure III.1-1 shows these stream segments on BLM administered lands. These channels are moderately sensitive to disturbance, have good recovery potentials and moderate stream bank erosion potentials. Sediment supply is low-moderate, except when fire or torrents occur.

A1a+ stream types are steep (>10%) stream types on bedrock and prone to the debris avalanche and shallow rapid debris flow process. The most frequently occurring landslides were found on soil mapping units 14F, 15F, 38F, 46F and 58F (Table III.1-2). The avalanches, debris slides and sometimes resulting torrents usually occur when concave hollows on headwalls above these channels are loaded with colluvium, soil materials and organic debris by natural or disturbance processes. When prolonged precipitation saturates thin soils, shear strength is reduced and failures are likely. This has been observed to be associated with the 5-10 year (or greater) recurrence interval storm. Shallow rapid debris torrents travel at 35-40 mph and are devastating to low order channels. They are responsible for scouring bed and banks, carrying huge volumes of sediment, and leaving depositional fans at high angle, tributary junctions. This perpetuates the A1a+ channel type, by passing large debris, gravels, and high sediments downstream to higher order depositional stream types. This process occurs on an infrequent basis.

Other type A first-second order channels occur on silt/clay substrates and are associated with soil mapping units 4D, 4E, 10B, 17B, 33, 47B, 63B, 63C, 53D, and 53E. These A5-A6 channel types originate from seeps and have a very low continuous summer flow. Some of these channels are draining perched layers of water in deep soils on gently sloping land forms. They are very sensitive to disturbance, have poor recovery potentials and very high streambank erosion potentials. Sediment supply is very high.

The upper extent of intermittent streams on District lands has been studied in two different geologies by using the intermittent stream ROD definition and interpretive criteria and found to form at drainage areas between 4-13 acres with a tendency of about 7 acres (Carpenter 1995).

Moderate Gradient Channels, Rosgen B Stream types

These are moderately sloped, slightly meandering channels which either lack a floodplain or have very limited development. About 20 miles (11%) of all channels in the analysis area fit this type. Many B stream types are perennial. The main processes affecting these channels are the input of water, sediment and LWD from upslope channel segments, and some bankcutting and entrenchment. Much LWD has been removed from this channel type, which is necessary for energy dissipation through step/pools. A consequence of the past practice of removing downed LWD and riparian trees has led to channel widening and downcutting or entrenchment. Sediment is being accessed from streambanks, or moved in from upstream stream types (A types), and temporarily stored behind obstructions or localized flats where natural stream grade controls are present. Where stream slopes exceeds about 2%, fine and coarse sediments are moving downstream during frequent flows. This stream type will not aggrade, even when sediment supply is high. However, without LWD wood structure in the stream, limited areas are available to trap gravels for fish spawning beds.

Low Gradient Channels, Rosgen C and F Stream types

These are low lying, meandering, wide and slightly entrenched to entrenched channels with a variety of substrates but with a high proportion of fines. About 19 miles (10%) of all channels in the analysis area fit these types. All C and F channels are perennial. These channel types are located lower in the drainages, along 4-5th order streams and have larger contributing areas. This includes middle and lower Big Creek, as well as some reaches in the lower mainstems of Fall, Brownson, Axe, Bear Pen and Swamp Creeks. The main processes affecting these channels are the input of water and sediment from upstream channels (A and B stream types) and lateral and vertical adjustments through bankcutting and channel scouring.

Early century modification of these channel types has occurred, including splash damming, riparian and flow changes, causing concurrent hydraulic changes and loss of stream pool volume and axial stream water storage in floodplains. Log drives were common in the lower 4.5 miles of Big Creek from 1896-1915, when much of the Douglas-fir and Port Orford cedar were driven down Lower Big Creek on dam released flood waves. Riparian zone hardwoods and conifers were also cut and spanner logs removed to facilitate log transport.(Farnell 1979).

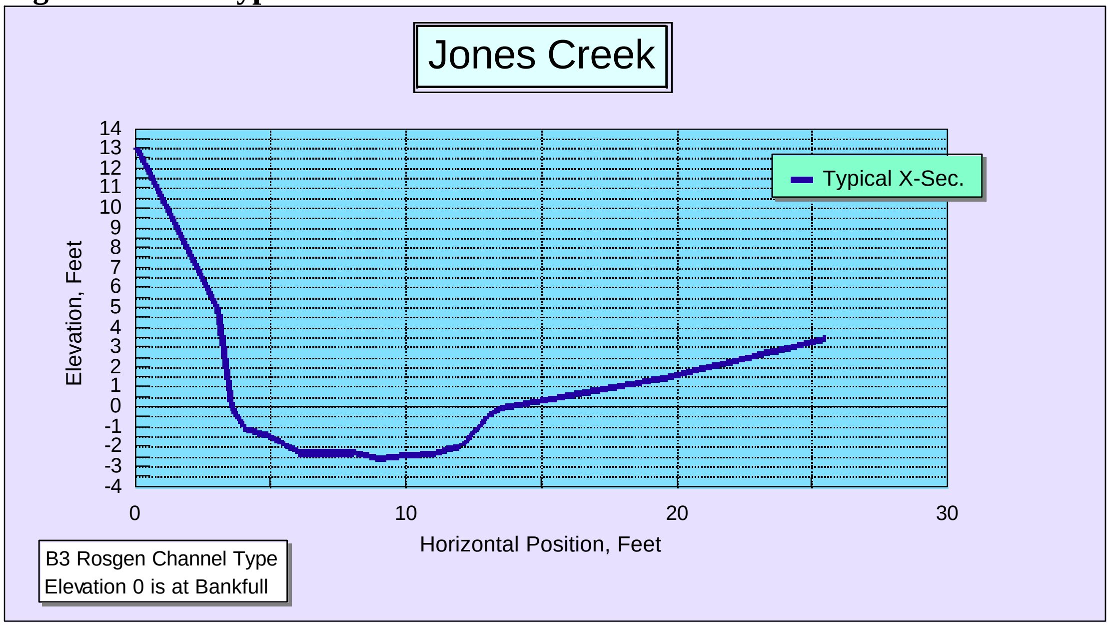
Low gradient channels are depositional areas for fine sediments. These stream types can easily be identified in longitudinal profiles shown in Appendix A-4. The higher frequent flows will move sediment along the bed and banks and will be redeposited downstream.

Stream Channel Characteristics

Each of the 10 drainages in Big Creek were inventoried in the field. Typical cross sections of the channel, pebble counts of the surface substrate of the channel bed, and longitudinal profiles of the channel gradient were created. Figures III.3-2, III.3-3 and III.3-4 show examples of these graphics for Jones Creek. This data, when looked at together, gives important information about stream channel characteristics and aids channel classification. Additional figures for other Big Creek drainages can be found in Appendix A-4.

A typical cross section was measured with a tape and rod in the lower portion of each drainage in low gradient (<2%) Rosgen B3c, C or F channel types at a site representative of the reach. The cross section contains information about bankfull width, depth and cross sectional area, and whether a floodplain is present above bankfull.

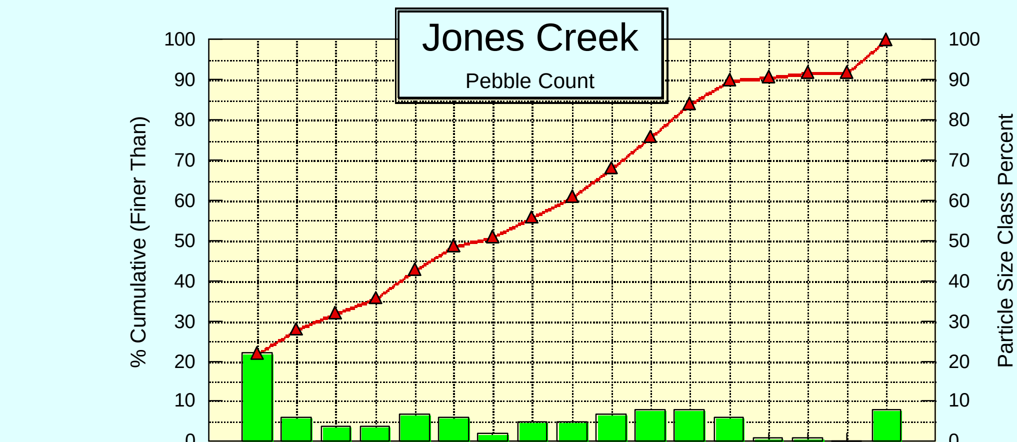
Figure III.3-2 Typical Cross-Section



A pebble count of the streambed substrate was taken in the same area in riffle sections. Table III.3-1 summarizes the results. Although only 10 measurements were taken, the sample is stratified within low gradient streamtypes. More replicate samples could be taken to determine confidence and trend of the data.

The initial pebble count data indicate that Jones Creek and Upper Big Creek have a significantly higher amount (28%) and (26%) of fine sand/silt/clays comprising the streambed substrate. The small size of substrate in Brownson Creek is mostly due to the absence of larger cobble sizes rather than a high amount small particles. Conversely, the Upper Big Creek channel is predominately bedrock. Figure III.3-3 typifies a pebble count diagram. Pebble count diagrams for all survey sites are in Appendix A-4.

Figure III.3-3 Typical Pebble Count Analysis



Particle Size, mm	0.06	0.09	0.19	0.38	0.75	1.5	3	6	12	24	48	96	192	384	768	1536	3072
	22	28	32	36	43	49	51	56	61	68	76	84	90	91	92	92	100
	22	6	4	4	7	6	2	5	5	7	8	8	6	1	1	0	8

Longitudinal profiles of the stream gradient were developed for each drainage, by intersecting GIS contour and hydrography coverages. These profiles give a picture of the stream gradient. This information is used to aid in stream classification.

Figure III.3-4 Typical Longitudinal Profile

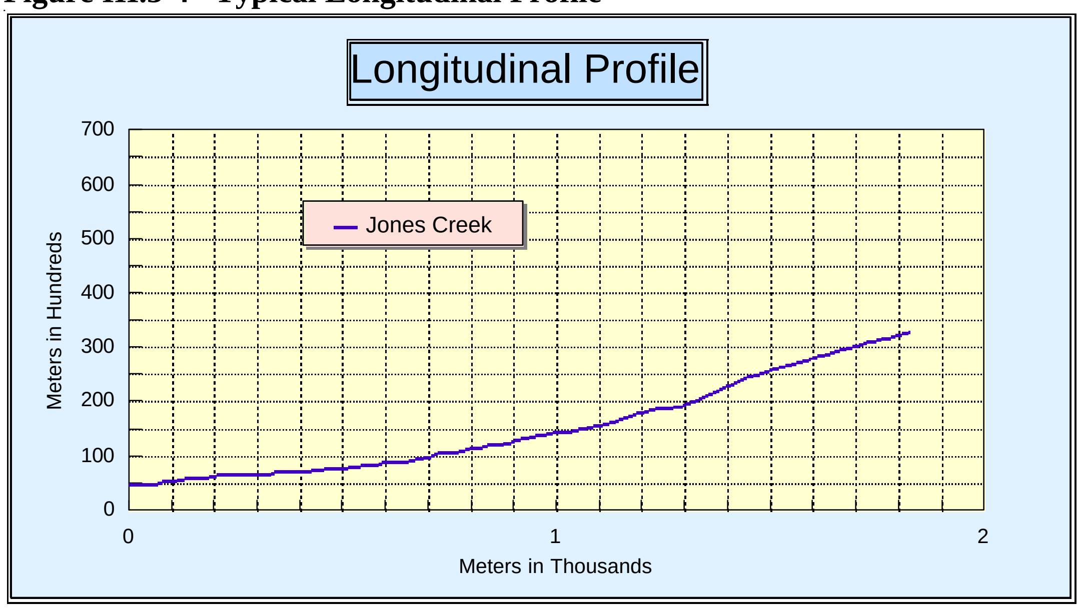


Table III.3-1 Stream Channel Characteristics at Selected Sample Sites

Stream Name	Cross Section Information				Longitudinal Profile			Pebble Count		
	Rosgen Type	Ave. Depth	Max. Depth	Ave. Width	Average* Gradient	Mainstem Distance	Stream Relief	Dominant Particle	Description	D50**
Lower Big Cr.	F4	1.9 ft	2.9 ft	42 ft	0.78%	10161 ft	79 ft	48 mm	very coarse gravel	20 mm
Middle Big Cr.					0.59 %	28408 ft	167 ft			
Middle Upper Big Cr.					3.4 %	13313 ft	453 ft			
Upper Big Cr.	B3c	1.9 ft	2.7 ft	21 ft	9.5 %	14531 ft	1378 ft	3072 mm	Bedrock	72 mm
Swamp Creek	B3c	1.6 ft	2.2 ft	27 ft	6.6 %	19340 ft	1270 ft	96 mm	small cobble	62 mm
Brownson Cr.	F3	1.8 ft	2.3 ft	20.5 ft	8.5 %	12369 ft	1047 ft	12 mm	medium gravel	5 mm
Fall Creek	B3	2..2 ft	2.9 ft	15.5 ft	7.9 %	16099 ft	1270 ft	96 mm	small cobble	34 mm
Bear Pen Cr.	B3c	2.0 ft	2.3 ft	18 ft	18 %	9688 ft	1745 ft	96 mm	small cobble	31 mm
Axe Creek	B4	2.0 ft	2.3 ft	18 ft	10.5 %	9314 ft	978 ft	96 mm	small cobble	31 mm
Jones Creek	B3	2.0 ft	2.5 ft	10.5 ft	15.3 %	5994 ft	919 ft	<0.062 mm	silt/clay	3 mm

*Average gradient is the entire mainstem length divided by the relief, rather than the reaches where the pebble counts were taken. This data is intended to give the reader a very general picture of overall stream rise, although it should be noted that all drainages have low gradient flats in the lower reaches and steeply inclined channels near the headwalls. See Appendix A-4 to view longitudinal profile plots.
**D50 = 50% of the channel surface substrate is at or less than the indicated size in millimeters

SYNTHESIS & INTERPRETATION

Management Effects on Stream Channels

Splash dam logging, which began in the lower watershed in 1896, and systematic upper watershed road building and logging, which begin in the analysis area in the early 1950's, has affected the stream channel's ability to function and remain stable. More than 46% of BLM lands and 56% of Big Creek has young timber stands less than 40 years old, which is considered hydrologically immature. Increases in annual yield has occurred and some peak flows may have been elevated. Existing roads may be causing quicker runoff to tributary channels because road system ditches act as extensions of the stream network and storm flow is quickly routed (see Section III.2-Hydrology). Roads and ground based logging, primarily from private lands, have compacted sites in the analysis area approaching 12% (see Section III.1- subsection Soil Productivity). These factors may have elevated annual or frequent discharges allowing degradation to occur in the A and B stream types.

Removal of LWD in stream channels by logging and removing of log jams has led to degradation of all stream types, especially the moderate gradient B stream types. Channel shape, substrate composition and the processes through which the transitional channels dissipate stream energy have changed in response to man's activities. The channel complexity, which involves energy dissipation through turbulent flow and channel roughness has been simplified. Much of the channel roughness provided by LWD has been removed, which changed the flow from a turbulent or varied velocity profile to laminar or a consistent velocity profile. Essentially, the amount of backwater or low velocity, depositional areas provided by log steps have been eliminated. The decreased number of velocity breaks tends to cause the channels to widen and downcut to dissipate the stream energy no longer used in the step/pool flow pattern.

Removal of mixed stands of hardwood and conifer riparian trees, which anchored the stream banks, has led to channel instability along the low gradient C stream types. These streams also cut downward into the floodplain, widened, lowered the water table within the floodplain and converted many C stream types to an entrenched F type. Splash dam logging in the early century converted Big Creek, below Axe Creek, from an C to F Rosgen channel type.

Photo-interpretation reveals that the number of landslides increased during the mid 1970's (Section III.1-Erosion Processes). This suggests that soil delivery to A and B channels was above natural levels. However, the numbers decreased during the 1980's, possibly as a result of drought years during this time or changes in management practices. Extra or chronic sedimentation to channels, instead of pulses with lapses for a large number of years, has caused hydraulic adjustments. Degradation is continuing in the transitional B stream types, primarily by bankcutting. Aggradation/degradation cycles are continuing in C and F stream types, depending on flow levels and corresponding stream energies.

Sediment Transport and Depositional Processes

The A and B stream types, because of their steep gradients, rapidly transport coarse and fine sediment through them. Because of the small watershed areas, streamflows are normally low and the majority of the sediments is carried in only a few storms each winter. The debris avalanche/torrent process, although infrequent, is the most important transport mechanism of coarse and fine sediments in these streamtypes. Middle and Upper Big Creek, and Bear Pen

Creek show the highest evidence of these channel torrents from natural conditions and road and channel intersection failure. Mid-slope roads acting as interceptors, channel landform constrictions, LWD, and debris torrent deposits can slow the routing process. Once depressions are filled by sediments behind obstructions, a new equilibrium is reached and incoming sediments will be held in suspension during the frequent flows and moved downstream. Sediment stored behind LWD or in debris fans will remain in storage for long periods of time. It can be mobilized again when the organic debris decay or a flood flow rearranges channel debris. Some aquatic organisms, particularly amphibians and invertebrates, are sensitive to the presence of fine sediments, which fill in interstitial spaces between rocks and degrade habitat quality for those species.

C channels are low gradient, and the active channel dimensions are maintained by the frequent flows. These channels are unconfined at flood stage and entrained sediment will deposit on adjacent lateral floodplains. This is because the floodplains have wide areas spreading water at shallow depths and vegetation providing roughness, which lowers velocity to where coarse and fine sediments cannot be held in the water column. C channels tend to be fairly stable. If chronic or frequent pulses of sediment from upstream activities overwhelm the transport capability of the stream, aggradation will occur at moderate flows. With a high watershed sediment supply, high flows will build a new higher floodplain, but the C channel will retain its approximate channel dimensions, but at a higher base level in the valley. Pebble count information shows sand/silt/clay particle sizes range between 14-25% of the surface bed material for C type streams. Although the sediment supply is high, the surface streambed armor layer does not appear to be overwhelmed with fine sediments. A large percentage of coarse and fine sediments are near the bankfull stage at the margins of the active channel. This implies sediment transport is flow limited rather than supply limited.

F channels in the analysis area have converted from C types, including much of middle and lower Big Creek. These are low gradient, entrenched, moderate width channels. Cycles of scour and fill and movement downstream with coarse and fine sediments at moderate flows will continue in these channels until they widen sufficiently so that the cross sectional area diminishes water velocity, depositing sediments during frequent or high flows. In this way a new floodplain will be built by the river within the entrenched channel.

Bank Erosion

Bank erosion, particularly in entrenched B and F channels, contributes sediment to the stream system. During high flows, a larger channel is required to convey the discharge and dissipate the high stream energy. In B channels, the removal of LWD has left stream channels with no way in which to reduce the water velocity in plunge pools, as many channels are downcut to bedrock. Consequently, the channel adjusts laterally, cutting away at the streambank, causing coarse and fine sediments to be suspended in the stream flow.

Down valley low gradient C stream types that have converted to an entrenched F type, exhibit bankcutting during frequent flows. This is most evident on the outside of bends where stream flow is cutting under the tree rooting zone. Brush and conifer/hardwood species on the high abandoned floodplain banks can slow, but not stop this widening process.

The F stream type in Lower Big Creek has clay streambanks derived from the Roseburg

Formation geology. These clays have shrink/swell potential, form a hard surface, and appear to resist and slow bank erosion, even when streamflows and bank shear stress are moderately high. Bank collapse, rather than bank undercutting, may be a more important mechanism along Lower Big Creek during high flows. Reduced root strength, by cutting of riparian trees would place more bank areas at risk of failure.

Jones Creek has a dominant bed particle size of silt clay, due to Serpentine and Roseburg Formation geologic parent materials. This stream has an armor layer of gravel/cobble, but can be expected to mobilize sediment, primarily from the banks, during frequent flows. During high flows, stream turbidities are an order of magnitude higher than other drainages (See Section III.4-Water Quality), and most of this sediment is coming from bank areas. Fall, Brownson, Axe, and Bear Pen Creeks streambeds are well armored with gravel/cobble but can also be expected to mobilize coarse and fine sediments stored in the banks during flows near or exceeding bankfull.

Channel Morphology and Riparian Vegetation Effects on Low Flows

Water availability during late summer from base flow is poor, due to the lack of water holding characteristics in the watershed (Section III.2-Hydrology). The drainages ability to produce summer low flows has not changed, but the channel morphology and riparian vegetation has changed. The ability to detain water, and slowly release it over a longer time period has been lost.

There is an implied assumption that the low flow hydrology of the drainages has changed in response to natural events and management activities. This assumption is based on studies in similar drainages. A good discussion on the changes of low flow can be found in Part II, Chapters 3 of "Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams in the Pacific Northwest and Alaska" (MacDonald et al. 1991). Changes in channel morphology and riparian vegetation have affected low flows. Removal of forest vegetation has been shown to increase low flows by reducing evapotranspiration (Hicks et al. 1991; however, because summer stream flows are very low in the Big Creek drainage, the additional volume of yield from harvested areas is small. Conversion of tree species from conifer to hardwood species such as Red Alder, can actually decrease summer low flows from preharvest conditions, because this species transpires more water during the summer low flow period and acts as phreatophytic vegetation. No studies quantifying summer water loss in streams due to species conversion have been thoroughly studied (Beschta, 1996).

Morphological changes affecting the retention of low flows in the high gradient (>10%) low order (1-2) high energy channels have been slight. These correspond to the A type channels. Because most of these channels are intermittent; they do not retain summer water. Exceptions are channel types A5-A6 draining deep soils or small perched water tables. Some of the type A channels have been soured to bedrock by debris flows. LWD has been removed from these channels, which acted as energy dissipation steps and sediment catchments. However, this change is thought to have little effect on retention of summer water.

Morphological changes affecting the retention of low flows in the moderate gradient (2-10%) middle order (2-3) transitional channels have been moderate. These are step/pool A and B type streams. Removal of LWD has eliminated the steps and flats behind them. These flats stored large volumes of sediment and near surface groundwater. Pool frequency and depth was higher, below each step. These conditions would allow more summer storage of water, when stream flows were naturally low.

Morphological changes affecting the retention of low flows in the higher order (4-5), low gradient (<2%), depositional stream channels, have been the greatest. The Middle and Lower Big Creek have converted from a C to an F Rosgen stream type. Today these stream reaches are totally confined and entrenched, and cannot reach old floodplain terraces. Therefore, loss of floodplain connectivity has occurred. There was considerable near surface groundwater storage in the floodplain alluvium, but cannot be maintained and has been drained by channel incisement. These stream reaches have also undergone much widening, increasing stream width and reducing depth. Removal of streambank riparian vegetation , instream LWD, and beaver dams are largely responsible. Wide, shallow streams retain little water in pools. Sediment delivery from upstream sources may have further decreased pool volume by filling. More beaver dams were probably in the C stream types in the past, and their dams would have retained summer water volume.

Stream Channel Trends

The A1 stream types are static, and neither improving nor degrading. A5-A6 stream types are degrading at a slow rate due to headcutting. B stream types are continuing to degrade, where sufficient LWD is absent to form log steps, and when the base level is above bedrock. Many of the C stream types along lower Big Creek have converted to an F type, and cannot reasonably return to a former state. This is unfortunate, because channel entrenchment has drained much of the floodplain stored water. Many F streamtypes would require sharp rises in the base level to access a flood prone area, and may not be possible under the present climate. It is more likely that eventually these F channel types will widen by bankcutting processes, and the river will construct a floodplain within the overfit channel. Bank cutting is being slowed in Lower Big Creek by streambank materials and their properties. Eventually, a C channel type may be restoring within some of the wide F segments, but may take many years.

Management Objective

The management objective for stream channel types is to attain a stable channel. Stability means that the stream has the ability over time to transport the sediment and flow produced by the watershed in such a manner that the channel maintains its dimensions, pattern and profile without either aggrading or degrading (Rosgen 1994). In addition, channel LWD structure needs to be reintroduced and beaver encouraged in the B and C stream types to improve channel condition and ability to store summer water.

III.4 CORE TOPIC - WATER QUALITY

Analysis Questions:

What are the historic and current processes delivering sediment to tributary streams and along Big Creek?

What is the response of the watershed to storm events in regard to producing sediment?

Where are the source areas causing sedimentation or stream and is it suspected to interfere with beneficial uses?

How quickly can the analysis area recover from the effects of sedimentation after a major storm event?

Are there are roads that are contributing sediment to stream and if so where? What is the future management of the road system to reduce sedimentation and other potential problems?

What are the processes that are increasing summer stream water temperatures above State ODEQ Water Quality Standards? Which stream segments have frequent exceedances?

Are there processes affecting dissolved oxygen levels within the analysis area? If so, identify the processes and what streams are affected?

Are there processes contributing to fecal coliform levels within the analysis area? If so, identify the processes and what streams are affected?

What are the influences and relationships between water quality and other ecosystems processes in the watershed?

What is the management objective for water quality the analysis area?

What management actions (restoration, maintenance, protection, etc.) could be undertaken that would maintain and/or restore water quality within the analysis area? (refer to Section IV-Recommendations)

REFERENCE CONDITION

Sediment Delivery

Limited reference condition information is available, consequently, quantitative estimates for sediment delivery have not been determined. There has always been a natural source component of sediment delivery to stream channels. Landsliding, debris avalanches and shallow rapid debris torrents, surface erosion after historical fires, stream channel sediment adjustments and flooding have contributed soil material.

Water Temperature
Stream temperatures are thought to have been cooler in the past. It is known that the riparian zones contained contiguous cover of conifer and hardwood trees shading the stream (see Section III.6 - Riparian Vegetation). Stream channel dimensions may have been different in the low gradient depositional stream types in the past, by streams being narrower and deeper and connecting to a floodplain. Water moving downstream received less solar heating, and may have exchanged with and replaced bank stored water in lowland alluvial reaches. This effect would act as a heat pump, removing heat from the stream in a down valley direction (Beschta 1996). A stream temperature measurement was taken at the mouth of Big Creek by the Fish and Wildlife Department on 7-15-69, with a indicated value of 64 F ° (Thompson et. al. 1972).

Dissolved Oxygen
Although dissolved oxygen levels fluctuate with the seasons, it is thought that they were seldom below saturation. Factors including decreased stream temperatures, lack of algae, less hardwood detritus, and narrower and deeper streams storing larger volumes of in-channel water, are thought to be characteristics that prevented significant oxygen reductions in stream water.

Fecal Coliform
There is not enough information to formulate a reference condition.

CURRENT CONDITION

Sediment Delivery
The main processes delivering sediment to tributary streams include debris avalanches and shallow rapid debris flows, from first and second order steep headwall channels. This delivery mechanism yields a high volume of sediments and debris, but occurs on an infrequent basis. Avalanche initiation areas include undisturbed vegetated headwalls on shallow to deep fine textured soils, old roads and over steepened landings above channels. Usually soils must already be in a saturated condition and a rainfall event exceed four inches or more in a 24-hour period for significant initiation to occur.

Natural source areas contributing sediment to streams include steep hillslopes and headwalls above first order channels. Figure III.1-2 shows probable initiation or failure sites based on a model output using the infinite slope equation.

Substantial stream channel bank sources of sediment loss occur in all drainage in Big Creek, except Middle Upper Big, Upper Big, and Swamp Creeks. This corresponds to Rosgen stream types; including A5, A6, B5, B6, F5 and F6.

Sediment sources due to forest management, especially forest roads, is well documented. Delivery of sediment to streams can occur for 1-2 years along intermittent channels after broadcast burning, until vegetation reestablishes the site. This results in a large amount of fine sediment input that may take several years for the stream system to flush out.

The higher stream discharges that occur several times a winter, and extreme events that occur infrequently, carry the majority of the sediment load. Flooding can cause soil loss and delivery to streams and extend the stream network to capture unconsolidated colluvium in hollows.

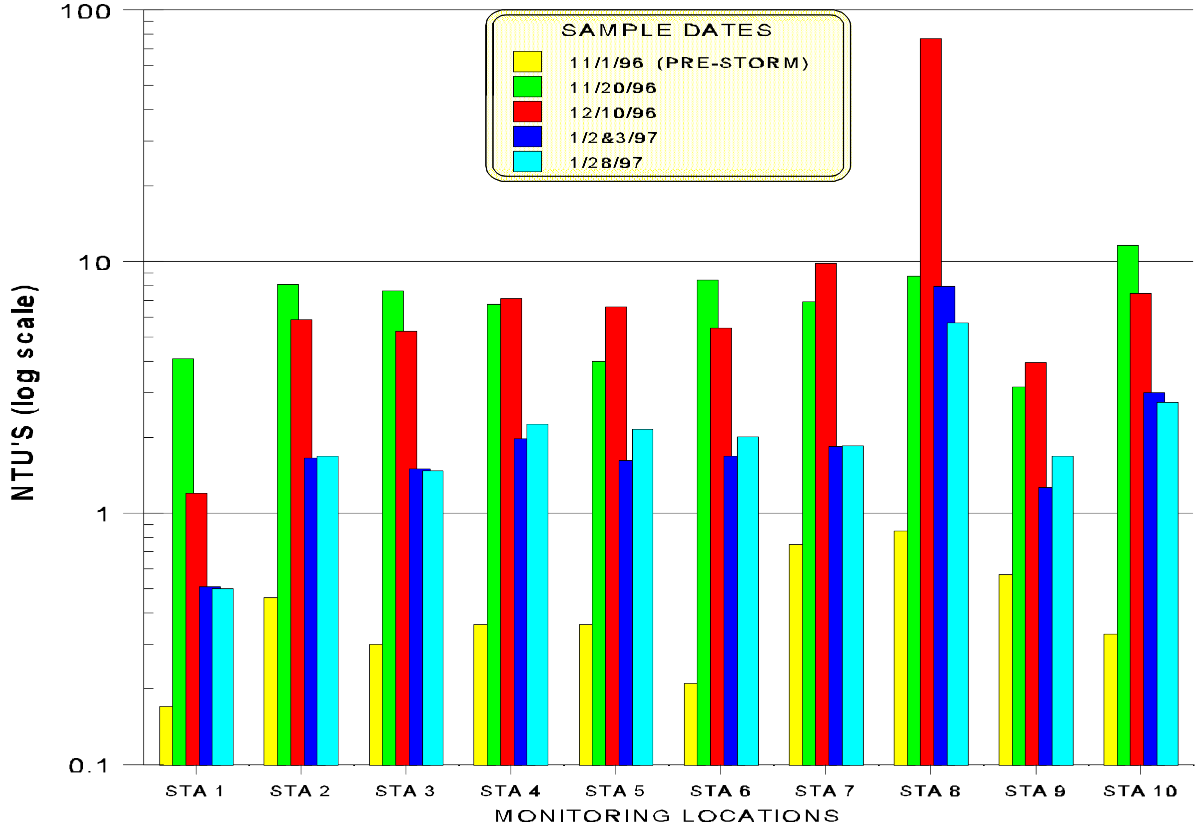
Exceptionally heavy rainstorms (1 in 50 to 1 in 100-year events), like the one on November 18, 1996 can cause widespread landsliding directly into streams of all sizes.

Figure III.2-3 shows that high flows which carry the greatest sediment loads occur less than 5% of the time. Figure III.4-1 shows results of a source search sediment monitoring in Big Creek, in the winter of 96-97. Pre-storm samples were compared with four storm periods at one location in each drainage in Big Creek. Results show that prior to storms, turbidities were the lowest in Upper Big Creek (1.7 NTU) and highest along Jones Creek (8.5 NTU). Storm monitoring indicated turbidity increases of 13 times greater than pre-storm conditions (Brownson Creek, 98 NTU) to 90 times greater than pre-storm conditions (Jones Creek, 768 NTU). Turbidity is a measure of the cloudiness of water, but can be correlated with a suspended sediment load. Jones Creek is draining a serpentine geology which may partially explain the highest turbidity. Jones Creek also had the largest amount of smaller particles in the bed of any drainage surveyed in Big Creek, with 50% of the bed material sand size or smaller.

Watershed recovery in terms of reduced sediment yield, after a major storm event is fair to good. No quantitative estimates are available, but streams tend to clear up in 2-5 days as stream flow levels decline.

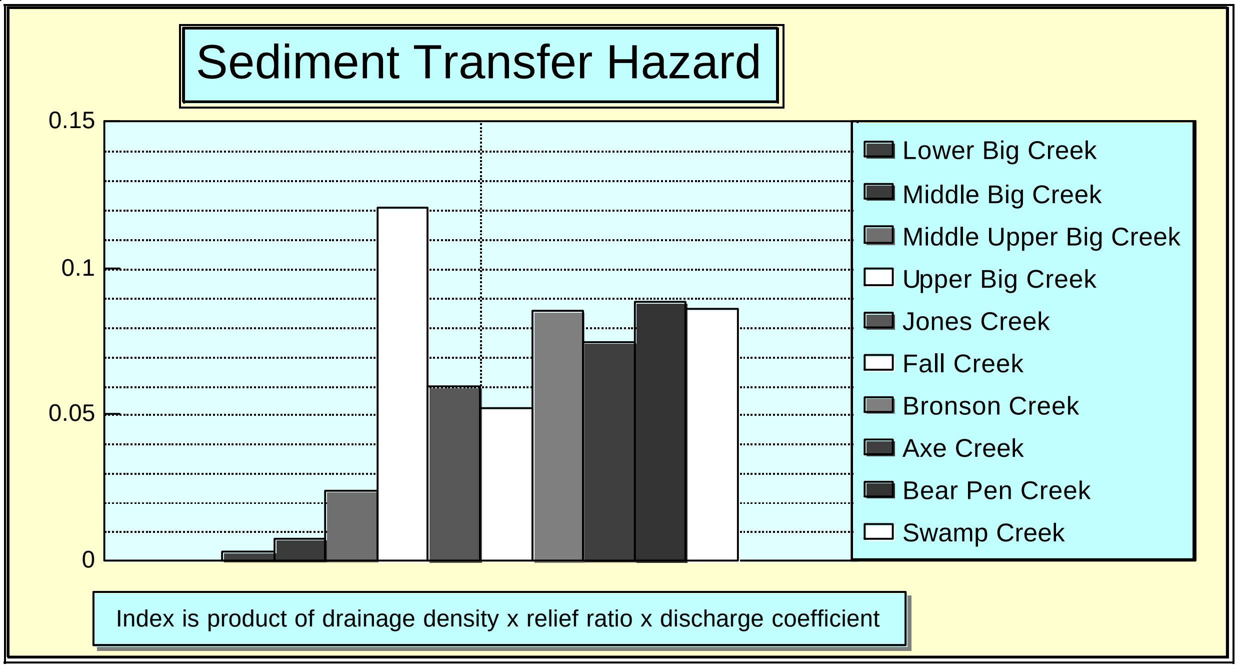
The likelihood of sediment transfer was determined for the Big Creek drainage (Geier et al. 1995). The sediment transfer hazard represents both the transport efficiency of the streams and the bankfull runoff of the drainage. The bankfull flow is closely associated with the 2-year flood event. Figure III.4-2 shows a comparative sediment transfer hazard from the Big Creek drainage. Upper Big Creek has the highest sediment transfer hazard risk with Bear Pen, Swamp, Brownson and Axe Creeks with a moderately high risk.

Figure III.4-1 Big Creek Sedimentation Monitoring Winter 1996-1997



Turbidity Station Location	
1	Upper Big Creek
2	Swamp Creek
3	Middle Upper Big Creek
4	Bear Pen Creek
5	Axe Creek
6	Middle Big Creek
7	Bronson Creek
8	Jones Creek
9	Fall Creek
10	Lower Big Creek

Figure III.4-2 Streams with High Transport Efficiency



<u>Sediment Delivery - Roads</u>

Roads alter the hydrology of drainage in several ways: increased surface runoff from compacted roadways because of reduced infiltration rates, interception of subsurface water by cut slopes, and more rapid routing of water to stream channels via road ditches and culverts. In essence the ditch system may operate much like an extended stream network. All of these effects tend to result in increases of annual yields and peak flows.

Old roads, natural surface roads, improper road drainage, and runoff from landings and other compacted areas are source areas for sediment delivery to stream channels. In average or drier years, dirt roads are probably the greatest source of fine sediments to streams during a typical rainy season. The fines (silt and clay) move as suspended sediment rather than as bedload. Sands and gravels (bedload) usually do not travel far in road side ditches due to low water volumes and velocities. Excess fines from roads should only be a potential problem during and immediately following heavy rainstorms and only if the sediment actually reaches a stream. If water from the road surface and ditch line filters through 50 to 100 feet or more of vegetation before reaching a stream, most of the sediment will drop out.

Within the analysis area, 7% of the BLM road system has natural surfacing, while at least 15% of the private road system is natural surfaced. The surfacing on 66% of the private road system is not known, but could be assumed that a high percentage of these roads are also natural surfaced. As most of these roads are inadequately maintained and lack a vegetative cover, they could be sources of sediment.

IA cursory inventory of culverts along Fall Creek Road, Bear Pen, and other roads constructed in the late 1960's and early 1970's revealed that many of the road culverts are starting to rust through the bottom. These failing culverts are or will soon begin to supply small amounts of sediment to the stream system. Failed culverts along Brownson Creek Spur Road (29-11-11.1) were replaced in 1990 and along Big Creek Mainline Road were replaced under the 1996 "Jobs-in-the-Woods" program to correct erosion problems.

Sediment Deposition and Storage

Depositional streams include middle and lower Big Creek, and flats along the lower reaches of Fall, Brownson, Axe, and Swamp Creeks. These stream types are low gradient pool/riffle C and F Rosgen type streams and have the highest risk for sediment deposition. Aggradation by sediments can reduce pool space, and change the size distribution of substrates toward the finer particles. Aggradation can cause channel widening. This can lower the habitat quality of stream reaches by increased widths and shallower depths.

Surveys of the channel materials were taken at transects at representative low gradient stream types in all of the 10 drainage in the Big Creek analysis area. These pebble counts were taken in riffles within the bankfull channel. Of the total surface substrates, sand sized and smaller particles made up between 19% and 49% of the total. Jones Creek had the highest percentage of fine materials and Swamp Creek the lowest (See Appendix A-4). Sediment may be interfering with some beneficial uses including fish and aquatic life in these pool/riffle low gradient streams.

Water Temperature

Streams in southwestern Oregon are known for their relatively high summertime temperatures, but it is not clear whether this is related to a latitudinal gradient, high solar radiation loads, low flows, or other related factors (Beschta et. al. 1987). Monitoring of stream temperatures during the drought of 1992 did not show a strong correlation between maximum stream temperature and elevation (Oregon Forest Industries Council 1993). Direct daytime heating of stream water from lack of shade is a principal factor to explain increased temperatures during critical summer months when the incoming solar radiation load is high. It is also known that temperatures increase in a downstream direction.

Elevated water temperatures have been noted throughout Big Creek, although actual recorded data is quite limited. High temperatures are attributed to loss of riparian vegetation providing shade, extremely low flows and changed morphology with poor functioning of stream channels. Based on BLM's 1994 temperature monitoring data, lower Big Creek from the mouth to the headwaters was listed on ODEQ's 303(d) list of water quality limited streams. The seven-day rolling average maximum temperature exceeded the basin criteria of 64° F for several periods during the summer (Table III.4-1). Violations of State South Coast Basin standards were noted at the mouth of Big Creek and along Big Creek near Bear Pen Creek near rivermile 5. The monitoring site on Brownson Creek did not exceed standards.

Table III.4-1 BLM and DEQ 1994-1995 Temperature Monitoring Summary for Big Creek

Streams	Seasonal Max.	Date	Seasonal Min.	Date	Delta T	Date	7 Day Max.	7 Day Min.	7 Day Delta T	Days >64E	Seasonal Max. 64E
Big Crk Mouth	68.8	7/21/94	48.9	10/5/94	8.9	7/20/94	66.9	60.8	6.1	54	4.8
Mouth,. DEQ	70.5	7/17/95	54.2	8/26/95	9.5	7/31/95	68.2	60.6	7.6	59	6.5
Brownson Crk	59.2	7/25/94	49.7	10/5/94	2.5	7/9/94	59.0	58.0	1.0	0	0
Big, near Bear Pen Crk	66.9	7/21/94	49.4	6/16/94	8.3	7/19/94	65.7	59.1	6.6	18	2.9

Definitions:
Delta T - Highest value of daily difference between max. and min. for the season
7 Day Max. - Average value of daily maximums for the highest seven consecutive 7 days
7 Day Min. - Average value of daily minimums for the same 7 days
7 Day Delta T - Average of the daily difference between max. and min. for the same 7 days
Seasonal Max. 64E - Number of degrees seasonal max. is above 64E F

Dissolved Oxygen

The amount of oxygen dissolved in water can affect water quality and aquatic habitat. The solubility of oxygen in water is inversely proportional to temperature and directly proportional to atmospheric pressure. Most tributary streams are at saturation for their given elevation and temperature, because of stream tumbling and aeration, except for low stream flow periods. Dissolved oxygen levels may be reduced due to microbial decomposition of organic matter, known as biochemical oxygen demand. During late summer/fall, when flows are low, dissolved oxygen may fall below saturation due to the addition and decomposition of leaf litter from riparian forests (Taylor and Adams 1986).

Although no measurements have been recorded, dissolved oxygen in lower Big Creek in the gentle gradient stream reaches probably declines to low levels during late summer low flow. Results from an ODEQ ambient stream monitoring site at rivermile 0.2 on the Middle Fork Coquille, west of the analysis area, show dissolved oxygen exceeding basin criteria for 18% samples taken (ODEQ 1994). Decomposition of algae in these valley bottom stream types is suspected of depressing oxygen levels.

Fecal Coliform

Sampling for fecal coliform has not been done in the analysis area. However, results from an ODEQ ambient stream monitoring site at rivermile 0.2 on the Middle Fork Coquille, down river of the analysis area, show fecal coliform levels exceeding basin criteria for 9% of samples taken (ODEQ 1994). Sources for elevated fecal coliform levels may be from cattle grazing in lower Big Creek, or seepage from sewer systems. Private residence's setback requirements for septic drain fields were narrower in the past (ODEQ 1996b).

SYNTHESIS & INTERPRETATION

The NonPoint Source Assessment (ODEQ 1988) shows sediment, and nutrients for Big Creek as a moderate problem. Downstream, ODEQ has established the Coquille River as a Water Quality Limited TMDL (total daily maximum loads) stream because pollution controls from sewage treatment plants and other point sources in the lower river below the analysis area have not been stringent enough to achieve the State's water quality standards. Non-Point Source contributors are not included in the TDML listing at this time, nor is sediment one of the measured parameters. The 1972 Federal Clean Water Act, section 303(d), requires that stream segments that do not meet the State's water quality standards be listed. Recent clarifications by ODEQ require that the state demonstrate good cause for not listing a waterbody.

Delivery of sediments and other materials will continue to provide inputs to stream channels. Debris avalanches and rapid debris flows are the primary mechanisms of channel recruitment of sediment. Upper Big Creek drainage has the highest sediment transfer hazard risk because of high drainage density, relief, and runoff including rain-on-snow. Magnitude and probability of occurrence of debris torrents is variable, depending on damaging storms, but usually with a return period of five years or greater. Sediment lodged in low order channels in debris fans is reworked downstream over a number of years.

Bank erosion is the second most important source of sediment in the analysis area. In the lower watershed throughout the Roseburg geologic formation, fine sediments are available in the streambanks. Although most drainage streams have an adequate amour layer on the streambed, this fine bank material can be accessed at annual high flows or greater, or where there is lateral migration of the channel, bank collapse and bank undercutting. Jones Creek is a special situation, because of it's Serpentine parent material. Even though Jones Creek has a lower sediment transfer hazard risk, it does have clay materials in the banks that are mobilized at higher flows. The turbidity graph showed that during storms, most of Big Creek's discoloration is coming from this stream.

Downstream depositional stream morphology is suspected to have changed by channel widening and subsequent entrenchment, and is not able to store excess sediment on floodplain terraces. As these floodplains have become abandoned, stream sediment is being temporarily stored in the stream channel, filling pools and streambeds. Results of pebble counts (Appendix A-4) show that between 19-49% of the surface substrate of the analysis area’s low gradient streams have sand, silt or clay sediments.

Early century splash dams and downstream log drives in lower Big Creek have removed most of the log structure and probably was key in downcutting the channel. This new lower channel base level has stranded former floodplains, is causing tributary streams to incise to Big Creek's level. Where entrenched streams have not widened enough for the frequent discharge to deposit sediment, (ie. no floodplain present) it will be carried downstream to the estuaries. Large woody debris that has been removed from low order channels may have been sinks for sediment to be deposited in long term storage behind them, instead of routing downstream.

During high runoff conditions, sediment is being flushed into Big Creek and out to the Middle Fork Coquille river and transported to the estuaries or ocean. This results in the sediment moving through the system faster both in time and space. The addition of sediment in this manner results in the inundation of aquatic habitat with fine sediment materials. The sediment covers fish spawning areas, reducing oxygen to fish eggs and thus reducing populations. Other stream processes that are affected are the populations of macro invertebrates, riparian dependent species such as Southern torrent salamanders, and nutrient cycling processes related to the woody materials in the stream environment.

Sediment Delivery - Roads

Many road crossing culverts in the watershed are rusting out through the bottom and need to be replaced. Small quantities of sediment may be expected to be lost until a replacement program can remedy the situation. Road drainage problem areas and compacted areas contribute additional sediment to higher order streams. In contrast, field observation reveals that gravel and bituminous surfaced roads are contributing only minimal amounts of sediment (Section III.I Erosion).

Water Temperature

The Aquatic Conservation Strategy and pattern of Riparian Reserves on intermittent and perennial stream channels will provide thermal control by shading the streams, except in cases of natural disturbance. Stream temperatures through private lands in lower Big Creek will continue to be elevated, unless streamside shade is restored. Water temperature in seeps and springs are primarily dependant upon the underground soil temperature.

Dissolved Oxygen

Little information is available to know if oxygen depletion is a problem in the analysis area. Isolated and slow-moving pools on flats within transitional tributary streams are suspected to have oxygen levels below saturation for short periods in autumn when flow is very low and leaf input is high. The wider, slow-moving sections of the lower 5 miles of Big Creek are suspected to have oxygen levels below saturation in summer, due to increased stream temperatures, low flow, and decomposition of algae.

Fecal Coliform

State water quality exceedances for fecal coliform are suspected in the lower Big Creek, and are thought to coincide with agricultural operations and human occupation. There is low dispersed recreation use throughout most of the drainage on BLM administered lands, so fecal coliform contribution to tributary streams is not expected.

Management Objective

The management objective is for clean, cool water that fully supports beneficial uses and meets or exceed Water Quality Standards for the South Coast Basin, or as amended by basin wide standards or criteria referred to in "Oregon's Criteria for Listing Waterbodies" (ODEQ 1996a). It also includes ensuring that actions do not degrade water and meets Oregon's Antidegredation Policy. Soil and Water Conservation Practices, implemented as a Best Management Practice (BMP) design for a project will be carried out to meet Oregon's water quality goals. The *Northwest Forest Plan FSEIS* and *Coos Bay District's 1995 Resource Management Plan Appendix D* list many of these BMP's to be routinely used in management actions.

Sedimentation is the chief parameter of concern from BLM administered lands, and has the highest probability of occurrence. Drainage of chief concern include upper Big Creek and Jones Creek.

Restoring streams, including control of livestock and increasing streamside shade on private lands in lower Big Creek, should have positive effects on water quality by reducing fecal coliform, lowering stream temperatures and increasing oxygenated water during the summer.

Because of the lack of LWD in most all stream types, interim Riparian Reserve width's should not be reduced below 100 feet on each side of intermittent and non fish bearing perennial streams. Fish bearing perennial streams along third order and higher channels will have a 440-foot (2 site tree lengths) reserve maintained along each side of the stream. This not only provides thermal protection during the summer, but is also wide enough to influence microclimates and likely retain cooler air temperatures.

III.5 CORE TOPIC - VEGETATION

GENERAL VEGETATION

Analysis Questions:

What is the historical array and landscape pattern of plant communities and seral stages in the analysis area?

What naturally-caused disturbances occurred in the analysis area?; how big were they?; and in what way did they form vegetative characteristics found within the analysis area?

What and where were the human-caused disturbances, and what impact did they have on the character and composition of the watershed?

Has the diversity of the various natural plant communities changed and how abundant are they, Are any communities missing or represented by only small remnant populations?

Are there any special status or survey and manage plant communities in the analysis area?

What are the current conditions and trends of the prevalent plant communities and serial stages in the watershed (riparian and non-riparian)?

What are the influences and relationships between vegetation and other ecosystem processes (e.g., hydrologic maturity, channel stability, disturbance, species movement, soil and erosion processes, etc.)?

What is the management objective for vegetation in the analysis area?

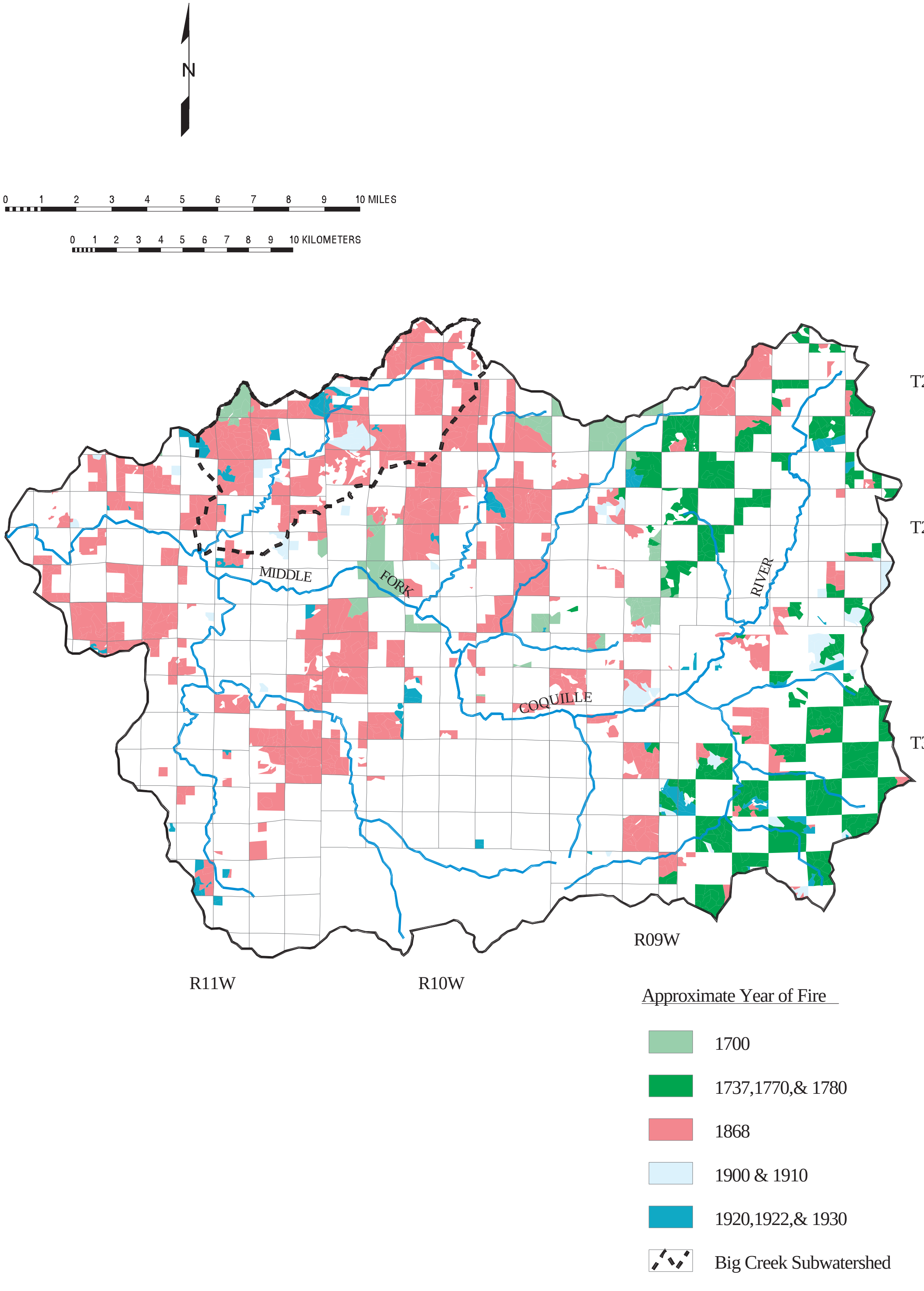
What management actions (restoration, maintenance, protection, etc.) could be undertaken that would maintain and/or restore the integrity and productivity of the vegetation within the analysis area? (see Section IV - Recommendations)

REFERENCE CONDITIONS

Historical Array

The historic landscape throughout most of the entire Coast Range was characterized by large, similar aged patches (ranging in age from 0 to 500+ years old) on the order of many square miles. Most of these patches formed mosaics, containing scattered old-growth trees (i.e., remnant trees >200 yrs. old), patches of old-growth, and small patches of various younger age classes. At any one time, any particular subwatershed could be dominated by one seral stage, but still contain components of both young and old stands. Research by Ripple (1994) calculated that 61% of all conifer Coast Range forests were in old growth condition prior to the widespread fires of the late

Figure III.5−1 Fire Disturbance Pattern −Middle Fork Coquille Watershed



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1840s. These fires, thought to set by early white settlers, burned approximately 35% of the Coast Range (Teensma et. al. 1991) so that only 43% of the forests were in old growth condition by the late 1800's.

The vegetation array throughout the Middle Fork Coquille was similar to that characterized for the entire Coast Range. For an approximate picture of landscape patterns prior to 1943 (the first year aerial photography was available), vegetation patterns were reconstructed by using FOI birth dates of residual stands (Figure III.5-1). Acknowledging the fact that the FOI may be inaccurate for these older dates, it is still evident that large stands of similar ages occurred throughout the watershed. Stands dating from around 1780 are concentrated towards the eastern third of the watershed, near Camas Valley, OR, while the more recently aged stands are concentrated in the western half. More recently aged stands resulted from a large fire in 1868 (Peterson, 1952) and appear to be the most widespread, as residual stands of this age can be located throughout the entire Middle Fork Coquille watershed. This landscape could be characterized as a large scaled, soft edged, slowly changing mosaic.

The 1868 fire in the Middle Fork Coquille watershed burned a majority of the vegetation in the Big Creek analysis area, resulting in a current abundance of trees 100-120 years old and the scarcity of older forests. One isolated pocket of older aged stand (birth date c.1700) survived and is located in the northwest portion of the area in Sec 3, T. 29 S., R. 11 W.

<u>Vegetation Diversity</u>

The landscape was generally forested with perhaps occasional meadows (Sec 15, T. 29 S., R. 11 W.). By examining existing 100-120 year old stands, it appears that their characteristics are similar to those which developed from large scale stand replacement fires. These conditions fit stand descriptions described by Franklin (1973) for mid-seral staged stands within the western hemlock zone. The percentage of Douglas-fir stems from harvested stands throughout the analysis area ranges from 60 to 75%, with a mixture of Port-Orford cedar (<15%), western hemlock (<15%), hardwoods (<15%), grand fir (<10%), and a trace (<1%) of western red cedar. Visual observations of these stands indicate that the understory is comprised of small hemlock, Myrtle, chinkapin, tanoak, and a variety of brush species.

Harvest data from the older aged stand in Sec 3, T. 29 S., R. 11 W. (i.e., where the 1868 burn was less intense) similarly confirm anticipated results from low intensity fires or underburns. Data from previous a timber sale in that stand reveals an understory stand heavy to Port-Orford cedar and western hemlock (45%), with the remnant Douglas-fir comprising 54% of the tree stems. The process of fire succession is well documented by Agee 1993 and this pattern is consistent with current theories about fire disturbance.

Lowland riparian areas probably contained many hardwood forests of Oregon ash, Oregon myrtle, and red alder (see Section III.5, subsection-Riparian vegetation). There were no exotic weed species, nor Port-Orford-cedar root rot (*Phytophthora lateralis*).

Plant diversity includes vascular plants, non-vascular plants (bryophytes - mosses, liverworts and hornworts), lichens, and fungi. This diversity not only includes the number of species (richness), but also the genetic diversity within species, community, and ecological process diversity. It is unlikely that any plant species have been extirpated from the watershed. Historically, plant diversity within the watershed most likely remained stable over time with the species composition fluctuating depending on the age of the forest stands in the watershed. Following disturbance events many early successional species most likely invaded these disturbed areas. Once canopy closure was reached the plant diversity temporarily decreased until the stand reached an age where canopy gaps began to develop and diversity again increased.

No data is available to make an accurate estimate of the diversity and biomass of bryophytes, lichens, and fungi within the analysis area, although some assumptions can be made when comparing historic and current disturbance patterns. Current disturbance patterns are typically human caused (extraction of forest products) and tend to simplify forest conditions (such as creating a single aged stands, removing large down wood, and intense site preparation) which create definite edges. These current disturbances also occur on a more regular basis, and are repeated over shorter time frames. Historic disturbances (fire, wind, pests, and landslides) on the other hand, were generally low in intensity (the exception being stand replacing events) thus creating more of a mosaic across the landscape which in some cases maintained or enhanced forest structure through the creation of more snags, increasing the amount of large down wood, retaining live trees (both in small clumps and scattered), and creating forest gaps. Because of these factors, the diversity and biomass of bryophytes, lichens and fungi was probably higher than what currently exists in the watershed. Over time, the diversity of these species probably remained static but the biomass probably fluctuated based on disturbance events.

Naturally-caused Disturbances - Fire
Fire is assumed to be the primary disturbance which resulted in this mosaic of varied age classes throughout the Middle Fork Coquille watershed. Fires probably occurred on or about 1700, 1780, 1820, 1868 (Peterson, 1952), and 1910, based on FOI birth dates. Historically, it appears that the larger disturbances (circa 1700, c.1780, and 1868) created areas of similar aged stands covering a third or more of the 5^{th} field watershed each time. Each fire, while large, did not consume all vegetation within their boundaries. Scattered old-growth trees, snags and downed logs (remnants), and isolated pockets of older aged stands containing these characteristics remained to create the varied mosaic. The relative abundance, condition, and distribution of shrubs, hardwoods, and conifers also varied in response to the fire severity. A mosaic of fire intensities resulted in a complex landscape with gradual transitions between stands and many complex stands with varying species compositions and differing amounts of residual stand components.

A detailed field examination of stumps and stand ages is needed to determine exact fire dates. For the Oregon Coast Range, Ripple (1994) calculated a 406-year fire cycle (the same stand being burned over again). The fire frequency (a fire occurring within a given area) calculated for the Tioga Creek subwatershed for the period from 1404 to 1923 was 17 years (BLM 1996a).

Naturally-caused Disturbances - Wind
Wind has played a limited role as a disturbance factor resulting in only a few salvage sales in 1963 and 1976. For this part of the Coast Range, storms generally originate from the south and southwest. The orientation of Big Creek itself is northeast-southwest. Areas of windthrow are generally located along east-west orientations, which parallels the current understanding of how wind storms affect windthrow (Andrus and Froehlich 1992).

The 1962 Columbus Day storm resulted in a 51 acre unit in Sec. 10, 29 S., R. 11 W. (TS 63-37). According to old cruise notes, the unit contained only 25% blowdown. An additional salvage sale of 55 acres (TS 63-38) was located also in Sec. 10 and adjacent Sec. 11. The November 10, 1975 storm was responsible for the 169 acre Bear Pen Creek Salvage sale (TS 76-46). This sale is situated along a prominent ridge system within the analysis area and was largely unharvested at that time. A 10 acre sale (TS 91-303) was also located along this ridge system in Sec 5, but cannot be associated with a large wind storm. Recently, the December 12, 1995 storm, has resulted in a small 5 - 10 acre patch located along an exposed high ridge in Sec 10 & 11, T. 29 S., R. 11 W.

Fine scale disturbance

Fine scale disturbances like individual tree and patch blow down, low severity fire, insects, disease, drought, and soil movement create small gaps throughout the landscape. In addition to these agents, riparian vegetation is also modified by flooding, stream bank erosion, and saturated soils. These disturbances are present, but a determination of their frequency or scale was not conducted due to their limited large scale impacts. Most stands were influenced by combinations of all these disturbance processes, occurring at varying frequencies and unevenly distributed throughout the stand and the subwatershed. These natural processes created a landscape which provided vegetative complexity and diversity at a variety of scales.

Insect and disease - Laminated root rot and black stain disease can kill patches of sapling and pole size trees. Bark beetles usually kill trees already weakened by other agents like drought, fire or disease, but may become epidemic following extensive fire or blowdown. Other pathogens and insects attack trees in this analysis area but none are known to cause significant mortality in established stands.

Land slides - Land slides usually affect only small areas at a time but the severity of that disturbance can be very high. Landslides result in the loss of the top soil and organic layer at their point of origin. Where they come to rest, they bury developed soil profiles with material that is predominantly subsoil and fractured rock. In extreme cases, all soil is lost down to bedrock. The loss of the organic layer and top soil to landslides sets back plant succession, and favors pioneer species. Red alder is particularly successful in occupying slide tracks and deposits because of its small winged seed facilitates long distance disbursal, rapid juvenile growth, and ability to fix nitrogen. From the stand point of red alder's regeneration strategy, fresh road cuts and fills provide the same conditions produced by landslides. Landslides that reach the creek can deliver structural material (woody debris, and boulders), gravel, fine sediment, and fine organic matter.

Floods - Like landslides, floods affect only a small part of the landscape but it too is a significant process. Flooding can kill or damage vegetation by burying small plants under sediment and breaking plants with brittle stems. Flooding affects the species composition on the flood plain by killing plants that do not tolerate saturated soils. This frees growing space for those plants that have mechanisms to survive saturated soil conditions or can regenerate on sediment deposits.

CURRENT CONDITIONS

As interpreted from 1943 aerial photos, approximately 20 - 25 % of the analysis area already had been harvested, either clearcut or partial cut. The main access roads through the area were already constructed by this time. Areas of harvest were concentrated along Big Creek itself, private timber company lands in the South Upper Big Creek drainage, the 1932 fire along the Elk Creek divide, and the 1936 fire adjacent to the Weaver Ridge Road. Human activities have altered 74% of the analysis area, resulting in a significant change in the age composition of plant communities. General information on the present distribution of age classes throughout the analysis area can be found in the Section I - Characterization and Figure I-10.

Vegetation Diversity

There are approximately 230 vascular plant species representing 70 plant families (Appendix F-3) documented or suspected (species with habitat present and ranges that overlap the watershed) to occur within the analysis area. This is a conservative estimate for the number of species since some genera (such as *Carex*) may have many species present in the watershed.

Exotic vegetation now comprise approximately 20% of the watershed flora (43 species). Most of these have been purposely introduced for various reasons and are associated with roads and disturbed areas. While most of the introduced vegetation does not persist over a period of time, some species, such as orchard grass (*Dactylis glomerata*), blackberry (*Rubus* sp.), and tall fescue (*Festuca arundinacea*) have the ability to spread and potentially displace native vegetation. (see the following subsection on Noxious Weeds)

Across the landscape (including private land), early seral habitats are more common than late-seral habitats and there is little difference among watersheds in the Middle Fork Coquille River system (adjacent watersheds look fairly similar). The historical large blocks of similar aged stands have been replaced with a highly fragmented pattern characterized by hard edges (distinct contrast between adjacent stands) and small patch size (on the order of 40 acres). During the 1970's and 1980's the Bureau restricted clearcut size to approximately 40 acres, and attempted to distribute their locations so that adjacent areas were at least 10 years old. The belief at that time was that this practice would benefit wildlife due to the resultant edge-effect (Thomas 1979). On private lands, larger areas were clearcut areas, and clearcuts were often adjacent to the previous years harvest, resulting in larger tracts of land uniform in age.

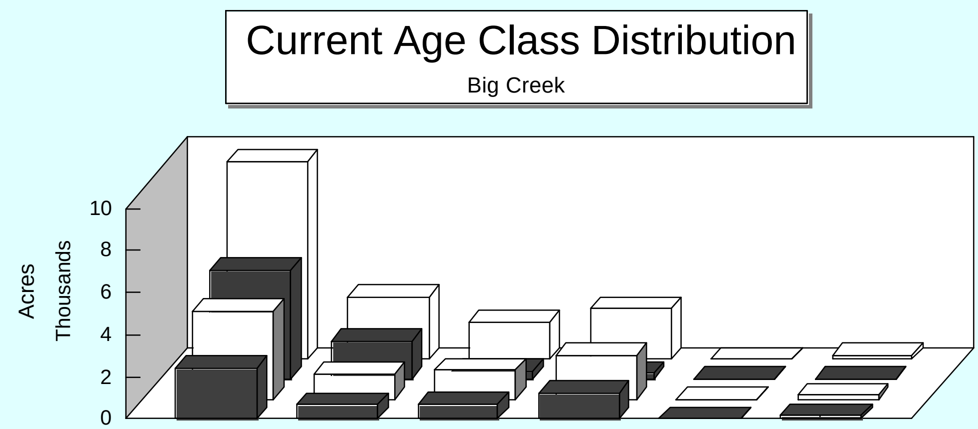
It is estimated that over 300 species of bryophytes and lichens probably occur within the watershed. The diversity of fungi is unknown but probably exceeded 500 species. It is unknown how these estimations compare with historical conditions. Overall the biomass of these species is most likely less than historic conditions with the increased forest activities within the watershed

Abundance

Age distribution of the area can best be characterized by young stands (<= 40 years of age) covering 56 %, mature stands covering 25 %, and old growth forests (> 200 years of age) occurring on only 1% (Figure III.5-2). Only 20 %of the area is in what could best be described as ‘pole-timber’ (41-80 years).

Age distribution on BLM lands is roughly similar with the two largest age groupings being the young stands (46 %) and mature timber (35 %). The age class distribution in Reserve areas mirrors that of the watershed as a whole.

Figure III.5-2 Current age class distribution of forests in Big Creek



Forest Age Class	0-40	41-80	81-120	121-160	161-200	200+
■ Reserve Areas	2451	668	728	1252	7	166
☐ All BLM	4179	1184	1369	2102	13	169
■ Private Lands	5186	1794	381	278	0	0
☐ All Lands	9365	2978	1750	2380	13	169

Based on 1997 FOI

On private land, cursory aerial photo interpretation suggests that only about 40 acres has not yet been harvested; therefore, old growth forest habitat is virtually absent from private land. Private land is primarily managed for timber production or livestock grazing and will likely never provide significant amounts of late-successional or old growth forests.

Special Status Plant Communities

Special status plant species currently known within the watershed include one occurrence of California globe mallow (*Iliamna latibracteata*) occurring along Big Creek Road just below the junction with Road No. 28-10-31.0. This species is currently at the northern extent of its range. The population size at this location is under 10 plants.

Special status plant species are those that are of concern because of their rarity and/or threats. These species include those listed as Endangered or Threatened under the Endangered Species Act, federal candidates, state listed species and BLM sensitive species (Bureau sensitive, Bureau assessment, and Bureau tracking). Each list of species has its own management requirements.

No formal inventories have been conducted for bryophytes, lichens and fungi (Survey and Manage and Protection Buffer species) within the Big Creek watershed. Any locations of these species in the watershed are found when conducting other inventories. Although many of these species potentially could occur in the watershed, the only known occurrences of these species are *Usnea longissima*, *Lobaria oregana*, *Pseudocyphellaria anthrapsis*, and *Sarcosoma mexicana*. The first three species have been found in older stands within the watershed while *Sarcosoma mexicana* have been located in northwest corner of Section 10, T.29 S., R.11 W. Of these, only *Sarcosoma mexicana* requires any specific management. This species is a protection buffer species and results in adding unmapped areas to Managed Late-Successional Areas. Specific management for this species is included in Section IV.1 Recommendations.

Human-caused Disturbances- Logging

Logging has had the most impact on vegetation since the 1940's. To date, 44% of BLM's ownership has been harvested compared to 99% of private ownership (Table III.5-1). Aerial photography reveals that private landowners harvested over 40 % of their ownership by the late 1950's. Since then, harvest from both private and BLM lands has been relatively stable each decade.

Table III.5-1 Logging Disturbance by Decade

BLM Ownership** (includes Coquille Tribal Forest) (10,068 ac)			Private Ownership (6,593 ac)		TOTAL (16,661 ac)
Decade	Acres harvested	% of Federal ownership	Acres harvested	% of PVT ownership	
1930's & 1940's	602	6 %	2206	23 %	17 %
1950's	754	8 %	1911	20 %	4 %
1960's	954	10 %	1372	14 %	14 %
1970's	856	8 %	813	8 %	10 %
1980's	1297	13 %	247	3 %	9 %
**1990 to 1992	1170	12 %	***699	7 %	11 %
Totals	5638	56 %	7248	99 %	73%

*** includes second rotation harvest of areas previously harvested in 1940's and 1950's

The District policy to salvage of dead or dying trees during the mid-1960's to early 1970's was concentrated in only a few sections. Documentation of timber harvest showed that salvage sales occurred throughout Sections 28,29,33, & 34, T. 28 S., R. 10 W.; Sections 3 & 5, T. 29 S., R. 10 W.; and limited areas in Sections 10, 14, & 15, T. 29 S., R. 11 W. In addition, it was common practice on timber sales during the 1970's to fall or harvest dead trees within 200 feet of roads or the boundaries of clearcut units. Therefore, in the remainder of the analysis area, most snags and down logs within remnant stands may be at or near natural levels (refer to III.6 Species & Habitat).

A portion of Sec. 9, T. 29 S., R. 10 W. was commercially thinned under the Sandy Bear-Pen Thinning Sale No. 70-47.

Because of the early harvest of private lands, logging of the second rotation of timber has begun, most notably in Secs. 31 & 32, T. 28 S., R. 10 W. and Sec. 4, T. 29 S., R. 10 W. This pattern is expected to continue for private ownership as the timber stands reach 40 to 50 years of age. As part of their forest management practices, herbicide application to control noncommercial species generally occurs within the first 15 years following harvest. Fertilization of older stands may also occur.

Human-caused Disturbances- Fire

There have been several human-caused fires within the analysis area since 1931 based on documentation from the Oregon State Board of Forestry (Figure III.5-3). Typically, these fires were small (1000 acres or less) and incendiary in origin (Appendix B-1). All of the fires occurred between August to October and were more frequent during the 1930's, as these were drought years. Surprisingly, there was no documentation of fires attributed to lightning, including those less than 10 acres in size. Wide scale fires due to lightning in the Coast Range are rare. The probable cause of the 1868 stand replacement fire, as well as others occurring in the mid 1800's, was European settlers (Zybach 1993).

SYNTHESIS & INTERPRETATION

General discussion the effects of natural and human disturbance processes on vegetation are found in Appendix B. How these processes specifically influence the analysis area is discussed below:

Disturbances

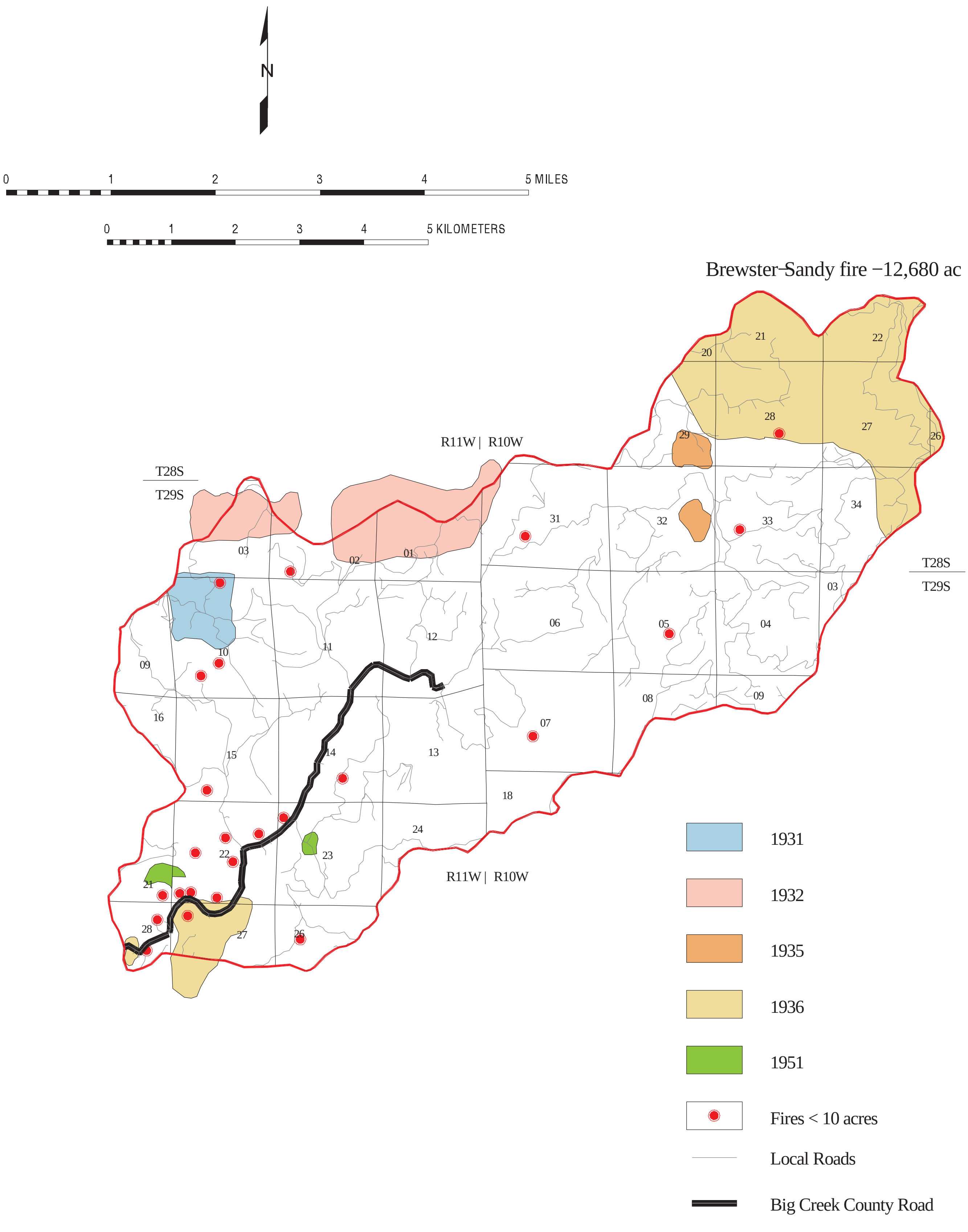
The likelihood of widespread disturbance due to wind is relatively low. The analysis area appears to be protected from large scale windstorms by the ridge systems (Bone Mtn., Eden Ridge, White Mtn.) to the south. Some localized, small scale, windthrow can be expected along exposed ridgetops. The probability of large scale fires due to lightning or human activities is also relatively low. Lightning caused fires are infrequent for this part of the Coast Range. The combination of an efficient transportation system with the proximity of the analysis area to the Coos Forest Protection office in Bridge, Oregon, results in a fast response to extinguish fires before the can grow to any large size.

Vegetation diversity

Plant diversity has probably remained relatively the same over time with minor fluctuations based on the amount of and time since the last disturbance event (natural- or human-caused). There appears to be no vascular plant species restricted entirely to late-successional forest conditions although some species reach their highest biomass in these communities, such as some mycotrophic plant species (Franklin et al. 1981). While some studies (Habeck 1968, Schoonmaker and McKee 1988) indicate that early successional stages have a higher plant species diversity, data from Spies (1991) indicates that species diversity may be higher in older forests (this is especially true when bryophytes, lichens and fungi are included).

An often overlooked component of plant communities include bryophytes (mosses and liverworts), lichens, and fungi. These species are not thought of being important in forest ecosystems, because of their small size and inconspicuous nature. In spite of this, these species have many important ecological roles within temperate forest ecosystems. It is estimated that

Figure III.5−3 Location of Human Caused Fires since 1931



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for every two acres of temperate forests, the biomass of epiphytes alone is one ton (Moffett 1997). Nadkarni (1984) determined that the mineral content of epiphytic bryophytes on bigleaf maple trees exceeded the biomass of the tree's foliage.

Bryophytes are found on all substrates (rock, soil, dead wood, and tree trunks and branches) and occur in all stages of forest development. Many species are restricted to specific microhabitats and substrates, such as the upper sides of tree branches in the upper canopy. These species have their greatest biomass and diversity in older aged forests. Studies (Norris 1987, McCune 1993) have shown that bryophyte biomass and diversity is significantly lower in younger forests. In logged over areas, some species do not appear until the forest reaches 100 years old (Norris 1987). As with vascular plants there appears to be a definite successional pattern of bryophyte species as a forest matures.

Bryophytes play important roles in the maintenance of ecosystem stability including regulating water relations and nutrient cycling. They also provide food and habitat for many invertebrates and vertebrates, maintenance of forest stream ecosystems, help increase soil stability, and providing a seed bed for many plant species.

Although lichens occur on all substrates, the species of most concern are those which occur on live trees (epiphytes). Like bryophytes, most lichens require specific environmental conditions (the physical and chemical nature of the substrate, wetting and drying frequency, temperature regimes, and light) in order to survive and appear to have definite successional patterns as a forest matures (Lesica et al. 1981). Studies have shown that lichen biomass and diversity increase with forest age (Neitlich 1993).

Until recently, fungi have had a negative image in a product-oriented society that equates disease and decay with the destruction of a resource which yields goods and services for humans. Fungi are now being looked upon as important species in the maintenance of forest ecosystems. In the Pacific Northwest, fungi are extremely diverse. Hawksworth (1991) estimated there are at least six species of fungi for every vascular plant species. Fungi occur in a variety of substrates including soil, needle duff, dead wood, and closely associated with the roots of most vascular plant species (mycorrhizal).

Fungi profoundly affect nearly all ecological processes and events, either directly or indirectly, which occur in coniferous forest ecosystems (Trappe and Luoma 1992). Ecological roles that fungi have include, mycorrhizal associations with nearly all woody vegetation which aids growth and in some cases protection from diseases, nutrient cycling (saprophytic fungi), soil aggregation, food webs, and diseases, such as *Phellinus*, which helps create forest gaps thus increasing forest complexity. Some arboreal rodents are mycophagists and play important roles in the dispersal of certain fungi spores (Carey 1991).

While the age of the forest is important in determining the biomass and diversity of bryophytes, lichens and fungi, it probably is a result of many environmental and structural factors associated with older, mature forests. Older forests typically have greater canopy structure which provides more available and stable substrates, aids in air circulation, therefore ameliorating the relative humidity (lichens are unable to tolerate continuous high relative humidity (Goward 1992)), have greater amounts of large woody debris in all decay classes, and a higher diversity of tree species

(Franklin et al. 1981, Spies and Franklin 1991). Therefore, it appears to be these habitat features associated with older forests and not stand age that influence the bryophyte and lichen diversity and biomass. It is quite possible for a younger forest with these habitat features to have a greater diversity and biomass of these species than an older aged forest.

The simplification of forest ecosystems through past intensive forest practices most likely has lead to a reduction in bryophyte, lichen and fungi diversity and biomass across the watershed. This reduction also results in losing the important ecological roles that these species have in these ecosystems. Recently there have been some efforts by Tappenier and others to look at how some forest activities (thinning, density management) may increase the diversity of the these species in younger aged forests. Again, the direct cause of increased diversity and biomass of these species is not stand age, but the characters associated with older forests. If we can create some of these habitat characteristics in younger forests we may be able to maintain these species across the landscape. The creation of forest gaps, retention of green trees, snags, and large woody debris retention are important habitat components for these species. Work by Neitlich (1995) has shown some promising results that the diversity of these species can be maintained for younger age classes.

Trends

With 56% of BLM lands in a ‘Reserve’ land allocation and an additional 15% being managed at a 150 year rotation, plant communities associated with late-successional forests will be well represented throughout the analysis area over time. Eventually, most Reserve areas will be in late-successional forest condition and most GFMA areas will be age classes <= 60 years of age (early and mid-successional). Age class projections show a steady increase in the amount of 80+ year old stands each decade until all Reserve areas reach this age. Acreage in stands >40 years of age increases steadily until the year 2037 when BLM-administered land reaches an equilibrium with around 82% of BLM lands in this age class. No stands enter the 200+ year old age class until 2057 (Appendix C, Figures C-1, C-2, & C-3). A small portion of Reserve areas may be affected by varying intensities of natural and forest management disturbances.

Private lands and those BLM managed lands designated as GFMA will be maintained in an early to mid-seral stage (40-80 yrs. old) depending upon ownership and timber market conditions. If private lands are managed on 60 year rotations, age classes may be fairly evenly split between 0-20, 21-40, and 41-60 year age classes. Coquille Forest lands will be managed consistent with the Northwest Forest Plan and may maintain age class distributions similar to BLM-administered land.

Influences and Relationships

The landscape will become less fragmented in Reserve areas as vegetation matures and the contrast between edges decreases. By concentrating harvest units in space and time, and if harvest areas mimic past natural disturbances, fragmentation also has the potential to decrease on GFMA lands. Some edge effects will continue to result where harvest areas abut Reserves (see Section III.6 - Species & Habitats).

The combination of fire and salvage logging of snags and down logs has greatly reduced the availability of these habitat features for wildlife (see Section III.6 - Species & Habitat).

It is not fully understood what impact the introduction of non-native grasses and forbs has had. Some early seral species have benefitted from their presence and surface erosion has been reduced, but the long term effects on the ecosystem are unknown.

Even with the trend towards removing the vegetation at regular intervals (60 year harvest cycle), it appears that surface erosion from harvesting should be within an acceptable rate, especially from BLM lands due to the filtering effects of the Riparian Reserve network. Harvest areas rapidly revegetate with sufficient ground cover to limit surface erosion. Riparian Reserve areas adjacent to streams will act to filter out sediment (see Section III.8 - Riparian Reserve Evaluation).

It could be assumed that elevated peak flows would continue as approximately 60% of the analysis area would be harvested on a 60 year rotation. Stands less than 30-40 years of age are not up to their full evapotranspration potential (see Section III.4 - Water Quality)

<u>Management Objectives</u>

With BLM's current management direction it is not likely that historic patterns of vegetation can be restored on non-Reserve designated lands. GFMA lands will be managed for timber production and early seral species. Forest practices under the Standards and Guides incorporates some of the key structural components produced by natural disturbance processes (ie., snags & down logs, species mixes, and landscape patterns). These objectives may also provide some benefit for mid and late-seral species. Silvicultural practices, such as precommercial thinning, commercial thinning, release treatments, hardwood and brushfield conversions, can be used to promote stand vigor, species mix, diversity, and fully implement ecosystem management.

Native plant diversity (including genetic, species, and community diversity) should be maintained over time. The extirpation of native plant species from the watershed should be viewed as a irreversible and irretrievable loss of a resource within the watershed. The management objectives for these species should be an attempt to maintain the diversity and biomass across the landscape to the extent practical. Future planning of forest activities should consider the potential impacts to these species and way to create habitat features for the benefit of these species.

Within Reserve areas, it is desirable to strive towards late-successional forests with old-growth characteristics.

RIPARIAN VEGETATION

<u>Analysis Questions:</u>

What is the historical array and landscape pattern of riparian plant communities and seral stages in the analysis area?

What processes are important in shaping/maintaining riparian vegetation?

Is there adequate riparian canopy closure to maintain desirable stream temperatures for aquatic organisms?

Is there adequate potential for recruitment of down wood to streams and riparian areas?

What components of riparian vegetation are important to maintain water quality and habitat quality for aquatic and riparian dependant species?

What are the influences and relationships between vegetation and other ecosystem processes (e.g., hydrologic maturity, channel stability, disturbance, species movement, soil and erosion processes, etc.)?

What are the current conditions and trends of the prevalent plant communities and seral stages in the watershed (riparian and non-riparian)?

What is the management objective (desired condition) for riparian vegetation in the analysis area?

What management actions (restoration, maintenance, protection, etc.) could be undertaken that would maintain and/or restore the integrity and productivity of the riparian habitat within the analysis area? (see Section IV - Recommendations)

REFERENCE CONDITION

Historical riparian vegetation may be classified into two somewhat distinct types: lowland (inhabiting floodplain terraces along the Middle Fork Coquille River and the lower 5 miles of Big Creek-up to the mouth of Axe Cr.) and upland communities (inhabiting Big Creek above the mouth of Axe Cr. and along the higher-gradient tributaries of Big Creek).

Lowland Communities-No historical data or pre-human impact aerial photos exist for riparian vegetation along Lower Big Creek. However, it is possible to make generalizations about historical conditions based on knowledge of processes affecting lowland riparian vegetation. Typically, lowland vegetative communities are structured and maintained by the interaction of the stream channel with the floodplain. Vegetation in the floodplain and riparian zone respond to soil composition, structure, moisture content as well as to riparian disturbance (flood innundation, scour, deposition) (Mitsch and Grosslink 1993). Vegetation may also be affected by the construction of dams and diversions by beaver which raise the water table, trap sediments on streambanks, and create side channels. Thus, lowland riparian vegetation typically consists of moisture-tolerant and disturbance/colonizer species such as shrubs and low-growing woody vegetation (such as willow, vine maple), and hardwoods such as alder, ash, maple and myrtle (Mitsch and Gosselink 1993, Franklin and Dyrness 1973). Historical and anecdotal accounts of vegetation along the M. Fk. Coquille river support these generalizations, suggesting that at the time of first settlement, lowland areas were dominated by mixed hardwood stands of myrtle, maple and ash, with widely dispersed cedar (Stickroth 1992, BLM 1997a). Lowland riparian vegetation along Lower Big Creek was probably very similar. Additionally, anecdotal evidence suggest there were also extensive stands of Port Orford cedar along the lower five miles of Big Creek on terraces and abandoned floodplains.

Upland Communities-The upland community is associated with the higher-gradient, hillslope-constrained reaches of Big Creek and its tributaries, as well as higher terraces along Lower Big Creek. These communities are typically structured/maintained by disturbance processes such as infrequent floods, debris torrents, windthrow, and fire. (Swanston 1991 and others). Beaver dams, sporadically present in the upper reaches, create high water tables and canopy openings adjacent to ponds.

The composition of these upland communities in Big Creek is interpreted from 1943 aerial photographs and recent examination of reference areas with relatively little or no apparent human influence. The communities fall into three categories:

Conifer-Dominated Reaches: Conifer species include Douglas fur, Western redcedar, Port-Orford cedar, Hemlock and grand fir. These reaches located along hillslope-constrained, erosional headwater streams and the upper reaches of low-order streams. V-shaped valleys, steep streambanks result in narrow or no discernable riparian “zones” (i.e., zone of hydrologic interaction characterized by hydrophilic plants). Narrow or no discernible riparian “zones.” Canopy cover is often 100%. Examples: Upper Fall Creek (Sec. 15 SW 1/4 NE 1/4), Upper Big Creek (in Sec. 28)

Hardwood-Dominated Reaches: primarily located along low-gradient, depositional reaches and in U-shaped valleys with floodplains of varying width containing recent or historic fluvial deposition. Beaver activity is common. In areas with frequent or recent fluvial disturbance, flooding tolerant species such as alder and ash are most common while longer-lived hardwoods such as maple and myrtle are found in moist terraces and protected lenses above zones with frequent flooding and innundation. Examples: middle reaches of Bear Pen Creek, lower Brownson and Swamp Creeks. Canopy cover along these hardwood-dominated reaches can be highly variable, ranging from little (in the event of recent disturbance or intense beaver activity) to 100%. Hardwood-dominated reaches may also be located along high-gradient, hillslope-constrained streams where frequent disturbance precludes conifer establishment. Examples may be seen in several unnamed small tributaries along the length of Big Creek.

Mixed Reaches: located along streams with moderate floodplains alternately constrained by hillslopes. Riparian area is a diverse mosaic of stands depending on local conditions (i.e., floodplain development, disturbance patterns, etc.). Hardwoods predominate where floodplains are well-developed; conifers predominate (with a narrow band of hardwoods immediately adjacent to the stream) where there is a little interaction between the stream channel and riparian area. Examples: Upper Middle Big Creek (Secs. 6, 31, 32). Canopy cover along these reaches is high, often completely covering the channel.

CURRENT CONDITION

Lowland Community-Impacts to lowland riparian vegetation probably began shortly before the turn-of-the-century when homesteaders began settling along the lower reaches of Big Creek. Settlers cleared riparian vegetation for grazing and cultivation and built valley-bottom roads. Additionally, crude roads (such as “plank” roads) were constructed through riparian zones along tributaries (such as Brownson Creek) to provide access for timber operations (BLM 1997a). According to a former resident of the Big Creek valley most of the riparian vegetation along Big Cr. had already been removed by farmers by 1927. In the 1930s, freshets associated with splash dams scoured and removed streamside vegetation, eliminated beaver dams and wood accumulations.

Currently, the riparian zone along Lower Big Creek is predominately agricultural and residential. Tree diversity and abundance are low (according to 1994 ODFW survey data, average no. of trees of any species and size in a 100' transect from the stream was 10.3; species other than red alder were very uncommon). In some cases, native riparian plant species have been replaced by exotics and escaped cultivars (such as Himilayan blackberry).

The stream channel in Lower Big Creek is downcut (average height of first terrace is approx. 9'). Furthermore, the channel lacks any structures (debris jams, beaver dams) substantial enough to aggrade the streambed and divert water to floodplains. As a result, interaction between the stream channel and floodplain has been eliminated along most of Lower Big Creek. Elimination of a high water table in the floodplain, combined with agriculture and residential development, has resulted in the conversion of predominately wetland, riparian vegetation to predominately dryland species.

Average canopy cover in Lower Big Creek exceeds 75%, which meets ODFW Benchmark Criteria for “good” habitat conditions. Notable exceptions may be found where grazing and agriculture have encroached on riparian vegetation. In several locations in sections 12, 14, and 16, riparian vegetation consists of only a thin strip of single trees bordering the stream.

Upland Communities: The primary impacts to upland riparian vegetation include timber harvest and road building. Clearcut harvesting (with no or inadequate riparian buffers) and repeated salvage of trees and logs have eliminated many large old-growth conifers and logs from riparian areas. Red alder is more abundant in upland areas than it was historically, particularly in areas where roads have been constructed and where harvest with ground-based systems has occurred. In some areas, selective removal of large conifer trees from “mixed” reaches has resulted in establishment of a dense myrtlewood understory, allowing the growth of few understory hardwoods or conifer.

In general, mature and old-growth confers are lacking throughout the watershed. FOI analysis indicates that roughly 58% of Riparian Reserves in the Big Creek watershed are dominated by conifers younger than 80 years; only 2.4% of Reserves are dominated by conifers 161 years or older. Comparison of aerial photos between 1943 and 1992 indicates incursion by red alder throughout the watershed, particularly along roads.

On average, canopy cover in the watershed exceeds 75%. While the average is high, there are several reaches along tributaries with little or no canopy cover. For example, Jones Creek averages only 33% and a substantial portion of Upper Swamp Creek is bordered only by shrubs and scattered alder.

SYNTHESIS & INTERPRETATION

Riparian vegetation is unique in the terrestrial ecosystem because it is shaped by both fluvial and terrestrial processes. Characteristics unique to riparian vegetation and riparian ecosystems which provide important ecological functions in watersheds include:

1. *Surface and soil moisture*: Riparian zones contain a diverse mosaic of surface soil moisture conditions which vary in time and space. These conditions range on a gradient from saturated soils and standing water beside the wetted stream channel to subirrigated sites on high terraces and inactive floodplains where seasonally high water tables recede to below the rooting zone in late summer. These assorted soil and hydraulic conditions support a diverse array of moisture-dependent plant species as well as obligate hydrophilic animals (amphibians, invertebrates, waterfowl, aquatic mammals). A variety of upland species may also be associated with the diverse or unique vegetation found in riparian zones.

2. *Diversity and interspersion of habitat features:* Riparian zones are structurally complex. They are characterized by assorted physical processes such as earth movement, deposition, erosion, disturbance, and often contain an array of terraces, old channels, down wood, snags, etc. Furthermore because riparian zones are at the interface between aquatic and terrestrial systems, they are a classic example of the ecological principle of the "edge effect" (Odum 1979). As a result, riparian plant and animal species diversity is often very high.

3. *Linear nature of riparian vegetation and riparian zones*-Riparian vegetation and ecosystems generally have a linear form as a consequence of their proximity to streams, enhancing their importance in landscape ecology. The linear nature of riparian vegetation and habitats provides protective pathways for animals. The migration and dispersal of fishes and terrestrial organisms often depends on the integrity of riparian ecosystems.

4. *Interaction of riparian vegetation with the aquatic ecosystem:* Riparian vegetation provides components necessary for stream ecosystem function, including shade, nutrients, energy dissipation, streambank integrity, and aquatic habitat structure and complexity. The interaction of vegetation and streams may be particularly important in headwater and small streams, where allocthonous inputs are the foundation for aquatic food-webs.

Over the last 100 years, timber harvest, road-building, and agricultural development in the Big Creek watershed have profoundly affected these major functional and ecological values of riparian vegetation and riparian ecosystems.

1. *Surface and soil moisture*: Management activities (particularly in Lower Big Creek) such

as stream cleaning, splash dams, and removal of streamside vegetation and large-wood inputs have increased scour, channel downcutting, and have simplified stream channels. The result has been the disconnection of the stream from its floodplain, eliminating the floodplain-water table connection and soil moisture gradients. Lower Big Creek is currently unable to support certain kinds of wetland and riparian vegetation as well as organisms requiring moist habitat conditions. Additionally, the capacity of riparian systems and stream channels to store moisture (and subsequently maintain summer base flows) is greatly diminished.

2. *Diversity and interspersion of habitat features:* Interruption of stream channel-riparian zone interaction, removal of riparian vegetation and down wood, diminished contribution of large materials from landslides, and road building have reduced structural complexity in riparian zones throughout the analysis area. In some cases, however, management activities have resulted in a more pronounced "edge effect" between riparian and upland vegetation because the riparian vegetation areas contain the only remaining trees following timber harvest.

3. *Linear nature of riparian vegetation, riparian zones:* Throughout the watershed, harvest and road-building in riparian areas have disrupted the continuity of riparian ecosystems. This process has been exacerbated by land-ownership patterns in the drainage. For example, riparian reserves adjacent to Big Creek which are dominated by conifers $\geq$ 80 years old exist only on federally managed land. These older reserves are separated by long reaches of much younger trees. Riparian fragmentation is also apparent along Fall, Axe, and Brownson Creeks. Fragmentation and disruption of riparian vegetation reduces its utility for migration and dispersal of fish and wildlife.

4. *Interaction of riparian vegetation with the stream:* Management activities along streams in the watershed which reduced the abundance, size, or diversity of vegetation have subsequently reduced inputs from riparian zones to the aquatic ecosystems. Harvest of conifers has removed large wood inputs, reducing habitat complexity and energy-dissipating structures in the stream channel. Widespread elimination of riparian vegetation in the watershed has resulted in higher water temperatures in lower mainstem Big Creek.

In addition to reducing the *amount* of wood inputs, management activities have changed the *nature* of inputs. For example, down wood in analysis area streams is now composed predominately of hardwoods (which tend to be smaller and have a much shorter lifespan in the stream than do conifers). The predominance of hardwoods and brushy species in riparian zones previously dominated by conifers alters the nature and amount of nutrient inputs. Deciduous shrubs and trees typically contribute greater amounts of organic litter to streams than do conifers, and deciduous litter is often the preferred food source of aquatic shredders (Anderson and Sedell 1979). However, the beneficial effects of increased nutrient inputs from a hardwood-dominated riparian zone will not be realized if insufficient instream structure (caused by lack of large wood in the channel) prevents retention of these added nutrients.

Management Objectives

The management objective for riparian vegetation in the Big Creek subwatershed is threefold:

- The first is to re-establish, to the extent possible, dynamic, hydrologic interaction between stream channels and riparian zones. This connection is required in order to re-establish soil moisture, substrate conditions, and disturbance regime necessary to maintain many riparian species historically present, such as ash, willow, and hydrophilic shrubs and forbs. This condition will support diverse riparian plant and wildlife species

- The second is to re-establish historic vegetation assemblages to the extent possible. Specifically, lowland riparian areas would consist of mixed hardwood stands, with scattered conifers on raised “lenses,” extending from streamside to the edge of the floodplains and flood-prone terraces. The understory would include a lush profusion of native shrubs and herbacious species. Upland riparian systems would consist of narrow bands of hardwoods in the zone of hydrologic interaction between stream channel and riparian area, with a dominance of conifer and scattered hardwoods in the outer riparian overstory. The understory would include a mixture of native shrub species varying with site conditions.

- The third is to re-establish connectivity between and among riparian systems throughout the watershed. Explore the possibility of cooperative riparian projects among BLM, Big Creek watershed landowners, and the Coquille Watershed Association which focus on re-establishing missing vegetation. Projects such as these would provide connectivity across sections where riparian vegetation has been removed.

PORT-ORFORD CEDAR

Analysis Questions:

What is the current distribution and level of infestation of POC root-rot in the watershed?

What is the potential for the continued introduction and spread of the disease?

What ecological processes would be altered should POC be lost, or populations greatly reduced in the ecosystem?

What management actions (restoration, maintenance, protection, etc.) could be undertaken that would reduce the spread or help prevent the introduction of the disease into new areas?

REFERENCE CONDITION

Port-Orford cedar (*Chamaecyparis lawsoniana*) has historically been a component of the forests within the analysis area. It can comprise up to 30 % the forest stands, but is found in a codominant to understory position.

CURRENT DISTRIBUTION

Phytophthora lateralis, Port-Orford cedar root rot, was unintentionally introduced in the northwest as early as 1923, causing in some cases, 100% mortality. The spores of the fungus, being highly mobile in water, travel downstream infecting previously uninfected areas. Spores also are transported by construction equipment, vehicles, man and animals.

A systematic survey to identify all locations nor the severity of the disease is currently being undertaken within the Resource Area, but has not been completed in the analysis area as yet. Figure III.5-4 shows infected locations based on informal roadside surveys.

SYNTHESIS & INTERPRETATION

Potential

The disease will continue to be spread throughout the watershed given the climatic conditions and the methods of spread. As water is the major method of transporting the spores through the soil and into the stream network, the disease will spread downslope from current infected sites. Humans, animals, equipment, and vehicles transport infected soil to uninfected areas. Areas adjacent to roads are common points of infection. Some spread occurs from root contact between trees.

Current thought is that there appears to be some variation in resistance to the disease by individual POC trees. The level of infection within an area appears to be correlated with resistance.

Ecological Processes

Because of the prolific seeding capability of POC (Goheen 1996), the tree species will continue to be present in the ecosystem (Zobel 1985), though that population maybe at a reduced level. It is thought that POC occupies a similar ecological role as Douglas fir (Franklin and Dryness 1973), so the ecological role it holds will not disappear altogether. However, reduction from historic levels will undoubtably have some affect on stand diversity.

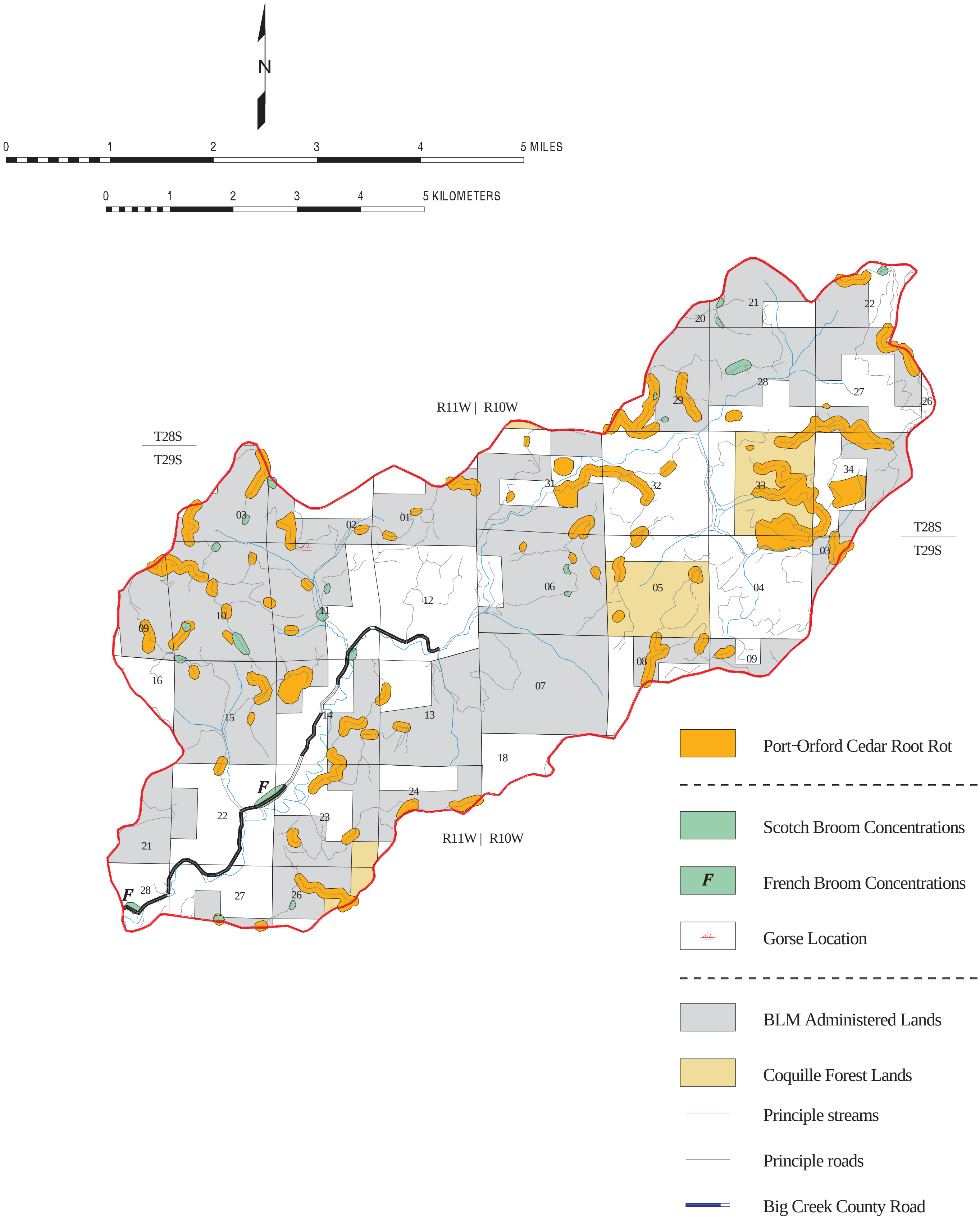
Management Objectives

The overall objective is to maintain the presence of POC within the watershed by reducing the rate of spread of infection, isolate and treat infected areas, and prevent infection of healthy areas. Strategies for management of POC root disease are listed in the BLM's, 'Port-Orford Cedar Management Guidelines' (BLM 1994b). These guidelines include: washing of vehicles/ equipment prior to operating in uninfected areas, timing of projects for drier seasons of the year, and requiring roadside sanitation treatment by removing POC. Infected riparian reserves within the watershed which are adjacent to roads can be treated by cutting of POC. Infection centers in headwall regions of a riparian zone can be treated by establishing a POC free zone of at least 50 feet around each infection center.

Salvage operations to remove infected or non-infected POC (in infected area) must adhere to the 'Port-Orford Cedar Management Guidelines' which state that steps must be taken to reduce the probability of introducing *Phytophthora lateralis* PL into uninfected areas. Substitution of down logs with other POC or other species is not consistent with this strategy.

Research is currently being conducted to test POC trees that appear resistant to *Phytohthora lateralis*. Those found most resistant will be placed in a seed orchard for propagation and eventually will be out- planted. Some randomly collected POC has been planted in seed

Figure III.5−4 Infected Port−Orford Cedar and Noxious Weed Concentrations



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orchards in an early attempt to preserve genetic material. POC treatment recommendations will be made for each action within the watershed area.

NOXIOUS WEEDS

Analysis Questions:

What is the current status of the spread of noxious weeds in the analysis area?

What is the potential of noxious weeds to spread and impact the analysis area?

What management actions (restoration, maintenance, protection, etc.) could be undertaken that would reduce the spread or help prevent the introduction of the disease into new areas?

REFERENCE CONDITION

Noxious weeds and other exotic vegetation did not exist until after white settlement began in the area. Most exotic species were introduced into southern Oregon during the late-1800's to mid-1900's and have since spread from their source of introduction. Therefore, it may have taken many years for these species to reach this watershed. Some of these species did not establish themselves until more areas were disturbed by human activities and propagules were transported in from infested areas.

CURRENT CONDITION

Noxious Weeds - Currently, noxious weeds are known throughout the watershed but at this time appear to generally occur as scattered populations (Figure III.5-4). There are 31 documented occurrences of gorse (*Ulex europaea*), Scotch (*Cytisus scoparius*) and French (*Genista monospessulanus*) broom within the watershed (Table III.5-2). This information is based on data up to 1994 and recent surveys along the main roads.

Table III.5 -2 Noxious Weed Occurrences of French Broom, Scotch Broom, and Gorse within the Analysis Area.

Noxious Weed	# of occurrences
Gorse (*Ulex europaea*)	1
French Broom (*Genista monospessulana*)	2
Scotch Broom (*Cystisus scoparius*)	28

Four of the these sites are known from along roads adjacent to private lands. Some of these sites have had prior treatments, such as pulling and some herbicide treatment. Most populations are at the level where manual treatments would be somewhat effective.

Occurrence data for tansy ragwort (*Senecio jacobaea*) and Klamath weed (*Hypericum* *perforatum*) are unknown, but generally consist of low numbers that inventories have not been conducted. Also, these species are effectively controlled by biological agents and are deemed at levels where they do not pose any resource risks.

All of the gorse and broom populations are highly associated with roads. The majority of the populations are under 100 individual plants with only four sites having population sizes over 100 plants. One large occurrence of French broom occurs along Big Creek County road just prior to the junction of Jones Creek road (29-11-23.0) and has the ability to act as a seed source for the rest of the watershed. French broom, in recent years, has rapidly spread throughout Coos County at rates much faster than gorse and Scotch broom.

It is likely that new weeds may become introduced (either unintentionally or intentionally) in this and other watersheds in the future.

SYNTHESES & INTERPRETATION

Noxious weeds have the ability to out compete and possibly eliminate native vegetation by competing for water, sunlight, soil nutrients, and space. The two broom species and gorse have the ability of fix-nitrogen (i.e. able to take it out of the air) therefore they are able to establish on nutrient poor (disturbed) sites. This adaptation also gives these plants an advantage over native species. Indirectly, these species may impact wildlife species (if infestations become large) by creating less desirable forage and reducing habitat quality. Very few wildlife species appear to utilize these species.

Gorse and broom species have seeds which can remain dormant for many years (possibly up to 70-80 years, if under optimum conditions). Therefore, if areas are infested following logging, there is a likelihood that these species could eventually disappear (when canopy reaches closure) only to reestablish once the stand is logged in the future. This is more likely to occur in stands with shorter rotations (60-80 years), such as matrix and private lands.

The current conditions for noxious weeds indicate that these areas are still treatable. The occurrences are scattered and not very dense at this time. Without any management, weed populations will increase in the future, primarily along road corridors. Besides the infestations within the watershed, there is the possibility of spreading weeds into and from adjacent watersheds. The Sandy Creek watershed, immediately to the east, has a bigger noxious weed problem which potentially poses a risk to Big Creek from vehicles transporting seeds from one watershed to another.

Management Objectives

The goal for noxious weed management within Big Creek watershed is to manage noxious weeds populations where they don't pose a risk to resources. Currently, the level of infection lends itself to efficient control, if action is undertaken promptly. It is practically impossible, and under tight budget constraints impractical, to remove these species from a watershed, but continued management can keep them at levels where the risk of spread is low. The current situation in this watershed indicates that effective management actions for noxious weeds will keep them at acceptable management levels. The further introduction of non-native plant species should be kept at a minimum.

III.6 CORE TOPIC - SPECIES & HABITAT

TERRESTRIAL HABITAT

Analysis Questions:

What are the key habitats in the watershed?

What was the historical condition, pattern, and distribution of key habitats in the watershed?

What is the current condition, pattern, and distribution of key habitats in the watershed?

What is the current open road density, and how does it compare with goals from the RMP?

What is the function of the analysis area within the larger 5th field watershed?

What are the influences and relationships of key habitats with other ecosystem processes in the watershed?

What are the management objectives (desired condition) for the wildlife habitat in the analysis area? How should habitat types be arranged (spatially and temporally)?

What management actions (restoration, maintenance, protection, etc.) could be undertaken that would maintain and/or restore the integrity and productivity of the wildlife habitat within the analysis area? (refer to Section IV - Recommendations)

REFERENCE CONDITION

Key Habitats
Key habitats and habitat elements in the analysis area include vegetative complexity, late-successional forest, landscape patterns (including roads), snags and down logs, and rocky habitats. These key habitats and habitat elements represent a composite of the following:

1. Habitats used by wildlife species of concern (Terrestrial Species Table III.6-4 and Appendix C, Table C-2).
2. Habitats that are relatively scarce in the landscape.
3. Key elements of habitats that affect many species and guilds

Refer to Section III.5-Vegetation for a description of historical and current stand conditions, including age-class distributions. Further discussion of wildlife habitats will focus on the key habitats and habitat elements listed above.

CURRENT CONDITIONS

Vegetative Complexity
On the Coos Bay District, the systematic forest inventories needed to accurately evaluate the

abundance and distribution of key vegetative and structural forest components have not been conducted. As a result, only a general analysis of forest complexity and its effects on wildlife can be presented at this time. These inventories need to be conducted to facilitate more detailed future analysis.

The majority of the area (74%) supports second growth plantations less than 80 years old and pastures/meadows. Conventional methods of logging, site preparation, regeneration, and stand maintenance encourage development of even-aged, homogenous stands of Douglas fir. The result is a vegetatively and structurally simplified landscape with one or two-storied stands (not multi-storied) that are fairly devoid of legacies (remnant green trees, snags, logs).

The remaining 26% of the analysis area supports a combination of small mid and late-successional forest patches, found almost exclusively on BLM administered lands. From a habitat perspective, these stands are vegetatively and structurally complex, containing canopies of much greater volume and habitat complexity than the single storied, uniform canopies typical of many plantations. These complex stands support a greater abundance and diversity of birds, bats, rodents, invertebrates and other species which forage, roost, or reproduce in the canopies. However, the small size of these patches may limit their value for some species.

<u>Late-successional Forest Habitat</u>

Several wildlife species of concern (Table III.6-4) prefer to use old growth forest habitat. LSRs and other Reserve areas are expected to provide old growth habitat for associated species in the long term; however, in the short term, many of the Reserve areas do not currently contain late-successional forests. Table I-3 indicates that 40% of BLM lands in the analysis area contain stands >80 years of age and 25% contain forests >160 years of age. Old growth forests, those > 200 years of age, currently occur on < 2% of the analysis area (all on BLM-administered land). The age class distribution in Reserve areas mirrors that of the watershed as a whole. On private land, cursory aerial photo interpretation suggests that all private forests are < 80 years of age (Table III.5-1). Private land in the analysis area is primarily managed for timber production or livestock grazing and will likely never provide significant amounts of late-successional or old growth habitat. Therefore, this type of habitat will eventually be only be located on the Reserve land allocations on BLM lands and the Coquille Forest. Opportunities may exist to encourage development of late-successional or old growth habitat within Connectivity lands.

<u>Snag/Down Log Habitat</u>

In natural forests of the Oregon Coast Range, snag and down log abundance was highest in stands which had recently experienced a severe fire. Mid-seral stages often have fewer snags and down logs, because the trees in the regenerating forest were too small to contribute (Spies et. al. 1988). Table III.6-1 shows mean numbers of larger snags and down logs found by Spies et. al. (1988) and Ursitti (1991) in the Coast Range.

The analysis area likely faces a shortage of snag and down log habitat because of the minimal acreage of older stands present and because of past harvest, salvage, and snag falling contracts in the 1940s-60s. BLM inventory data from harvest units in the Middle Fork Coquille watershed indicates that <u>approximately</u> 26 lineal feet/acre remain on units harvested 1988-1993.

Table III.6-1 Average numbers of snags/acre and volume of down logs/acre (all decay classes) in naturally regenerating stands in the Coast Range (from Spies et. al. 1988, Ursitti 1991). [$\pm$ 2 standard errors]

	Young (40-70 yrs old)	Mature (80-120 yrs old)	Old Growth (200-525 yrs old)
# snags/acre >20 in. dia. and 16 ft tall[1] [range]	1.6 [0 - 3.2]	2.8 [0.4 - 5.3]	4.0 [2.4 - 5.7]
volume of down logs/acre (ft^3/ac)[2]	1101 [514 - 1615]	1730 [757 - 2701]	3260 [2372 - 4144]
volume of down logs/ac (ft^3/ac) - riparian areas [range]	—	6531 [3501 - 11733]	11504 [7989 - 18435]

[1] Minimum retention levels for snags equate to approximatly 40% (theoretically) of levels found in natural stands.
[2]The minimum down log retention levels for hard logs (decay class 1 and 2) from the RMP equates to 167 ft^3/ac (approximately 5-15% of what is found in natural stands). Divide ft^3/ac by 1.39626 to get the number of feet of 16 inch diameter log necessary to equal the given volume.

Rocky Habitats

The Big Creek analysis area contains some rocky outcrop habitat (Figure III.8-3). Several species including bats, raptors, and woodrats utilize these habitats for roosting, nesting, or resting. Based on some limited field surveys, many of the smaller formations contain at least one or two deep cracks that could be used by bats and also contain other protected ledges or cavities that could be used by other wildlife for resting. Talus areas provide habitat for invertebrates, amphibians, sharp-tailed snakes, among others.

Landscape Pattern

Evaluation of landscape patterns usually incorporates degree of fragmentation, edge effects, and available refugia and connectivity. The analysis area is highly fragmented and probably contains little interior forest habitat; notable exceptions occur in Bear Pen and Axe Creeks (29-10-7, 29-11-13), Upper Big Creek (28-10-21,22,27,28), and Fall Creek (29-11-15). Bear Pen and Axe Creeks in particular have over 700 acres of potential interior habitat 40 years of age or older (see Figure III.6-1). Areas of existing late-successional habitat offer refugia which can serve as sources for repopulation of adjacent areas for species associated with late-successional habitat (see Late-successional section above). Late-successional habitat which connects across ridge tops can provide connectivity to adjacent drainages. Figure III.6-2 shows three areas holding potential for providing connections to adjacent subwatersheds.

Figure III.6−1 Interior habitat areas in stands > 40 years of age

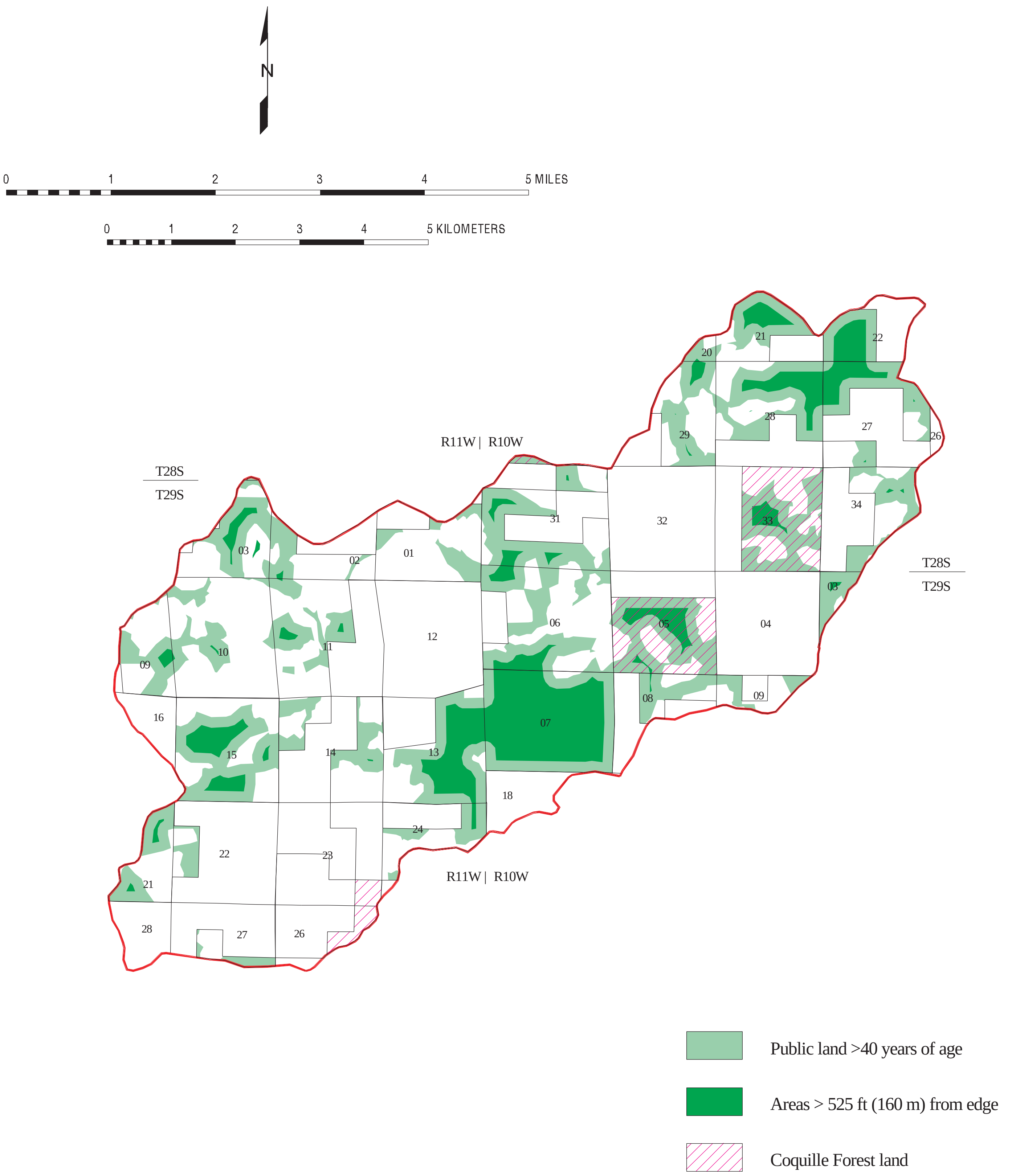

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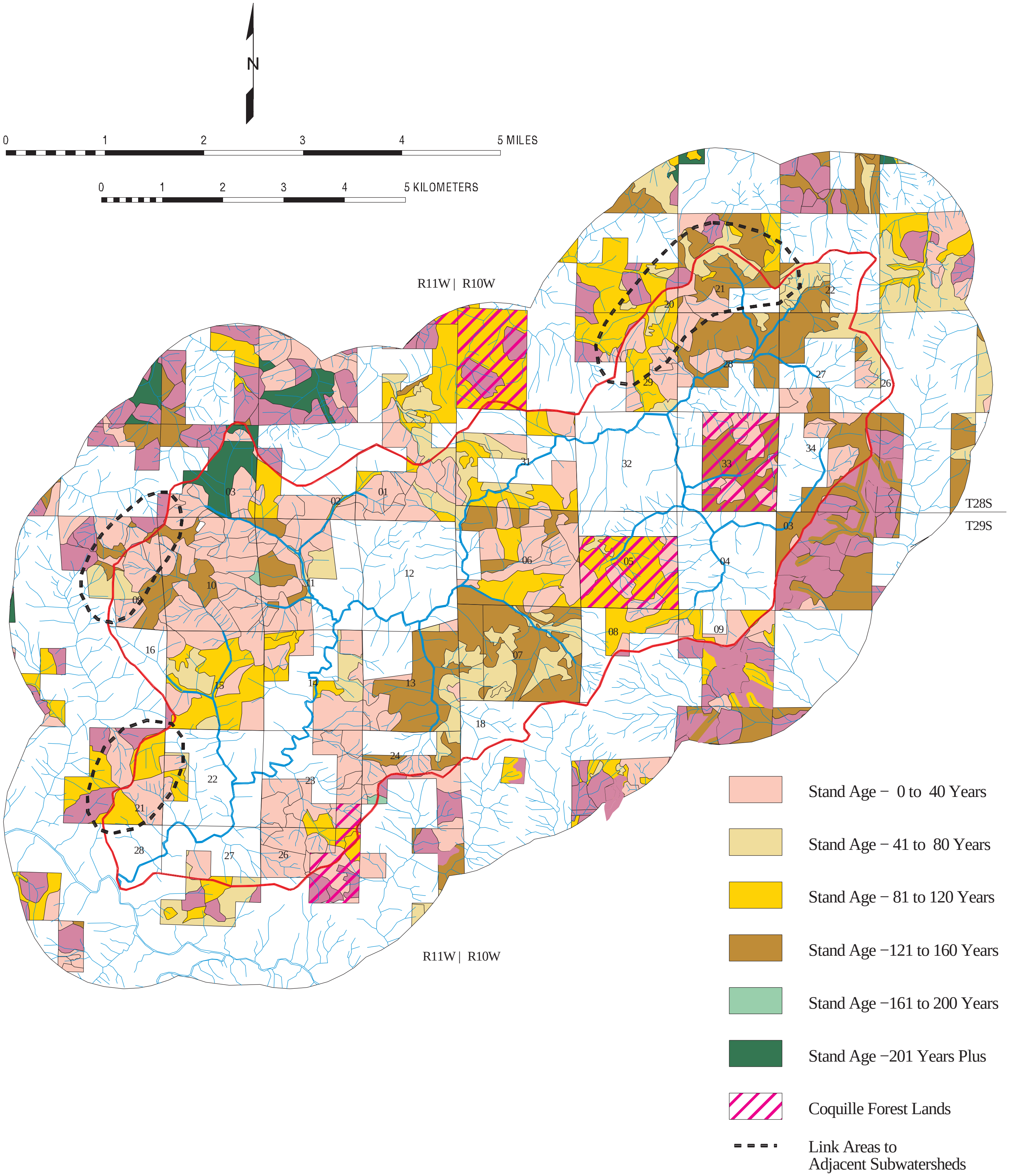
Figure III.6−2 Age Class Distribution on Federally Managed Lands Showing Links to Adjacent Subwatersheds



Scale = 1:84480 (3/4" = 1 mile)

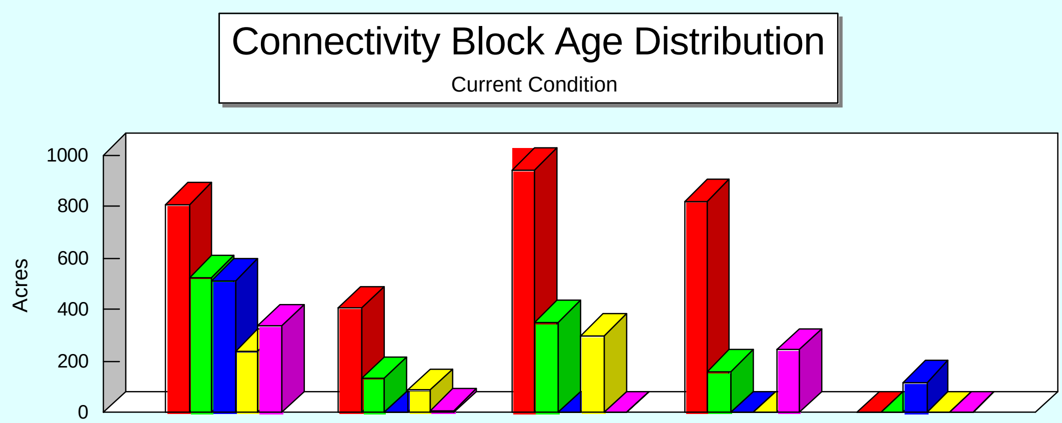
Connectivity Areas

The analysis area contains nearly 3000 acres of Connectivity land use allocation. These connectivity areas are situated between LSR260 to the north and LSR261 to the southeast (Figure III.6-4). Several connectivity areas (or blocks) are wholly or partially contained within the Big Creek analysis area. Because these connectivity areas were intended to function as islands of habitat in the landscape and because several of these areas crossed the analysis area boundary, we analyzed habitat and function of all the connectivity area LUA in the Big Creek planning area vicinity (blocks 1,2 and 4; see Figure III.6-4).

Connectivity blocks are to be managed to retain at least 25 - 30 % of the block in late-successional habitat. Presently, blocks '1', '2', and '4' in the Big Creek analysis area contain 60%, 43%, and 47% respectfully of their area in the 80+ age class. In addition, these blocks are to be managed so that they will eventually contain 4 - 5 different age groups or habitat classifications (early, mature, transitional, and old-growth). With the exception of the old growth/160+ age class, these age groups are present (Figure III.6-3).

Cursory field examination of stands 60-100 years of age indicated they contain a Douglas fir overstory and a dense brush ground cover. The understory is primarily comprised of hardwoods (myrtle, tanoak, and chinkapin) on south aspects and more conifer (hemlock, Port-Orford cedar) on north aspects. The small diameter snags (suppression mortality) are falling down creating new class 1 and 2 down log habitat.

Figure III.6-3 Age Class Distribution of Connectivity Blocks In and Around Big Creek Analysis Area

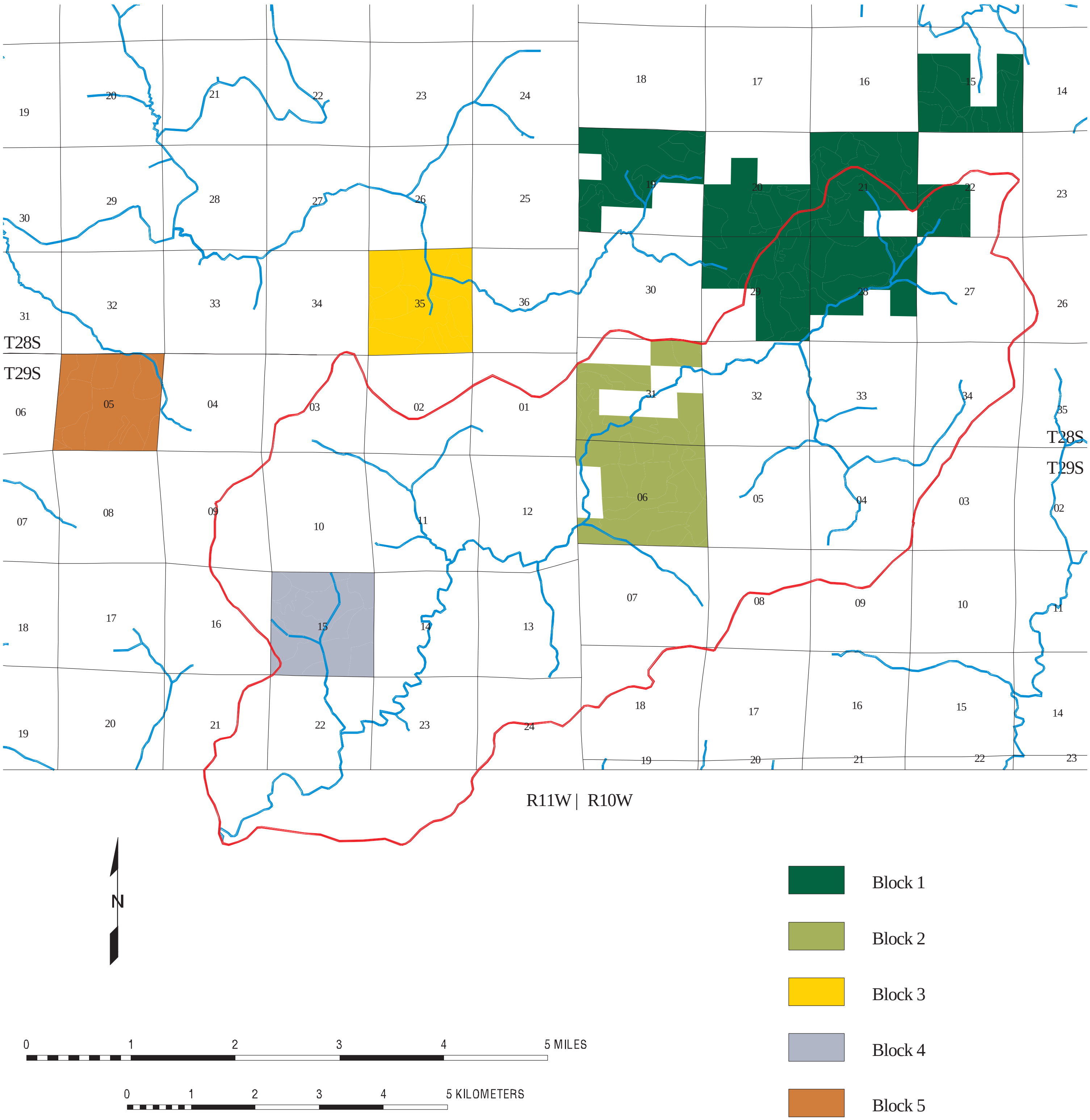


Age Class	0- 40 Yrs	41-80 Yrs	81-120 Yrs	121-150Yrs	>151 Yrs
Conn Block 1	810	406	940	819	0
Conn Block 2	525	133	351	159	0
Conn Block 3	515	0	0	0	121
Conn Block 4	243	87	298	0	0
Conn Block 5	337	10	0	244	0

Road Density

The current road density for the analysis area averages 4.16 miles/mile^2. The density of roads on BLM lands is slightly higher at 4.24 miles/mile^2 (Appendix E, Table E-1). The open road density is currently 4.0 miles/mile^2.

Figure III.6−4 Connectivity Blocks in and around Big Creek Analysis Area



Scale = 1:84480 (3/4" = 1 mile)

SYNTHESIS & INTERPRETATION

<u>Vegetative Complexity</u>

Managed plantations and landscapes have much lower vegetative and structural complexity than natural forests. These even-aged plantations are typically dense, containing trees more evenly spaced and more uniform in diameter, age and height than natural forests (Spies and Franklin, 1991). They have closed, uniform canopies with few gaps, and trees or snags from the previous stand are scarce or absent. Natural processes occasionally result in dense uniform stands, but more often, natural stands retain a great deal of variability, and substantial habitat complexity.

<u>Late-successional Forest Habitat and Function</u>

The analysis area contains no mapped LSRs. Administrative withdrawals (TPCC), unmapped LSRs (owl and murrelet sites), and Riparian Reserves provide the only long-term late-successional habitat. The majority of habitat needs for wildlife associated with late-successional forest habitats are met with the LSR network; however, analysis at the subwatershed scale is still appropriate to ensure the area can support populations of late-successional species with limited mobility and accommodate dispersal of late-successional wildlife species as they disperse or travel between large LSRs. The region-wide LSR network should accommodate the long-term needs of these species. The critical point is in the next few decades while harvest of some existing late-successional habitats continues in the GFMA before similar habitat characteristics (broken and decayed trees, down logs, snags, etc.) have the chance to develop in LSRs. This results in a net decreased availability of these habitats until LSRs begin to develop late-successional habitat characteristics.

With <1% of the analysis area containing old growth (>200 years of age), the habitat function for old growth dependent species will be lacking until old growth habitat characteristics develop in the Reserve areas. Significant acreage of forests will not enter the 200+year age class for 60 years (see Section III.5 Vegetation). Currently, nearly all of existing old growth habitat is in Reserves and will not be subject to harvest.

<u>Retention of 15% late-successional habitat</u>

Both the Northwest Forest Plan and Coos Bay's RMP require the retention of late-successional forests in fifth field watersheds "in which federal forest lands are currently comprised of 15 percent or less late-successional habitat". Late-successional forests are those seral stages that include mature (80 to 159 years old) and old-growth classes (160 years and older)(S&G B-1). The highest priority for retention should be the older age classes on those lands which have a 'reserve' designation (i.e., Late-Successional Reserve, Riparian Reserve, Administratively Withdrawn Reserve), followed by GFMA & Connectivity land use designations.

The Middle Fork Coquille-fifth field watershed contains 62,764 acres of BLM managed lands and 15% of these (9414 acres) must be maintained in the late-seral condition. According to FOI analysis, 6967 acres of the more desired transition or old-growth habitat types are located in LSR, MMR, and other withdrawn areas (Table III.6-2). Due to the accuracy of hydrologic data, it is not possible to calculate acres of Riparian Reserves on a fifth-field scale to evaluate their contribution towards the 9414 acres of late-successional habitat. Analysis of Riparian Reserves is possible on the subwatershed level and Sandy-Remote and Big Creek show a contribution of contribute 2518 acres. As watershed analysis is completed in the remaining subwatersheds, the acreage calculation of old-growth habitat types within the Riparian Reserves will be completed and that acreage added to the total. Therefore, the objective of retaining 15% of the federal land base in transition or old-growth habitat types will be met through the Reserve network.

Table III.6-2 reflects the reductions in 80 year and older timber from GFMA lands as a result of sold or planned 1997 and 1998 timber sales.

Table III.6-2 Late-Successional Habitat Acreage - Middle Fork Coquille Watershed

Land Allocation	Middle Fork Coquille (62,764 total BLM acres)			
	0 - 79 yrs	80 - 119 yrs	120- 159 yrs	160+ yrs
LSR & MM Reserves	7329 (11%)	2639 (4%)	1212 (2%)	4797 (8%)
Riparian Reserves*	4954 (8%)	1228 (2%)	2285(4%)	233 (<1%)
other withdrawals	743 (1%)	788 (2%)	658 (1%)	300 (<1%)
CONN	2536 (4%)	769 (1%)	1077 (1%)	626 (1%)
GFMA**	19,174 (31%)**	5,531 (9%)**	4,000 (6%)**	1829 (3%)**
Totals	34,736 (55%)	10,955 (18%)	9,228 (15%)	7,785(12%)

* This figure reflects the Riparian Reserve acres within the Sandy-Remote and Big Creek analysis area ONLY. The accuracy of the data in the HYD coverage precludes calculation of RR acreage on this large a scale.
** This figure includes acres of Riparian Reserves within the GFMA allocation outside of above two analysis areas.

For comparison purposes, the percentage of late-successional forest within the Big Creek analysis area shown below in Table III.6-3. A direct comparison of this 80 yr+ reserved acreage to that present in the Middle Fork Coquille watershed cannot be made until Riparian Reserves acreages are calculated for the Middle Fork Coquille.

Table III.6-3 Late-Successional Habitat Acreage - Big Creek Analysis Area

Land Allocation	Big Creek (9,021 total BLM acres)			
	0 - 79 yrs	80 - 119 yrs	120- 159 yrs	160+ yrs
LSR & MMReserves	-	-	-	-
Riparian Reserves & other withdrawals **	3129 (35%)	731 (8%)	1259 (14%)	173 (2%)
CONN	751 (8%)	391 (4%)	202 (2%)	-
GFMA	1473 (17%)	253 (3%)	651 (9%)	8 (<1%)
Totals	5353 (60%)	1375 (15%)	2112 (23%)	181 (2%)

** The acreage within Riparian Reserves is calculated from an edited HYD coverage which allows for this calculation. This acreage does not account for additional streams which will be located upon field reviews or minor modification of riparian reserve widths on intermittent streams.

Snags and Down Logs

Snag and down log abundance has declined dramatically throughout the landscape over the last 50 years. The availability of these structures is influenced by past management activities such as timber harvest, salvage, and natural disturbances (or lack thereof) such as fire and windthrow (see Section III.5-Vegetation). Without major changes to the current Forest Practices Regulations, snag and down log abundance is likely to remain very low compared to natural stands on private and state lands. Although snag and down log abundance will be greater on BLM lands, it is also likely to remain low on GFMA lands compared to natural stands. Snag and down log retention levels on GFMA lands represent approximately 40% and 5-15% respectively of the levels found in natural stands. One critical function of Reserve Areas is that they will eventually contain substantially more snag and down log habitat than GFMA areas.

Snags

Currently, snag abundance is probably far below 40% population levels on most early, mid, and late-seral BLM lands in the analysis area. The Snag Recruitment Simulator model (Marcot 1991) suggests that approximately 2 hard snags per acre, 11" or greater DBH, distributed throughout the landscape are necessary in order to provide sufficient hard snags in the present and soft snags in the future (Appendix C, Table C-3). Appendix C, Table C-4 shows snag levels necessary to support various population levels. The model further suggests critical snag shortages in the near future unless additional snags are created through management. Even with aggressive snag creation efforts, short-term shortages of soft snag habitat are probably unavoidable because it takes 19-50 years for a hard snag to become a soft snag, decay class 3+ (Cline et. al. 1980).

The District RMP directs that at a minimum, snags be retained sufficient to support cavity nesting species at 40% of potential population levels throughout the GFMA. It will take at least 60 years (one harvest rotation) to eventually meet the 40% population level on GFMA lands, if snag creation efforts are limited to harvest units. It is possible to hasten the attainment of the 40% population potential goal on GFMA lands by either managing for >40% population potential in harvest units or creating snags on other GFMA lands before they are subject to regeneration harvest. Even if these levels are eventually achieved throughout the GFMA, actual cavity nester population levels on the landscape will likely be much lower, due to the lack of snags on intermingled private lands.

Snag abundance is also probably critically low on reserve lands and will continue without aggressive snag creation efforts. The current lack of hard snags (and therefore, future soft snags) creates a situation where it will be impossible to meet snag density goals for both hard and soft snags for at least 19-50 years.

Location of snags is also important. Preliminary radio telemetry data on bats suggests at least some species may preferentially roost in ridgetop snags. Harvest practices in the past tended to leave most wildlife trees on the edges of harvest units, but doing so discourages maintaining snags in a variety of topographic positions. Snags representing a variety of decay classes, topographic positions, seral stages, and distributions (i.e. large and small clumps and singly) need to be provided through time.

Down Logs

Currently, down log abundance is probably far below natural levels on most early, mid, and late-seral BLM lands and virtually nonexistent in recent harvested areas. Future recruitment of down logs is severely limited by the current low numbers of snags throughout the area, which often turn into down logs as they age.

Although the District RMP establishes interim guidelines for down log retention within regeneration harvest units, these guidelines are considered a minimum requirement until more accurate models are developed which establish specific down log retention levels for groups of plant associations or stand types. For most regeneration units harvested using the minimum retention requirements, down log volumes after treatment would likely be much lower than average values for naturally regenerated forests because a portion of class 3 -5 down logs are inevitably destroyed during the logging process. Minimum retention levels are 5-15% of the level found in natural stands and are probably well outside the natural range of variability (Table III.6-1). If down log creation efforts are limited to future harvest units, it will take at least 60 years (one harvest rotation) to eventually meet down log targets on GFMA lands. It is possible to hasten the attainment of down log target levels on GFMA lands by either managing to exceed target levels in harvest units or creating down log habitat on other GFMA lands before they are subject to regeneration harvest.

Down log abundance is also probably critically low on reserve lands and will continue without aggressive down log creation efforts. Because the current lack of hard snags and down logs (and therefore, future down logs) creates a situation where it will be impossible to provide adequate soft down log habitat in the future.

Rocky Habitats

Unique habitat characteristics and the relative scarcity of rocky outcrops and talus enhance their ecological value in the landscape. Rocky habitats offer unique microclimates; the interstitial spaces between rocks in talus provide habitat for many amphibians and invertebrates; cracks, crevices, shallow caves, and overhangs can provide shelter for raptors, invertebrates, woodrats, bats, and other mammals. Many lichens and bryophytes find habitat only on rocky substrates. Many of the species associated with rocky habitats are especially sensitive to the microclimates they offer. The surrounding vegetation, topography, geology, and hydrology all contribute to creating unique microclimates that these sites provide for wildlife and vegetation. Many of the smaller rock formations and talus habitats have not been located and mapped.

Vegetative Complexity

The spatial and temporal landscape patterns of the Oregon coastal forests have changed dramatically over the last century, substantially affecting the ecological communities associated with these forests. Forest management practices have converted a landscape dominated by large interconnected patches of late-successional forest, to one dominated by young managed plantations, within which only small, isolated patches of late-successional forest remain. The intensive forestry practices and short rotations used to maximize yields have also prevented the reestablishment of vegetatively and structurally complex forest habitats on these plantations.

Landscape Pattern:

Fragmentation

Simple observation and comparison of historic (1943 and 1950) and current aerial photos show a landscape which has become much more fragmented with smaller patch sizes and more edge. For species such as the American marten or northern spotted owl which have large home ranges, many of the existing old forest patches are too small to support a successfully reproducing pair. Further fragmentation of late-successional habitats will continue to reduce the size of patches and create edge habitats, thereby reducing the effectiveness of their interior habitats. While most late-successional forest patches are large enough to support one or more reproducing pairs of species with small home ranges, patch size also has a major influence on key physical and biological conditions which affect habitat suitability. For example, bats select roost sites with very specific habitat characteristics that are well protected from variations in temperature and humidity. These conditions are commonly found within the interior portions of large late-successional forest blocks. However, within small patches, environmental conditions are more variable and strongly influenced by the environmental conditions of the adjacent habitats.

Edge effects can alter habitat characteristics up to 3 tree heights (approx. 600 feet) into the adjacent stand (Harris 1984), effectively reducing a circular 111 acre stand to only 30 acres of interior habitat. Lehmkuhl and Ruggiero (1991) cite research suggesting microclimate edge effects persist within 525 ft of forest edges. Landscapes dominated by edge habitats favor generalist species at the expense of others dependent on interior habitat. Birds nesting on these edges may experience higher failure rates due to predation and nest parasitism (see Noss and Cooperrider, 1994 for a discussion). Fragmentation has been identified as an important threat to biodiversity (see Noss and Cooperrider 1994).

Refugia

Reserve, or refugia, areas function as centers for repopulation of adjacent habitats, and can support populations for relatively immobile species such as small mammals, invertebrates, and herps and are especially important for species associated with late-successional forests.

Based on the existing age class distribution of lands in the analysis area, at least four decades growth will be needed before the late-seral stands could attain sufficient vegetative and structural complexity to function as old growth forest habitat (see Section III.3 General Vegetation). In the interim, protecting the remaining refugia sites will be critical to maintaining existing populations of late-successional species, and facilitating their recolonization of recovering habitats throughout the landscape.

Due to landscape and regional changes in habitat quality, abundance, distribution and disturbance frequency, habitat refugia are likely more important to the ecology of the current managed forests than they were to the natural forest landscape. The ecologically simple early seral plantations which dominate the current landscape cannot support many native wildlife species. Refugia that are scattered across the landscape and that are large enough to support populations of species with limited mobility and small home ranges are critical for the conservation of these species.

Habitat Connections

Connections between habitat areas become especially important for species in fragmented landscapes. Habitat connections occur at two scales: connections between large LSRs to facilitate movements of fairly mobile species such as spotted owls and marten between these LSRs; and connections between individual habitat patches to facilitate movements of less mobile species between these patches. Ultimately, the connections between individual habitat patches promote movement between large LSRs as well. Smaller Reserve areas (Riparian Reserves, small LSRs, owl 100 acre cores, TPCC withdrawals) and remaining habitat in the GFMA accommodate movements of species between large LSRs.

In the long term, connection between large LSRs should be accommodated by the approximately 59% of BLM land in the analysis area (32% of all ownerships) in some form of Reserve areas (Table I-1). Connectivity Blocks, with their additional protective measures, will also facilitate dispersal of mobile late-successional species across the landscape. In the short term,however, 59% of the Reserve areas are currently < 80 years of age.

Existing mid and late-seral habitats on GFMA and Connectivity Blocks can bolster habitat connections for the next 40 years or so until the Reserve areas grow older (Appendix C, Figures C-1, C-2, & C-3). Given harvest pressures though, retaining mid and late seral habitats in the GFMA by deferring harvest for 40 years is unlikely; therefore the emphasis should be on deferring harvest as long as possible on the areas which contribute most to habitat connectivity such as stands which connect to adjacent subwatersheds, larger more contiguous stands, and stands in areas with relatively little late-successional habitat.

Maintaining connections between individual habitat patches will depend on minimizing fragmentation of existing connected habitats in the GFMA and Reserved allocations. Riparian Reserves on intermittent streams are particularly important for maintaining these connections because they often connect upland with riparian habitats and, together with perennial stream reserves, form continuous corridors through BLM lands. Even though 51% of Riparian Reserves are >40 years of age, the current fragmentation pattern of these areas does not lend themselves to form these critical connections (Figure III.8-2). Suitable habitat on GFMA lands can bolster critical connections between individual habitat patches. Riparian reserves will not receive significant additional acreage of forest > 80 years of age for 50 years. Habitat patches which span ridges separating subwatersheds can facilitate movements of individuals between these adjacent subwatersheds. Figure III.6-2 shows three areas holding potential for connectivity to adjacent subwatersheds, one of which also lies in a Connectivity Block.

Roads can block or discourage movements between habitat patches. Road density, open road density, road closure type, surface type, and right-of-way width all impart the barrier effect of roads to different species. Open road density is currently above goals established in the RMP and is of particular concern in the ODFW Tioga Wildlife Unit because of impacts to deer and elk. Building new road corridors into unroaded habitat can fragment those habitats and inhibit movements to a variety of species (see Noss and Cooperrider 1994 for more discussion). Minimizing new road construction, decreasing open road density, decommissioning existing roads and encouraging vegetation growth on them would decrease the disturbance and barrier effects of roads to wildlife.

Road Density

The RMP provides goals for open road density. Numerous studies suggest that some wildlife species, particularly small mammals and invertebrates, seldom cross roads - even roads that are closed to vehicles (Noss and Cooperrider 1994). Roads can also affect wildlife by encouraging harassment by vehicle traffic and increased access for legal or illegal hunting. These effects have been particularly well documented for large mammals such as elk (Wisdom et al. 1986). Roads can also provide a travel path into interior habitat for edge associated species.

Pope and Anthony (In Press) noted that vehicle traffic on secondary roads was greatest during fall hunting seasons. Even short, dead end spur roads received an average of 171 vehicle trips/month. In a telemetry study of elk in the Coos Bay District, Pope and Anthony (In Press) found that elk avoided areas within 164 feet of roads and poaching accounted for 50% of the elk mortality.

While all closed roads, including gated roads, are considered closed for purposes of open road density calculation, the location of closed roads and the type of closure can dramatically affect their impact to wildlife. For example, closing a road which is paralleled by a road remaining open obviously does little to reduce the effective road density. Similarly, the type of device used to close a road has a direct correlation to its effectiveness. A gated road which continues to receive significant administrative use or because gates are left open also does little to reduce harassment to wildlife. An explanation of the types of road closures as well as some assumptions of the duration and degree of closure are found in Coos Bay's TMO data dictionary.

Management Objectives

1. Provide a landscape where fragmentation and edge contrast is generally decreasing and where refugia of high quality late-seral habitat are scattered throughout the area and connected by mid and late-seral habitats; reserve areas should be dominated by late-seral habitats interspersed with small areas of earlier-seral habitats with soft-edged transitions between habitats.

2. Emulate the timing, intensity, variability, and scale of natural disturbance processes where practical. The following guidelines can be used to accomplish this objective:

- Concentrate harvest units in space and time.
- Use wildlife trees or harvest prescriptions to feather edges of harvest units to soften the transition across edges.
- In thinning units, use harvest prescriptions with variable spacing.
- Maintain species diversity of canopy species and understory shrubs, including hardwoods, in harvest units.

3. Maintain microclimate features of important special habitat areas such as seeps, springs, wetlands, and rocky habitats.

TERRESTRIAL SPECIES

<u>Analysis Questions:</u>

What are the species of concern in the watershed? What was the historical and what is the current relative abundance and distribution of species of concern in the watershed?

How have management activities and natural processes changed the abundance and distribution of these species and the character of their habitats?

What are the influences and relationships of species and their habitats with other ecosystem processes in the watershed?

What is the management objective (desired condition) for the wildlife species in the analysis area?

What management actions (restoration, maintenance, protection, etc.) could be undertaken that would maintain and/or restore the integrity and productivity of the wildlife habitat within the analysis area? (refer to Section IV - Recommendations)

REFERENCE CONDITION

No historic data exists on the distribution or relative abundance of wildlife species in the Big Creek vicinity. Interviews of long-time residents of Big Creek suggested black bear and beaver used to be more common. Given the preponderance of late-successional and old growth habitats which historically occurred in the Coast Range (see Section III.5 - Vegetation), wildlife species associated with late-successional habitats and fairly stable environments were probably more common than they are now. Wide-ranging species intolerant of frequent disturbance such as wolverine and grey wolf were likely present in the Coast Range; although they have been extirpated in historic time. All the wildlife species of concern were likely more abundant and widespread historically. Habitat loss and fragmentation, human disturbance and hunting/trapping, and competition or predation from exotic species have all contributed to population declines; while many of these factors have been affecting populations for centuries, changes have been more pronounced in this century (since European settlement). Some species including Southern torrent salamanders, tailed frogs, bald eagle, band-tailed pigeons, northern spotted owls, marten, and red tree voles have probably experienced the most significant declines.

Conversely, edge and disturbance-adapted species such as great horned owls, crows, ravens, and raccoons were probably less common than they are currently. Barred owls, opossums, and perhaps other species native to eastern U.S. have expanded their range into the Coast Range in historic time. Exotic species were not introduced until white settlers moved in during the mid-1800s.

CURRENT CONDITION

Table III.6-4 lists the wildlife species of concern, grouped by taxonomy or habitat associations, which were considered for analysis in this document. See Appendix C, Table C-2, for a comprehensive list of species and a description of the derivation of the list of wildlife species of concern.

Arthropods

This diverse species group is associated with a variety of forest layers and structures. No surveys or inventories have been conducted for arthropods. Generally they are sensitive to plant species composition, forest structure (number of layers, presence of openings, presence of snags/down logs, etc.), and disturbances. Little is known about these important species groups. We do know however that arthropods hold critical roles in the function of forest ecosystems as they pollinate plants, recycle nutrients, and feed numerous insectivorous animals. Arthropods and plants form the foundation of terrestrial food webs.

Bats

Bats are associated with a variety of habitat structures. Bats roost in buildings, bridges, rock crevices, tree cavities or foliage, and loose tree bark. Old growth forests provide higher quality roost sites than younger forests (Christy and West 1993). Foraging areas include the forest and forest openings, riparian areas, and open water. Only limited, opportunistic surveys have been conducted for bats. Bats are known to roost on bridges over Big Creek at Axe Creek, Bear Pen Creek, and the 29-11-28.0 road. Rock bluffs, hollow trees and snags, and deeply fissured or loose bark may offer roosting crevices for bats. Only a few rocks bluffs have been casually surveyed for bat roosting habitat potential; suitable roosting crevices were noted in many of the rocks. Most of this rock habitat has not been surveyed for bat potential.

Old growth forest birds:

Northern Spotted Owl

The analysis area has been extensively surveyed for spotted owls. There are three site centers known. Much of the available habitat is in marginal condition (mature forest). In spite of the relative shortage of prime suitable habitat, owls have nested (but irregularly) at two of the sites. Based on radio telemetry data for the owl at the third site, this site is probably only occasionally used by floater or dispersing individuals. Since most of the area around the owl sites is GFMA, all the sites will likely eventually "wink out" as surrounding habitat is cut. The long-term conservation strategy for the owls is for reproductive populations to persist in the large LSRs while maintaining a matrix of GFMA lands conducive to dispersal between LSRs. Given the 40-60 year harvest rotation on private lands and the almost nonexistence of currently suitable habitat, private land will likely contribute dispersal habitat, but will never contribute significantly to suitable spotted owl habitat. Habitat loss and fragmentation is the primary threat to spotted owl populations (Thomas et al. 1990).

Approximately 54% of BLM-administered land contains habitat suitable for spotted owl dispersal, roughly approximated as forests >=40 years of age, 53% of which occurs in interim riparian reserves. Approximately 44% of the subwatershed (all ownerships) contains spotted owl dispersal habitat.

Table III.6-4 Wildlife species of concern

GROUP	SPECIES
Riparian/aquatic associates [1]	Dunn's salamander (*Plethodon dunni*)
	Yellow-legged frog (*Rana boylei*)
	Pacific giant salamander (*Dicamptodon tenebrosus*)
	Southern torrent salamander (*Rhyacotriton variegatus*)
	Tailed frog (*Ascaphus truei*)
	Beaver (*Castor canadensis*)
Arthropods	Canopy herbivores
	Coarse wood chewers
	Litter & soil dwelling species
	Understory & forest gap herbivores
Bats	Big brown bat (*Eptesicus fuscus*)
	California myotis (*Myotis californicus*)
	Fringed myotis (*Myotis thysanodes*)
	Hoary bat (*Lasiurus cinereus*)
	Little brown myotis (*Myotis lucifugus*)
	Long-eared myotis (*Myotis evotis*)
	Long-legged myotis (*Myotis volans*)
	Pacific western big-eared bat (*Corynorhinus townsendii*)
	Silver-haired bat (*Lasionycteris noctivagans*)
	Yuma myotis (*Myotis yumanensis*)
Old growth forest birds	Northern spotted owl (*Strix occidentalis caurina*)
Bald eagle	Bald eagle (*Haliaeetus leucocephalus*)
Other forest birds	Band-tailed pigeon (*Columba fasciata*)
	Sharp-shinned hawk (*Accipiter striatus*)
Terrestrial mollusks	*Monadenia fidelis flava*
	Vespericola sierranus
Mustelids	Marten (*Martes americana*)
Voles	Red tree vole (*Arborimus longicaudus*)
	White-footed vole (*Arborimus albipes*)

[1] These species are discussed in the Aquatic and Riparian Species subsection.

Bald Eagle

There are no documented bald eagle nesting or roosting sites in the subwatershed. Suitable habitat may be present along the Middle Fork Coquille Rivers, but habitat surveys have not been conducted. Isaacs (personal communication) felt bald eagles likely nested along the Middle Fork Coquille as far up as Remote. Nests averaged 0.5 mile from water in Oregon (U.S. Fish and Wildlife Service, 1986).

Other Forest Birds

These birds are associated with a variety of forested habitats. Band-tailed pigeons use a variety of forest habitats and feed primarily on berries and nuts. Band-tailed Pigeons occur in low numbers throughout the analysis area and seem to have experienced a general population decline from the mid 1960's to the late 1980's (Jarvis and Passmore 1992). Declines may be due to reduced forage and mineral sites, reduced nesting habitat in the United States and increased pressure from agricultural interests and hunting on the winter ranges. They are potentially affected by pesticide and herbicide use which eliminates forage species. Sharp-shinned hawks are associated with a variety of forest types and conditions. Few surveys have occurred for this species. The sharp-shinned hawk is likely to occur in low numbers. No surveys for either species have been conducted in the analysis area.

Terrestrial mollusks

No surveys for terrestrial mollusks have been conducted on the district and very little is known about their life history and distribution. Monadenia is known from sites in nearby Curry County and inhabits deciduous woodlands, often in riparian areas. Vespericola occurs near springs and is associated with old growth forests (Frest and Johannes,1993). Both species associate with riparian areas and are potentially affected by activities in Riparian Reserves and by the designation of final Riparian Reserve boundaries.

Mustelids

The marten is uncommon in the Oregon Coast Range, and populations within the state are probably in decline from habitat loss. Sightings of American marten have been occasionally documented within the district during the past 10 years, although their current abundance and distribution is unknown. Martens are typically associated with large, contiguous blocks of late-successional forest habitat which contain abundant down logs and snags. Several studies have shown associations with down logs and riparian areas (Buskirk and Ruggiero 1994). The analysis area contains a number of late-successional forest blocks which may provide sufficient suitable habitat to support marten.

Voles

Red tree voles are arboreal rodents that occur in patchy distributions primarily in late-successional forests (Huff et al. 1992). Possible nest structures have been noted in 29-11-15 and 21 and 28-10-28. Using habitat definitions if the draft red tree vole protocol (BLM Instruction Memorandum No. OR-97-009 dated 4 Nov 96), approximately 59% of federal land in the Middle Fork Coquille watershed is suitable habitat. This is above the threshhold of 40% stated in the draft survey protocol; therefore, surveys prior to ground disturbing activities are not required. The white-footed vole inhabits riparian areas, particularly along small streams with an alder forest component (Maser, et al. 1981). This rare vole has been documented in the district but no surveys have been conducted. Both species are susceptible to habitat loss and fragmentation.

SYNTHESIS AND INTERPRETATION

Past land management practices have substantially altered the habitat conditions, wildlife populations and ecological communities of the Oregon Coast Range. Species associated with late-successional forest habitats, or key habitat components (snags, complex tree canopies, down logs, or complex stream habitats) have been most affected (see Section III.6 Terrestrial Habitat). Due to these changes, populations of many wildlife species have declined dramatically, and many are restricted to small isolated habitat islands. The small size and isolation of these populations put many species and ecological communities at risk. These species of concern are influenced by disturbances to their habitats, climate, and human activities which disturb reproduction or other critical life function.

One of the major goals identified for both the NWFP and the District RMP is to protect, maintain and restore the native wildlife habitats, biological communities and ecological functions to federally managed forest lands. To accomplish these goals, conventional forest management practices must be modified to better retain and/or restore key habitat components and characteristics to the forests, and insure these components are suitably distributed across the landscape and through time. Due to the large number of native plants and animals inhabiting these forests, and the limited understanding of the ecology and habitat requirements for most species, managing forests to provide habitat on a species by species basis would be ineffective (Marcot, et. al., 1994). Instead, forest management should focus on emulating the habitat patterns and ecological processes which created and maintained the natural forest landscape. Given the current political and social environment, fully emulating all the characteristics and ecological processes of the natural forests is not feasible. For example, reintroducing large-scale catastrophic fires would present an unacceptable threat to homes and private property. However, by modifying conventional forest management practices, and properly applying these techniques across the landscape, many of the habitat components and characteristics critical to the native ecosystems can be restored to our managed forest stands.

Arthropods

Management activities which may benefit this group include limiting broad-scale slash burning and intense forest fires, limiting ground disturbance and compaction, maintenance of tree clumps in harvest units, maintaining the natural diversity of plant species, providing variety in forest structure, and maintaining high levels of snag and down log habitats (SEIS, App. J2). Management of federal land under the Northwest Forest Plan Management incorporates many of these beneficial or mitigating actions to varying degrees. Under Survey and Manage guidelines, general regional surveys were to begin for these species by FY 1996 in an attempt to learn more about their distribution and biology. To our knowledge, these surveys have not been initiated but are sorely needed to fill this information gap. Management activities could affect arthropod communities and specie diversity. Interim management guidelines recommended in the following sections should decrease impacts to these species until regional surveys can refine our knowledge of them: Snags, Down Logs, Vegetative and Structural Diversity. Management actions on private land will likely continue to heavily impact arthropod species.

Bats

The following sections address habitat needs for bats: Riparian Assessment Module, Snags, Late-successional Forest Habitat, and Rocky habitats. Surveys for these species are needed to identify species occurrence and distribution, high activity areas, hibernacula, and unique feeding and roosting habitat.

Old Growth Forest Birds:

Northern spotted owls

The owl sites in Big Creek are expected to eventually "wink out" and support only occasional occupation thereafter. Their long term function for spotted owls will be that of providing habitat for dispersing and floater individuals. The analysis area has been well surveyed for owls and additional owl sites are unlikely given the marginal condition of habitat and the current distribution of known owl sites. The region-wide LSR network is intended to accommodate the long-term survival of spotted owls. The greatest risk to owl survival is in the next few decades as the net amount of habitat decreases (see Late-successional Forest Habitat section). Mitigating that risk requires temporarily maintaining owl sites in the GFMA and retaining existing habitat in the GFMA as long as possible to allow habitat conditions on LSRs, RRs, and other reserves to improve. Since habitat in the GFMA will be reduced gradually, owl sites in the GFMA will continue to persist and produce young for the short term (a few decades).

Approximately 54% of BLM-administered land contains suitable habitat (>=40 years of age) for spotted owl dispersal, 58% of which occurs in Riparian Reserves. Table III.6-5 presents current and projected dispersal habitat availability for the subwatershed. The projected figures account for recruitment of habitat, potential regeneration harvest on BLM land, and assume 33% of private lands provide dispersal habitat (which is approximately what it is now). BLM-administered dispersal habitat increases for the next 40 years and reaches an equilibrium in 2037 with 82% of BLM-administered land supporting dispersal habitat.

Thomas et al. (1990) recommended that at least 50% of an area be in suitable dispersal habitat condition to facilitate dispersal of owls between large LSRs, so while dispersal habitat conditions are adequate on BLM land and in the long term, dispersal habitat condition in the analysis area as a whole may be marginal for the next decade or so. The analysis area lies in an important dispersal corridor between large LSRs to the north and south.

Table III.6-5 Current and projected dispersal habitat conditions (forests >= 40 years of age) for northern spotted owls.

	1997	2007	2037
BLM (% of BLM)	4837 ac (54%)	5476 ac (61%)	7416 ac (82%)
Private (% of pvt.)	2453 ac (32%)	2547 ac (33%)	2547 ac (33%)
Total (% of subwatershed)	7290 ac (44%)	8023 ac (48%)	9963 ac (60%)

Bald Eagle

Potential marginal nesting habitat exists on BLM-administered land in the lower part of Big Creek (29-11-21). This area offers mature/late-successional habitat close to the Middle Fork Coquille river. A potential historic nest occurs along the river in the adjacent Sandy/Remote subwatersheds that was potentially occupied as recently as 8-9 years ago. Very little habitat probably exists west of Myrtle Point on private lands. Maintaining larger riparian reserves in this area would also preserve future nesting options for eagles. The Pacific Bald Eagle Recovery Plan identified habitat loss as the primary threat to bald eagles (U.S. Fish and Wildlife Service 1986). In addition to habitat needs, bald eagles require a nesting area free of unusual disturbance in order to complete their nesting cycle. The recovery plan identifies criteria for minimizing disturbance to nesting bald eagles (U.S. Fish and Wildlife Service 1986).

Other Forest Birds

The previous subsections address habitat needs for other these species: Snags, Landscape Patterns, Forest Complexity.

Terrestrial mollusks

The following section addresses habitat needs for these species: III.8-Riparian Reserve Evaluation.

Mustelids

The previous subsections address habitat needs for these species: Late-successional Forest Habitats, Snags, Down Logs, Landscape Pattern, Forest Complexity, and Section III.8-Riparian Reserve Evaluation.

Voles

Draft survey methods and management recommendations for red tree voles were recently distributed to districts (version 1.1, received 30 Jul 96). The purpose of the protocol is to identify important habitat areas which connect LSRs, to prescribe survey methods, and to prescribe protective measures for the species where necessary to maintain connectivity between LSRs. White-footed voles are perhaps the rarest microtine rodent in North America (Maser et al. 1981), and they have been documented in the Umpqua Resource Area, near Bandon, and other areas further south within the district. They appear to associate with mature alder riparian areas (Maser et al. 1981, Oregon Natural Heritage Database). Projects which reduce mature alder riparian habitat could affect local populations or fragment what is probably an already highly fragmented distribution. (see Section III.8-Riparian Reserve Evaluation); therefore, it could be important to maintain some alder, even in areas targeted for encouraging conifer species. Survey efforts for white-footed voles by the BLM Roseburg District in 1996 were largely unsuccessful.

Management Objective

The management objective for the species of concern is to prevent local extirpations and contribute to recovery of special status species and other species at risk, and to maintain or restore a landscape conducive to movements of individuals among habitat patches.

AQUATIC AND RIPARIAN HABITAT

Analysis Questions: See also Section III.6-Species and Habitats (subsections: Terrestrial Habitat, Terrestrial Species)

What was the historical condition and distribution of aquatic and riparian habitats throughout the analysis area, and how have human activities affected them?

What is the current abundance, distribution, and condition of spawning and rearing habitat for fish, and how are they maintained?

What is the current abundance, distribution, and condition of aquatic and riparian habitats for *other aquatic and riparian associated species (e.g., herptiles, invertebrates, beaver), and how are they maintained?*

Where are"hot spots" for spawning? rearing? for which species?

What and where are the human caused obstructions to the movement and dispersal of fish or other aquatic species?

What is the role of this analysis area within the larger 5th field watershed?

What are the influences and relationships of aquatic and riparian habitats with other ecosystem processes (e.g., sedimentation, vegetation)?

What are the trends in aquatic and riparian habitat condition, and what forces have the potential to reduce or limit the viability of key habitats or habitat elements?

What are the management objectives for aquatic and riparian habitats in the analysis area?

What management actions (restoration, maintenance, protection, etc.) could be undertaken that would maintain and/or restore the integrity and productivity of aquatic and riparian habitats within the analysis area? (refer to Section IV - Recommendations).

REFERENCE CONDITION

Quantitative surveys and measurements of aquatic and riparian habitat prior to 1949 have not been located for the Big Creek Watershed and probably do not exist. Large wood was probably common in streams (both in aggregations and as single pieces), originating from adjacent riparian zones and adjacent hillslopes in the late-seral condition. Additionally, there were likely substantial inputs following landslides, debris torrents and large stand-replacement fires (such as those in the 1860s). Anecdotal evidence (BLM 1997a) suggests that beaver were probably abundant at the turn of the century and as a result, habitat conditions associated with beaver (large complex pools, channel complexity, alcoves, beaver-associated riparian vegetation) were probably also common.

CURRENT CONDITION

Several homesteads were established in the watershed before the turn of the century. Early human impacts to aquatic and riparian habitats included grazing, small-scale agriculture, logging, splash-damming, small-scale road-building, and extensive beaver trapping.   At least one splash dam was present on mainstem Big Creek. Later in the century, additional residential development, widespread timber harvest and road building, beaver dam removal, and stream-cleaning were common.

Formal aquatic and riparian habitat surveys in the Big Creek watershed began in 1949 (Appendix D, Table D-1) These early efforts were primarily intended to locate potential passage barriers for anadromous fish, and species other than anadromous fish and beaver (i.e., amphibians, invertebrates) were not evaluated.

During the summer of 1973, intensive habitat surveys were conducted along Axe, Bear Pen, Big, Swamp, Brownson, and two tributaries of Axe and Brownson Creeks. These surveys quantified stream substrates, pool abundance, amount of shade and noted numerous beaver dams and dam complexes along most of the streams (and especially in Swamp Cr). Turbidity and sedimentation observed during these inventories were often attributed to beaver activity. The surveys also noted frequent debris jams along most of the streams surveyed and, along with beaver dams, recommended their removal.

During the summer of 1994, the BLM conducted intensive stream habitat inventories of Big Creek and its tributaries (reports on file in Myrtlewood Resource Area and ODFW, Corvallis, OR). Data collected during these surveys was intended to allow evaluation of survey streams in relation to ODFW habitat benchmark criteria (Appendix D, Table D-2). It is difficult to compare data from the 1973 and 1994 surveys because they were collected using different methods and for different objectives. However, general comparisons of habitat conditions between the two decades can be made. First, in 1973, streams throughout the watershed were dominated by large wood, both in aggregations and single pieces. In contrast, two decades later, wood is practically non-existent, either as single pieces or in aggregations. Secondly, beaver dams were abundant in surveyed streams in 1973 while in 1994, beaver dams were still present but much reduced.

Generalizations based on a combination of anecdotal evidence (based on interviews of long-time residents of the Big Creek watershed) and extrapolation based on aquatic inventory information suggest the following are the primary effects of human activities on the aquatic and riparian systems in the Big Creek watershed:

- Extensive logging of riparian vegetation reduced inputs of large wood and levels of shading, resulting in loss of instream complexity, downcutting of stream channels, and high water temperatures.

- Splash dams and water transport of logs scoured riparian vegetation and, in combination with stream-cleaning, eliminated large roughness elements (boulders, logs, beaver dams), resulting in habitat simplification, channel down-cutting, sedimentation, etc.

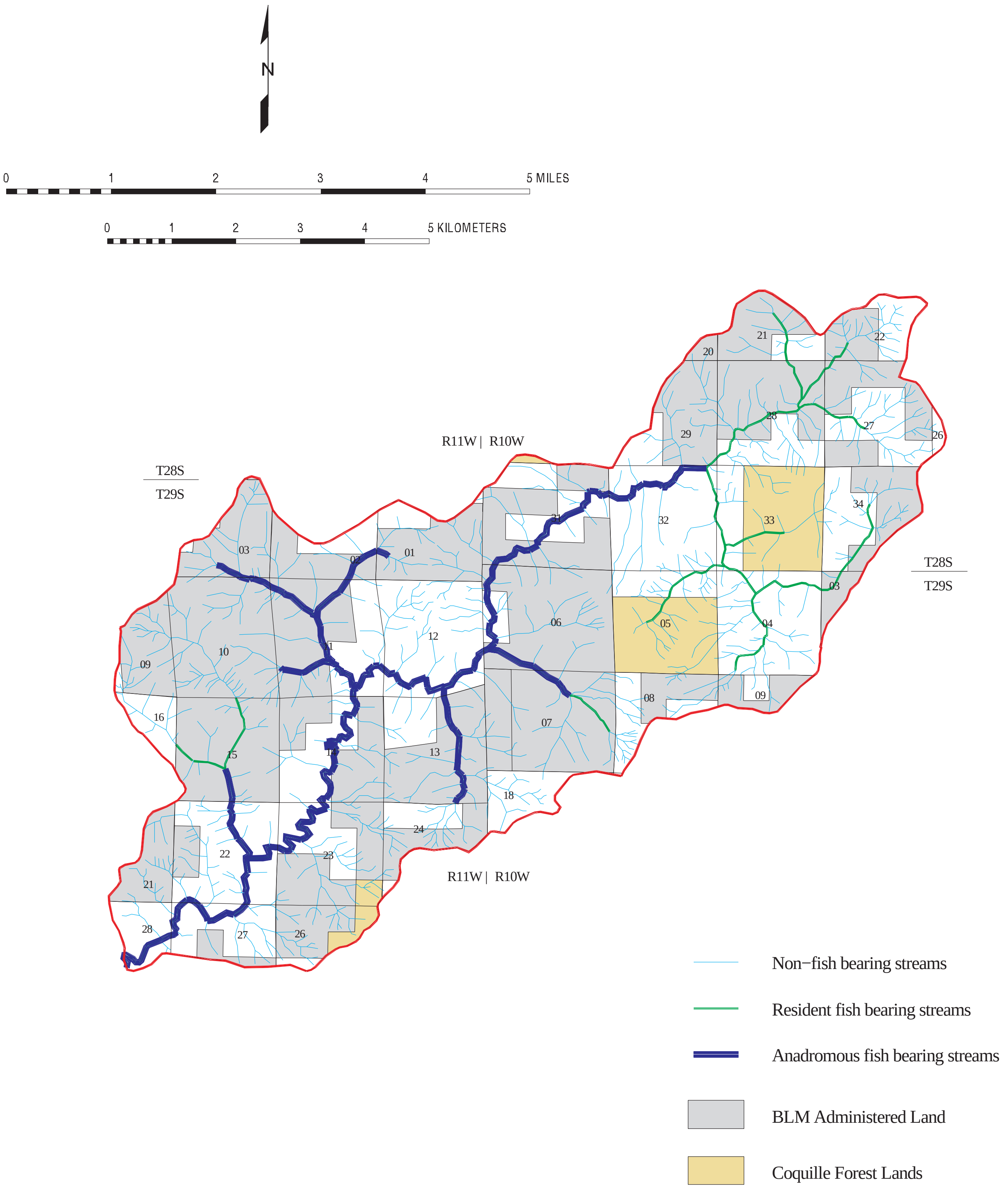
- Extensive riparian road networks encroached on streams, generating and routing sediment into streams, increasing downcutting, and disconnecting streams from floodplains. Additionally, the construction of roads and installation of culverts severed the connection between larger streams and tributaries, blocking passage for many organisms as well as blocking inputs of wood and boulders from debris torrents and landslides.

Fisheries

Distribution of Fisheries Habitat

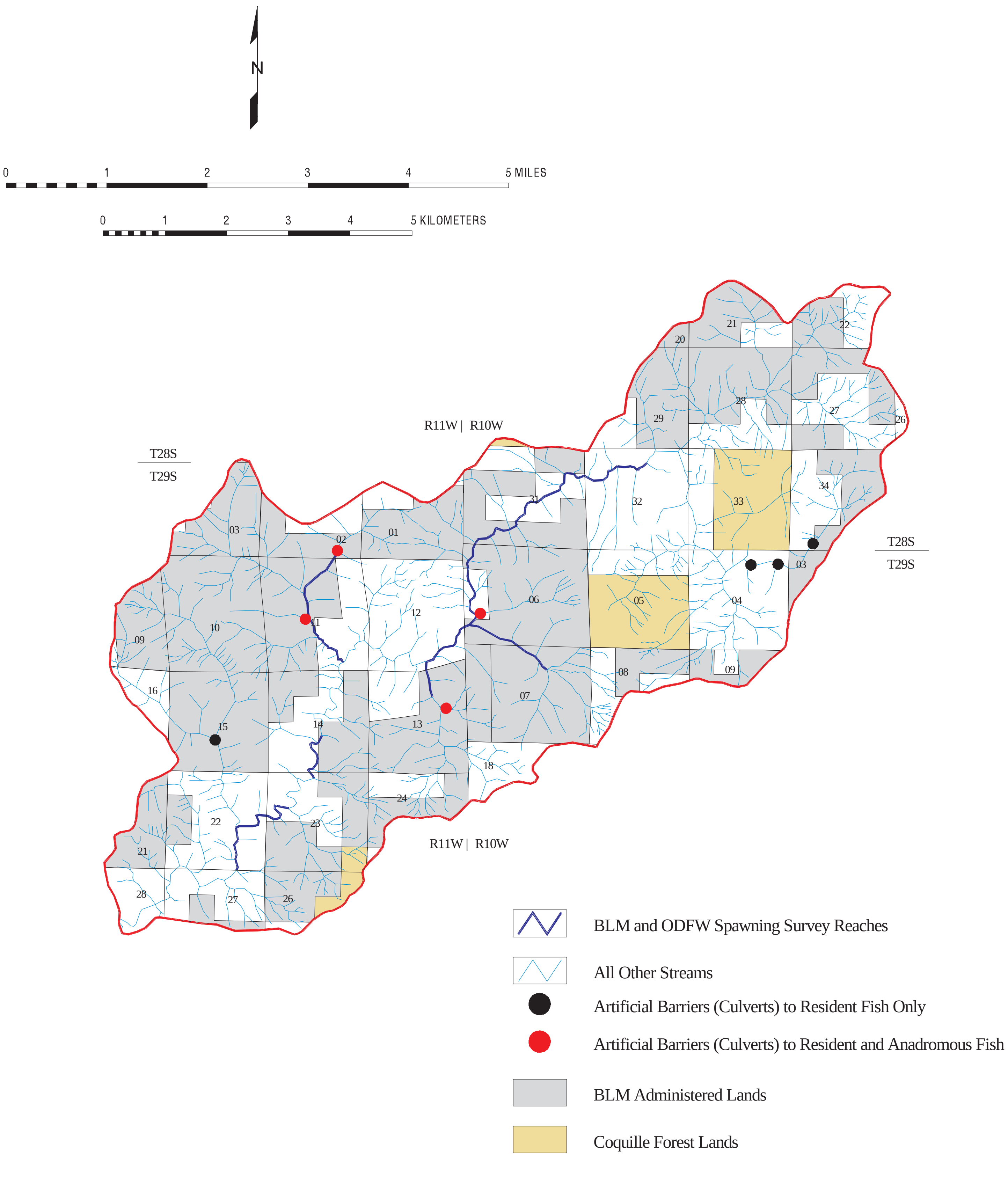
The Big Creek watershed contains approximately 18 miles of anadromous fish and an additional 11.5 miles of resident fish use (Figure III.6-5). Anadromous spawning habitat is widely distributed in the watershed, along lower-gradient 3rd to 5th order stream reaches (Figure III.6-6). Additionally, coho salmon have been observed spawning in small (2nd order) unnamed tributaries to Brownson and Big Creek. Use of small streams by coho is probably extensive in

Figure III.6−5 Anadromous and Resident Fish Presence



Scale = 1:84480 (3/4" = 1 mile)

Figure III.6-6 Anadromous Spawning Reaches and Artificial Barriers (Culverts)



Scale = 1:84480 (3/4" = 1 mile)

the drainage, but no data exists to support an estimate of the distribution of these fish in the watershed.

Miles of anadromous fish distribution change yearly, based on habitat and flow conditions. For anadromous fish, access to spawning and rearing habitat in the watershed is thought to be limited by the following *natural* barriers or habitat conditions:

- *Mainstem Big Creek*: a boulder canyon (Sec. 32) and a ten-foot waterfall a short distance upstream from canyon
- *Fall Creek*: a long, steep cascade (Sec. 22)
- *Jones Creek*: summer low flows preclude rearing here; high gradient and poor habitat preclude spawning use.
- *Bear Pen Creek*: high gradient in Sec. 7.
- *Swamp Creek*: anadromous fish not present due to barrier in Big Creek

Additionally, access to habitat is limited for both anadromous and resident fish by several human-created barriers (culverts) (see Figure III.6-6).

Abundance And Condition of Fisheries Habitat

Spawning & Incubation Habitat

There have been no basin-wide assessments of available spawning habitat in the Big Creek watershed; furthermore, the amount and quality of available spawning habitat varies yearly according to flow conditions (depth and velocity). Limited spawning surveys conducted by the BLM and ODFW, (reports of file in the BLM, ODFW offices) indicate that spawning habitat exists and is used by anadromous fish along mainstem Big Cr., Brownson Cr., and its main tributary, Bear Pen Cr., Axe Cr., etc.(Figure III.6-6). As mentioned previously, small streams are probably used extensively for spawning by coho salmon as well as cutthroat trout.

1994 inventories conducted in Big, Brownson, Brownson Trib, Bear Pen, Fall, and Axe Creeks indicated that most gravel riffles (assumed to be used as spawning habitat) contained a moderate amount of sand, silt and organic matter (Table III.6-6). However, the amount and condition of gravels and riffles in the late summer (when the inventory was conducted) may not represent spawning conditions during the fall and winter, when higher flows clean fines from riffles and redistribute gravel beds. Furthermore, floods during November 18-19, 1996 contributed and redistributed a large amount of sediment. Subsequent cursory examination and anecdotal evidence following the flood suggest new gravel beds were created and that fish were spawning much higher in drainage network.

Rearing Habitat

In the Big Creek watershed, the structurally complex habitats important for salmonid rearing are limited or non-existent. For example, the average woody debris complexity score for most reaches surveyed in the analysis area was about 1.5, corresponding to very low wood abundance, creating little or no habitat complexity or complex flow patterns and ineffective at providing cover at moderate to high discharge. Additionally, complex pools (with wood score ≥ 4) were very rare; only one was found in the watershed.

In general, pool habitat is fairly common throughout the watershed. The percentage of habitat made up by pools in Big, Fall, Brownson, Brownson Trib, and Swamp Creeks was (respectively) 41, 29, 30, and 44 percent. In Axe and Bear Pen Creeks (where average gradient ranges from 4.4-5.5%), the percentage of habitat made up by pools is low (7% in Axe and 4% in Bear Pen).

Despite the absence of structurally complex areas, several areas exist which currently provide or have the potential to provide adequate rearing habitat. These "hot spots" include:

- *Bear Pen Creek*: contains most complex habitat of watershed streams according to 1994 habitat inventory. Middle reach meanders across wide floodplain, only slightly downcut. Well-shaded. Riparian area largely without roads. No culverts present.

- *Upper Fall Creek* (Sec. 15 SE 1/4, NE 1/4): riparian zone dominated by large conifer. Low gradient, lateral pools and undercut banks common. Numerous beaver dams. Excellent potential for trout.

- *Brownson Creek & Trib*: Low overall gradient, meanders across narrow floodplain (bounded by road). Well-shaded. Numerous beaver dam and lateral pools.

Amphibians & Invertebrates

Habitat

Despite the fact that most of the stream miles in the Big Creek watershed are composed of small (1st-3rd order) perennial and intermittent non fish-bearing streams, there is little or no information on invertebrate or amphibian habitat or communities in these systems.

Macroinvertebrate community samples may be used to assess habitat quality indirectly (Rosenberg and Resh 1993). Data from limited macroinvertebrate samples collected in spring and fall on Upper Big Creek in 1995 showed abundance in the riffle community sampled to be lower that might be expected in a standard riffle sample (2,400-3,900 organisms vs. 5,000-6,000)(Hynes 1970). However, sample richness, evenness, and diversity were fairly high, indicating that water and habitat quality was generally good (report on file in Myrtlewood Resource Area) . From these limited samples, it is difficult to generalize about macroinvertebrate habitat and communities throughout the watershed because of tremendous variation inherent in macroinvertebrate samples and among microhabitat conditions across the watershed. However, based on knowledge of habitat requirements for macroinvertebrates and amphibians combined with information about habitat changes stream ecosystems on Big Creek, we may assume that removal of structure from stream channels (reducing habitat diversity), increases in water temperature, and additions of fines from adjacent roads have reduced affected macroinvertebrates and amphibians similarly to fish.

Table III.6-6. Comparison of habitat conditions in Big Creek and selected tributaries against ODFW Habitat Benchmarks.

“Good” habitat conditions are based on values from surveys of reference areas with known productive capacity for salmonids and from the 65th percentile of values obtained in surveys of late successional forests. “Poor” habitat conditions are based on values associated with known problem areas and from lower 25th percentile of combined data for each region. “Moderate” conditions lie in-between.

=Good Habitat Conditions =Fair Habitat Conditions =Poor Habitat Conditions

Benchmark Critera	Big Creek								Fall Creek		
REACH	1	2	3	4	5	6	7	Trib A	1	2	3
Pool Area	48.1	53.69	54.4	47.1	20.99	12.63	1.53	1.5	.40.92	31.51	10.54
Pool Frequency (channel widths)	9.5	10.5	10.7	11.6	10.3	18.8	145.4	227	9.4	19.8	40.0
Residual Pool Depth (m)	0.686	0.789	0.740	0.740	0.625	0.520	0.270	0.30	0.54	0.45	0.50
Width-to-Depth Ratio	48.5	48.9	53.5	53.0	38.7	33.4	27.2	23.0	14.7	60.0	1.0
Silt, Sand & Organic Material	9	6	6	9	4	11	5	9	7	5	88
Gravel (% area)	51	58	43	44	25	42	38	40	45	44	12
Shade (reach average %)	77	83	80	84	91	93	94	93	92	89	84
LWD (pieces/100m)	2.6	1.8	1.6	1.6	4.6	5.6	1.9	20.1	7.5	7.8	8.6
LWD (volume/100m)	1.1	1.6	1.6	2.7	10.1	14.7	3.3	38.6	1.6	3.9	10.0
Riparian Conifers (#>20" DBH/1000 ft)	0	30	0	61	0	41	X	152	0	0	0
Riparian Conifers (#>35" DBH/1000 ft)	<1	<1	<1	0	<1	<1	X	2.5	0	0	X

Table III.6-6 (continued)

Benchmark Critera REACH	Brownson Creek		Axe Creek	Bear Pen Creek	Swamp Creek	Jones Creek
	1	2	1	1	1	1
Pool Area	39.76	2.24	6.74	4.4	51.71	X
Pool Frequency (channel widths)	9.80	172.30	60.30	90.80	20.10	X
Residual Pool Depth (m)	0.71	N/A	0.48	0.45	1.29	.X
Width-to-Depth Ratio	30.2	1.0	16.90	31.6	22.80	X
Silt, Sand & Organic Material	42	X	14	15	54	X
Gravel (% area)	40	55	34	42	27	X
Shade (reach average %)	82	94	94	94	82	33
LWD (pieces/100m)	5.2	3.6	11.0	16.2	12.40	<1
LWD (volume/100m)	6.3	0.1	0.80	42.5	23.90	0
Riparian Conifers (#>20" DBH/1000 ft)	0	0	0	81	0	0
Riparian Conifers (#>35" DBH/1000 ft)	0	0	0	<1	0	0

Human-caused Barriers to Movement And Dispersal

Road density in the Big Creek watershed is high (up to 4.17 road miles/mi^{2}). Thus, many perennial streams throughout the watershed are crossed multiple times by roads. Roads and stream-crossing structures have been shown to function as barriers to the movement and dispersal of many fish and riparian wildlife species. Road crossings can inhibit fish passage because of blockage, deterioration, poor design (outfall barriers, excessive water velocities, disorienting turbulence, flow patterns, etc.) (Furniss et al. 1991). Culverts placed above the water level may allow entry only for larger fish with substantial jumping ability; entry by non- or poorly jumping organisms (i.e., juvenile salmonids, sculpin, herptiles, crustaceans, molluscs) is nearly impossible. Furthermore, lack of natural substrate in culvert bottoms may prohibit passage by organisms which require roughness, cover, and a precise microclimate. Currently, at least three culverts in the watershed are probable barriers to anadromous fish and at least five block movement of resident fish passage (see Figure III.6-6). Nearly every stream-crossing culvert in the watershed is a barrier to upstream migration of all other stream organisms due to disconnection of culvert outlet from the natural stream bottom and lack of natural substrate in the culvert-bottoms. Notable exceptions are located on Fall Creek, Brownson Creek and the main tributary to Axe Creek, where culverts have accumulated a substantial amount of gravel.

SYNTHESIS

Influences and Relationships

For a given number of spawners and seeding level, habitat conditions that set carrying capacity for rearing include stream productivity, abundance of certain habitat types (such as pools), and the quality of those habitats (i.e., complexity, water velocity and quality, depth, turbidity). The quality of spawning habitat is affected by substrate composition, cover, water quality and quantity. Successful incubation depends on extra- and intra-gravel chemical, physical and hydraulic variables, dissolved oxygen, water temperature, amount of fine sediment, etc. Access to suitable habitat for spawning and rearing may also be important in setting population levels.

In the Big Creek watershed, management activities over the last century have impacted the abundance and quality of each the above habitat factors, resulting in diminished system capacity to support fish populations.

- *Stream Productivity*

Stream productivity and fish production and survival are positively correlated (Meehan et. al. 1991, Konopacky 1984, McFadden and Cooper 1962) and abundance of food (macroinvertebrates) may override even cover in determining carrying capacity of juvenile salmonids in summer months (Christensen 1996). In the Big Creek watershed, management activities over the last century have reduced the input and retention of nutrients in Big Creek watershed streams. Intensive road-building in the drainage has likely increased sediment supply, modifed runoff, altered water and substrate quality, ultimately reducing macroinvertebrate populations. In reaches where macroinvertebrate communities are supported by inputs of organic material from riparian zones, removal of large wood from the channel has diminished the stream's capacity to retain the nutrients. Additionally, alteration of riparian vegetation during timber harvest or road-building has removed a major food source for macroinvertebrates. Typically, removal of streamside vegetation increases incoming solar radiation, causing concomitant increases in algae-dependent macroinvertebrate populations. However, fish production in Big Creek is not likely to increase because higher water temperatures are likely to outweigh benefits from the increased food supply. Finally, diminished salmon returns in the watershed have subsequently diminished the nutrient inputs associated with large numbers of salmon carcasses following the spawning season.

- *Habitat Abundance & Quality*

Pool abundance and quality is a major factor affecting abundance and survival of juvenile salmonids (Nickelsen et. al 1992a). Despite the fact that pool habitat is abundant in many streams in the analysis area, nearly all of the pools present are scour pools. Backwater, alcove, and beaver dam pools are very rare or absent in the watershed. Scour pools, unlike backwater, alcove and beaver dam pools, are erosional at high flows and therefore do not provide suitable winter rearing habitat for most salmonids. In particular, juvenile coho salmon avoid high velocity (scour) pools at high flows and instead utilize backwater, alcove and beaver dam pools (Nickelson et. al. 1992a and 1992b).

The removal of beaver and beaver dams throughout the watershed has reduced the abundance of an important habitat type for salmonids. Typically, proliferation of beaver and beaver dams may be closely linked to fish production and survival (Olson et. al. 1994) and beaver ponds are often used in high densities by coho salmon. In fact, production of coho salmon smolts in many Oregon coastal streams is suspected to be limited by the availability of habitats created by beaver activity (Nickelson et. al. 1992b). In addition to providing complex pool habitat, beaver dams also trap sediments, help maintain summer base flows, reduce stream temperatures, improve riparian vegetation development by changing the water table, and reduce water velocities and scour (Olson et al 1994) (see Section III.3 Stream Channel). Thus, the elimination of beaver and beaver dams throughout the Big Creek watershed is likely a major cause in declines of salmon populations (particularly coho) from historic levels.

Although most stream data collected for the Big Creek watershed and subsequent management in analysis area focuses on larger streams (4^{th} order or greater), most of the stream miles in the watershed are made up of small streams. Because small streams are so numerous in the watershed and because they dissect the uplands, they are most likely to be affected by management.

Small streams are responsible for habitat quality and nutrient availability in larger tributaries downstream. Fishes such as coho salmon and cutthroat trout are often found spawning and rearing in these small perennial systems. Small streams also provide habitat for a variety of amphibian and invertebrate species. They typically contain considerable micro-habitat diversity, producing rich biotic communities supported by allochthonous inputs from the adjacent forests. These small upland systems often contain species not found in mainstems or lower reaches (Tew 1971). For example, in the adjacent Sandy Creek watershed, limited sampling in small streams produced greater caddisfly diversity than was present in mainstem Sandy Cr., including 7 species not found in the mainstem itself (BLM 1997b)

Persistence of these small-stream communities depends on stability of small stream channels (maintained by riparian vegetation, down wood), flow regime, and shade and detritus contributed by riparian vegetation.

There have been no systematic surveys of amphibian or aquatic invertebrate habitat in the Big Creek watershed. Typically, habitat conditions important for aquatic amphibians and invertebrates (which spend some or all of their life in the water) are similar to that of fishes: water temperature and chemical composition, water velocity, stream productivity, amount of solar radiation, and physical variables such as substrate composition, habitat complexity, availability of cover, etc. (Hynes 1973, deMaynadier et. al. 1996, Nussbaum et. al. 1983). Invertebrate diversity is usually closely associated with substrate diversity and complexity of flow patterns (Christensen 1996). It is therefore assumed that management activities affecting instream habitat, flow patterns or riparian vegetation affect small stream communities in much the same way as the larger systems.

- *Access to Habitat*

The presence of man-made barriers in the Big Creek watershed limits the ability of fishes and other species to access historic habitat. The capacity of aquatic and terrestrial species to access habitats and refugia may be an important factor in ensuring survival. Movement and dispersal may also be necessary to create and maintain genetic diversity. Formerly continuous populations that become reduced in size and isolated by barriers are more susceptible to genetic, demographic, and environmental changes (Shaffer 1982, Soule 1987).

Only four culverts in the watershed are barriers to salmonid species; however, nearly every other stream culvert is a barrier to passable by non-jumping aquatic organisms, including sculpin, crayfish, molluscs, and other invertebrates. Some adult amphibians are capable of overland travel and may be able to by-pass problem culverts; however, research indicates that roads may also significantly inhibit the movement of some salamander species (deMaynadier and Hunter 1995). For a Southern Torrent salamander, which is rarely found farther than one meter from a stream (Blaustein et. al. 1995, Bury pers. comm., Applegarth pers. comm), a road would likely serve as a nearly impassable barrier. Because many riparian areas in the Big Creek watershed are intersected by roads, maintenance of aquatic dispersal routes may not only important for aquatic species but may provide the only dispersal route for terrestrial ones as well.

Barriers to the passage of certain aquatic organisms may have serious impacts on ecosystem process in small streams above barriers. These barriers could act as one-way valves allowing downstream movement of organisms, but no upstream movements. If a large number of organisms are flushed out of the headwater due to a high flow event, long-term population levels could be affected by the reduction of individuals and the lower genetic diversity. Amphibians, crayfish, and invertebrates make up a large portion of the biomass produced in aquatic systems, contribute to the maintenance of food webs by processing vegetation and leaf litter, and increase availability of nutrients to other organisms (Christensen 1996, Taylor et. al. 1996, Hynes 1970).

Role in the 5th Field Watershed

It is difficult to quantify the impact of the Big Creek watershed on the larger 5th field watershed due to lack of data on the 5th field scale. However, sufficient data exist to support the conclusion that the Big Creek watershed holds a higher value than other subwatersheds in maintaining salmonid survival in the greater Middle Fork Coquille system.

This determination is based on several factors:

- *Greater proportion of federal ownership*-relative to other watersheds in the M. Fork

Coquille basin, a greater proportion of the Big Creek watershed is federally owned. This enhances our ability to manage the system effectively for the protection and recovery of anadromous and resident fishes.

- *Lower intensity of stressors*-relative many low-gradient streams in the M. Fork Coquille system (such as the Lower Rock-Myrtle Cr. system), Big Creek and its tributaries receive less pressure from grazing, residential and agricultural development, and timber harvest.

- *Habitat quality and abundance*-streams in the Big Creek watershed contain a greater abundance of pools and higher pool frequency than many neighboring systems. Levels of silt and sand are substantially lower and gravels more abundant here than other surveyed streams elsewhere in the M. Fork Coquille system. The Big Creek watershed also contains a greater proportion of low-gradient stream miles than elsewhere. The high proportion of low-gradient stream miles combined with relatively high levels of beaver activity compared to elsewhere particularly enhance the importance of this watershed to survival of coho salmon in the basin.

- *Abundance of fish-bearing streams*-due to topographic characteristics of the Big Creek watershed, there are more fish-bearing stream miles here than in many other watersheds in the M. Fork Coquille basin. Although absence of natural barriers in the watershed increases the distribution of anadromous fish, there are also portions of the watershed inaccessible to anadromous fish, providing refuge for resident populations. Abundance of streams bearing both resident and anadromous fish increases available refugia for all populations in the case of stochastic events.

- *High spawning densities*-Unlike many other streams in the M. Fork Coquille basin where spawning activity is highly localized, spawning activity is distributed widely throughout the Big Creek watershed. In addition to providing greater abundance of spawning habitat, BLM spawning survey reaches in Big, Bear Pen, and Brownson Creeks appear to support higher densities of spawners than BLM survey reaches elsewhere in the basin, increasing the relative importance of Big Creek in the M. Fork Coquille system.

Aquatic Habitat-Management Objectives

Connectivity: Maintain and restore connectivity between and within streams for *all* aquatic species. Human-caused barriers and impediments to movement and dispersal, such as deteriorated or poorly designed culverts, should be removed or modified to allow *all* species access to historic habitat. Specifically, culverts should be placed in contact with the stream bed and designed to replicate natural stream-bottoms (i.e., to collect gravel throughout).

Emphasis on Processes: Restore the processes which create and maintain habitat for aquatic organisms. For example, the input of large wood and boulders onto floodplains and into stream channels via landslides and debris torrents is an integral part of creating and maintaining habitat for riparian and aquatic organisms. Currently, the input of these materials via landslides and debris torrents is typically blocked by riparian roads and culverts. The removal (when possible) of riparian roads and/or avoidance of road construction in riparian zones helps restore or maintain inputs of large material.

Protect Refugia: Portions of the watershed (such as Bear Pen, Brownson, and Axe Creek drainages) currently providing good-quality habitat for fishes, invertebrates, amphibians, and other aquatic species should receive priority in protection and restoration. In drainages where culverts are few or absent (such as Bear Pen and Axe Creeks) and stream ecosystem connectivity is relatively intact, management activities should avoid installation of structures such as roads and culverts which may restrict access of species to habitat.

Habitat Quality: "Any species-specific strategy aimed at defining explicit standards for habitat elements would be insufficient for protecting even the target species" (Standards and Guidelines, B-9). Projects to restore or improve habitat quality should focus on restoring conditions appropriate for all aquatic organisms. A specific management objective for habitat quality is twofold: (1) meet or exceed ODFW criteria for "good" fish habitat, and (2) conduct habitat improvement projects which create and maintain a diverse array of flow conditions and substrates to support diverse invertebrate and amphibian communities.

Cooperation: Opportunities exist for joint habitat-restoration projects in middle and lower Big Creek with private landowners and with the Coquille Watershed Association. Management should focus on establishing joint project-goals and sharing implementation and monitoring of subsequent projects.

Emphasis on Aquatic-Riparian Linkages: A dynamic linkage between riparian zones, floodplains, and streams is necessary for proper functioning of each element. Management activities should focus on creating and maintaining hydrologic and physical links between riparian and aquatic systems, including: placement of instream-structures which aggrade stream channels and route water onto floodplains, and placement of large wood that links stream channels to floodplains, stores sediments, and provides habitat for riparian and aquatic organisms.

AQUATIC AND RIPARIAN SPECIES

Analysis Questions:

What aquatic and riparian-associated species historically occupied drainages in the analysis area?

What aquatic and riparian-associated species are currently present, and how are they distributed?

What is the role of this analysis area within the larger 5th field watershed with respect to species viability?

What are the influences and relationships of aquatic and riparian associated species with other ecosystem processes and elements (e.g., sedimentation, vegetation, habitat), and what natural and management-related processes have the potential to reduce or limit the viability of these organisms?

What are population trends of sensitive aquatic organisms in the analysis area?

What are the management objectives for aquatic and riparian species in the analysis area?

What management actions (restoration, maintenance, protection, etc.) could be undertaken that would be maintain and/or restore the desired populations of aquatic species? (See Section IV - Recommendations)

Table III.6-7 contains the species and species functional groups or guilds found in the Big Creek watershed. Specific information about each species or groups with special management status follows the table. Although there have been no known recent extinctions, populations size and distribution have changed.

Table lists species that are obligate users of streams or riparian areas during their life cycle that are found or are likely found within the watershed. Species are grouped by guild to emphasize functional relationships.

<u>Fall Chinook Salmon</u>
The biology and life-history of chinook salmon have been summarized elsewhere (see Groot and Margolis 1995). The fall chinook salmon of the Big Creek watershed and the Coquille River basin are "ocean-type" and are part of a gene conservation group extending from Coos Bay to Elk River. Among the fall chinook populations in this group, the Coquille (and Coos) populations tend to be relatively small, with an age at maturity that is intermediate compared to other coastal populations (Nicholas and Hankin 1989, cited in ODFW 1995a).

Adult chinook return to Big Creek from the ocean in the early November and spawning occurs until late December. Peak spawning usually occurs from the second week of November through the first week in December. After emergence, chinook juveniles probably rear in Big Creek from three to six months before migrating to the estuary or ocean.

No data exist which support an estimate of historic or current chinook population levels in Big Creek. For management purposes, however, is assumed that population levels and trends in Big Creek have mimicked those of the Coquille basin (for which there is rough population data). According to cannery records, the Coquille commercial catch ranged from 1,000 to 19,000 fish annually from the 1890s to 1924 and then declined until the fishery was closed in 1957 (ODFW 1995a). ODFW fall spawning ground counts in the Coquille basin indicate that fall chinook increased steadily in abundance during the 1960s, then stabilized with no trend in the 1990s. While a stable or increasing fall chinook salmon population may be implied by current data, it should be noted that major impacts to the population may have occured in the era of splash-damming and large scale commercial harvest *before* spawning survey data was collected. Current population sizes in the basin cannot be accurately measured but are estimated to range from 1,800 to 7,500 (ODFW 1995). The relative contribution of Big Creek and its tributaries to the population cannot be measured.

Table III.6-7 Aquatic and Riparian Species of Ecological Concern in the Big Creek Analysis Area.

Species listed have been found in the watershed or incorporate the watershed in their home range. [1]Species without specific legal or management status but are of concern due to role in ecosystem function. [2]At risk of extinction according to Nehlson et. al. (1991).

Species Group/Guild	Common Name	Scientific Name	Habitat Association	Pop'l Trend	Status
herbivorous	Beaver	*Castor canadensis*	Loti, lentic, riparian	unknown	ecological concern[1]
insectivorous	Chinook salmon (fall)	*Oncorhynchus tshawytscha*	Lotic	stable	ecological concern[1]
insectivorous	Coho salmon	*O. kisutch*	Lotic, lentic	decreasing	Proposed T&E At risk of extinction[2]
insectivorous/piscivorous	Coastal cutthroat trout	*O. clarki*	Lotic, lentic	decreasing	At risk of extinction[2]
insectivorous	Winter steelhead	*O. mykiss*	Lotic	decreasing	Proposed T&E At risk of extinction[2]
omnivore	Pacific Lamprey	*L. tridentata*	Lotic (channel margins)	decreasing	State Sensitive-Vulnerable
insectivorous/piscivorous	Pacific Giant Salamander	*Dicamptodon tenebrosus*	Lotic, lentic, riparian, springs/seeps	unknown	ecological concern[1]
insectivorous	Southern Torrent Salamander	*Rhyacotriton variegatus*	Lotic (channel margins), springs/seeps	unknown	State Special Status-Critical
insectivorous	Dunn's Salamander	*Plethodun dunni*	Riparian, springs/seeps	unknown	ecological concern[1]
scraper/herbivore (tadpole) insectivorous (adult)	Tailed Frog	*Ascaphus truei*	Tadpole: Lotic Adult: Lotic, riparian	unknown	Bureau Tracking State Sensitive-Vulnerable

collector-gatherer/omnivore (tadpole)	Red-legged Frog	*Rana aurora*	Tadpole: Lotic (channel margins) lentic, springs/seeps Adult: Lotic, lentic, springs/seeps, riparian	unknown	Bureau Tracking State Sensitive-Vulnerable
insectivorous (adult)	Foothills Yellow-legged Frog	*Rana boylei*	Tadpole: Lotic (channel margins) Adult: Lotic (channel margins), riparian	unknown	Former Fed'l Candidate 2 Bureau Tracking
scraper-herbivore	Beers's false water penny beetle	*Acneus beeri*	Larvae: Lotic (cobble, rubble) Adult: unknown	unknown	Former Fed'l Candidate 2 Bureau Tracking
scraper-herbivore	Burnelli's false water penny beetle	*Acneus burnelli*	Larvae: Lotic (cobble, rubble) Adult: unknown	unknown	Former Fed'l Candidate 2 Bureau Tracking
insectivorous	Montane bog dragonfly	*Tanypteryx hageni*	Larvae: Lentic, springs,/seeps Adult: riparian	unknown	Bureau Tracking
scraper-herbivore	Denning's Agapaetus caddisfly	*Agapaetus denningi*	Larvae: small springs Adult: riparian	unknown	Bureau Tracking

Coho Salmon

The coho salmon of Big Creek and the Coquille basin belong to a gene conservation group ranging from the coastal lake region between the Siuslaw River and Coos Bay to Cape Blanco (ODFW 1995). Adult coho return to Big Creek and its tributaries in early November and spawn until mid-January, with peak activity in late December. Juvenile coho probably spend one summer and one winter in the Big Creek subwatershed before migrating to the ocean.

No data exist which support an estimate of current or historic coho population levels in the Big Creek watershed. Spawning ground surveys conducted from 1992-1996 by BLM and ODFW (reports on file in MRA and ODFW) indicate that spawning escapement in the survey reach exceeded the ODFW target of 42 fish/mile. As with chinook, is assumed that coho population levels and trends in the Big Creek watershed have mimicked those of the Coquille basin (for which there is rough population data). Standard spawning ground surveys of coho conducted throughout the Coquille basin since 1958 show a clear decline in spawning escapement (ODFW 1995). From 1985 to 1995, the population of adult wild coho salmon within the Coquille basin was below the minimum escapement goal of 16,380 (42 fish/mile) for eight of ten years.

Winter Steelhead

The steelhead trout of the Big Creek watershed and Coquille River are part of a gene conservation group extending from the Umpqua to the Lower Rogue Rivers. There have been few or no genetic studies conducted on steelhead in this region and as a result, there is an absence of genetic information on steelhead in the Coquille and surrounding basins (ODFW 1995b).

Steelhead enter and spawn in Big Creek from mid-January through the first week in April. The spawning period for steelhead is quite protracted, but peaks have been observed one each in February and in March (depending on rainfall events).

Typically, the only information gathered on spawning winter steelhead is collected incidentally during coho salmon spawning surveys. As a result, current population size and carrying capacity of adult and juvenile winter steelhead in the Coquille River are unknown (ODFW 1992), but are likely below the spawning population escapement goal of 10,000 fish. Based on angler catch records, winter steelhead populations in the Coquille River were below their 20-year average during seven out of ten years from 1981-1990 (Nickelson et. al. 1992c), suggesting a downward trend in the winter steelhead population of the Coquille River. The BLM has conducted steelhead spawning surveys in Big Creek and elsewhere, but there is insufficient information to estimate the watershed or basin population and the data suggest no trend in escapement.

Other Fish Species

No data is available from which to assess the population status of other fishes (sculpins, Cyprinids, lamprey) in the Big Creek watershed. Anecdotal information suggests that the numbers of spawning resident and sea run cutthroat trout (ODFW 1992) are below historic levels. Speckled dace populations are suspected to be above historic levels or at least more widely distributed due to water temperature increases within the watershed.

Beaver

Stream surveys in the 1970s noted that beaver and dams were abundant throughout the watershed, suggesting that populations must have increased following this initial trapping period in the early 1900s. However, in the 1970s and '80s, beaver dams were suspected to increase turbidity, cause massive siltation of spawning beds, and create barriers to anadromous fish passage and were actively removed by dynamite or mechanical means. As a result, current beaver populations are much reduced from historical levels.

Influences and Relationships

Salmonids

A variety of natural factors (described below) limit population levels of resident and anadromous salmonids in the Big Creek watershed. Management activities in the watershed affect salmonid production and survival when they alter the frequency or magnitude of these natural factors.

During all freshwater life stages, the major factors determining salmonid production and survival are water quality, habitat quality and availability, and food abundance. Incubation success is particularly affected by flow extremes, temperature, silt levels, and predation. Immediately after hatching, a large percentage of mortality is due to physiological stress during the conversion from yolk feeding to exogenous food sources and the establishment of territories. For the remainder of freshwater rearing, major factors regulating abundance change seasonally. In summer months, food availability and temperature-caused physiological stress are major limiting factors. During the winter, when fish switch from active feeding and growth to conserving energy, availability of suitable winter habitat limits abundance.

The effects of specific management practices on watershed and channel processes have been described in detail elsewhere in this analysis. In general, these practices directly affect fish production and survival when they alter the levels or timing of peak and base flows, route sediment into streams, simplify channels, limit habitat complexity, reduce food supply, and increase stream temperatures.

In the freshwater environment, the effects of management activities on salmonids may not be equal across all species. Resident trout and coho salmon may be particularly susceptible to limiting factors in the freshwater environment because they spend a greater portion of their life-cyle in freshwater than do chinook. Based on the relatively low survival rates from coho fry to smolt when compared to chinook (Sandercock 1991), it is apparent that the freshwater environment plays a major role in the fluctuation of coho abundance. In the Big Creek analysis area, management activities over the last century have differentially affected habitat required by coho salmon for life-stages where highest mortality rates are typically observed. For example, survival during the critical period immediately after emergence is dependent on the availability of low velocity areas and the ability of coho fry to establish territories within them (Sandercock 1991) but management activities in the analysis area have eliminated channel-margin habitat and complex pools which provide refuge for fry. Additionally, activities resulting in channel downcutting, the disconnection of streams from floodplains, and removal of beaver dams have eliminated off channel and floodplain habitats required by coho for winter rearing. Elimination of winter rearing habitat is proposed as the major factor limiting coho production in coastal streams (Nickelsen et al 1992a).

Interspecific competition in freshwater habitats may also limit the abundance of some salmonid species. For example, although cutthroat and steelhead trout prefer pools with overhead cover, in the presence of coho salmon, they may be excluded from these habitats (Hartman 1965, Bugert 1985, Glova 1986). The effects of interspecific competition for habitat may be exacerbated by management activities which limit habitat abundance and complexity, or that introduce coho into sections of streams normally accessible only to resident fish. Typically, complex pools support higher densities and diversity of fish species. Management activities in the analysis area such as stream cleaning or riparian harvest that reduced or removed instream structure have limited the capacity of watershed streams to support diverse communities of salmonids.

Other Fish Species

Information has not been collected on non-salmonid species in the watershed and it is therefore difficult to identify population trends and the major factors affecting abundance and survival. It is likely that non-anadromous species such as lamprey, sculpin and the Cyprinids in the analysis area have been particularly affected by management activities since these species occupy freshwater throughout most or all of their lifetimes.

Based on knowledge of habitat requirements for these species, it routinely assumed that management activities affecting abundance and diversity of habitat for salmonids have also affected habitat conditions for other species. For example, ammoecetes of Pacific Lamprey spend 5 years in freshwater, rearing in depositional areas in pools and along channel margins. It is probable, therefore, that management activities in the analysis area which have increased scour and downcutting have reduced the abundance of low-velocity depositional areas required by lamprey.

Beaver

In the absence of hunting pressure, beaver abundance is regulated by the density of available territories, and the density of territories is limited by available food (Payne 1984). It is not known whether beaver population levels in the analysis area are limited by hunting/trapping pressure or habitat and food conditions. It is possible that the lack of "velocity checks" (provided by down wood in the stream channel) throughout the watershed precludes dam-building.

Trends

Insufficient data exist to assess fish population trends and to quantify the impact of Big Creek salmon stocks on the health of the larger 5th-field watershed (the Coquille Basin). It is assumed that population dynamics in Big Creek generally mimic those at the larger scale of the Middle Fork Coquille and Coquille Rivers. A comparison of current and historical conditions indicate that, at the 5th -field scale, coho salmon and steelhead stocks have declined in recent years, while chinook salmon appear to be somewhat stable. Protection of aquatic and riparian habitats on public lands and restoration initiatives on both public and private lands will likely assist in the recovery of anadromous and resident fish stocks, if ocean conditions and fish harvest management are concurrently favorable.

Implementation of the Aquatic Conservation Strategy of the Northwest Forest Plan should improve habitat conditions for most aquatic and riparian-associated species on federal land. Because the State Forest Practices Act provides limited protection during private timber harvest and road building activities, aquatic and riparian habitats will likely continue to fragment and degrade.

Management Objectives

The objective of management in the Big Creek watershed should focus on providing habitat conditions for self-sustaining populations of native anadromous and resident species.

For chinook salmon, which spend only a short time in fresh water, it is extremely difficult to conduct meaningful assessments of population sizes and trends at the watershed scale based on numbers of returning adults (spawning) because inter-annual and between-population variation are typically great (Healey et. al. 1984). Management objectives should therefore focus on *establishing and measuring* conditions known to maximize chinook production and survival (abundant, clean gravel/cobble beds for spawning and incubation, presence of marginal areas and complex pools for rearing) and *preventing or minimizing* conditions known to cause widespread mortality of eggs, alevin, and fry (instability of gravel beds, lack of velocity checks, sedimentation).

For coho salmon and steelhead trout, which may spend several years in the Big Creek subwatershed, freshwater rearing conditions may play a dominant role in regulating abundance and survival. Management objectives should therefore focus on *establishing* and *measuring* freshwater rearing conditions known to maximize production and survival of these fishes (abundant, clean gravel beds for spawning and incubation, presence of low-velocity, complex in-channel and off-channel pools, good water quality and sufficient food supply) and *preventing* or *minimizing* conditions known to reduce survival and abundance (instability of gravel beds, sedimentation, low abundance of suitable rearing pools, high stream temperatures, etc.). Attainment of this objective means reaching minimum summer seeding (rearing) levels of approximately 1 coho parr/m^2 /pool (Nickelson et. al. 1992).

Cutthroat trout spend their entire life-history in the analysis area. Specific habitat objectives for chinook and coho salmon and steelhead trout should benefit cutthroat trout as well. In particular, activities which increase habitat complexity will subsequently reduce interspecific competition between cutthroat trout and the dominant competitor, coho salmon. In addition, management should focus on maintaining connectivity to historic small-stream habitat and refugia for native trout (through the removal of barrier culverts and protection of small streams). Finally, introduction or release of coho salmon above historic, natural barriers in the watershed (such as on Fall and Big Creek) should be discouraged to protect resident trout populations above.

Little is known about the habitat requirements of other fish species in the watershed, such as the sculpin, Cyprinids, and Lamprey. In general, management actions which maintain or improve water quality and increase habitat complexity and food abundance should benefit these species as well.

III.7 CORE TOPIC - HUMAN USES

Analysis Questions:

What are the cultural resources within the analysis area?

What the tribal uses and treaty rights within the analysis area?

What are the dominant human uses within the analysis area?

What are the transportation management objectives for BLM roads within the analysis area?

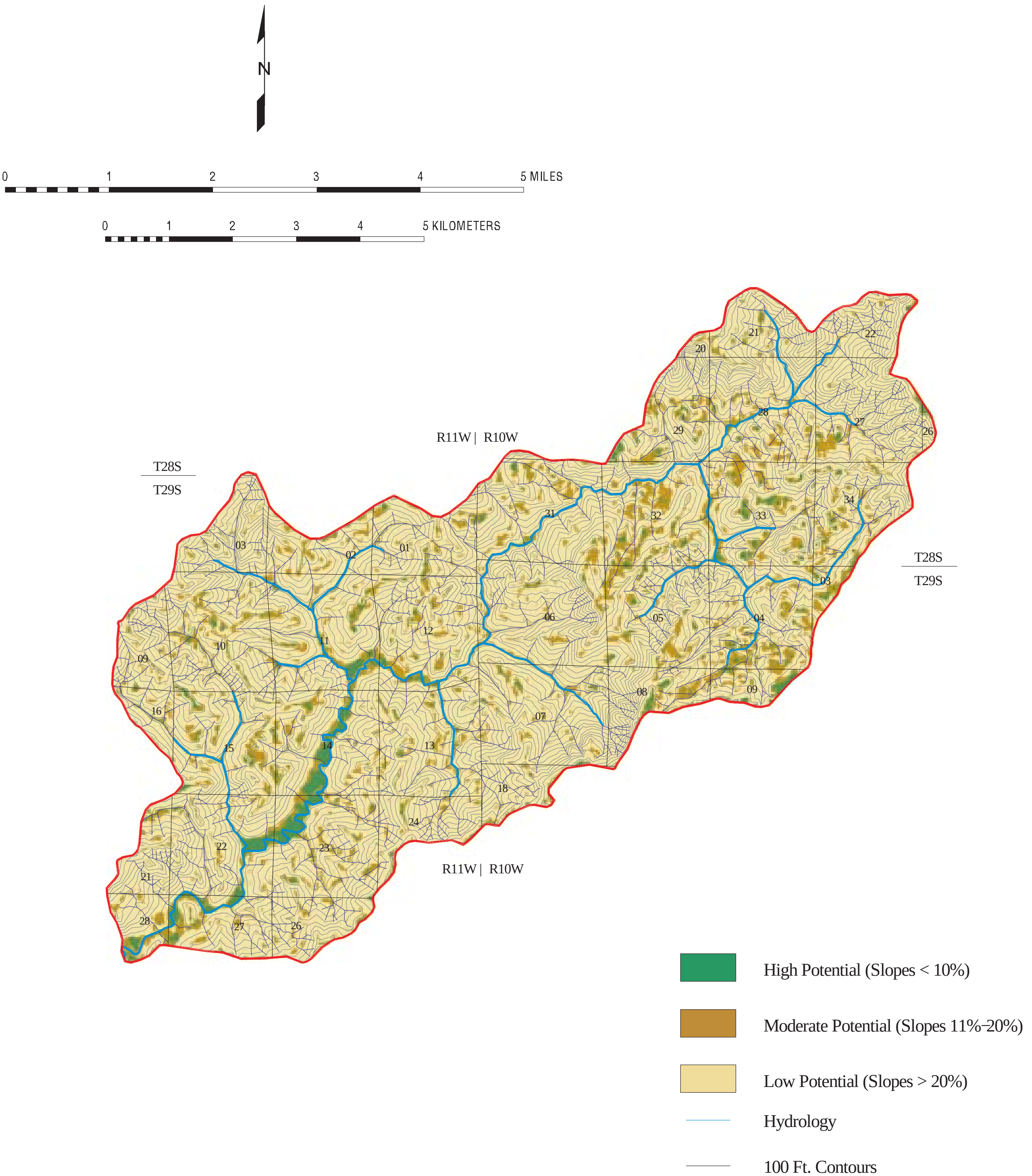
CULTURAL RESOURCES

The Big Creek analysis area has been the location of both prehistoric and historic cultural activities. In historic times, the focus of prehistoric activities probably was the Middle Fork Coquille River, into which Big Creek flows. The river provides an important transportation link between the southern Oregon coast and Camas Valley, both vital areas for prehistoric resource acquisition. As well as allowing access to gathering and hunting areas, the river and tributary streams also provided their own suite of fish and shellfish resources.

Archeological surveys of lands within the Coast Range have located relatively few prehistoric cultural resources. While several other criteria also are seen as important, the great majority of recorded prehistoric sites in the Coast Range have been found on relatively flat land forms (Toepel and Oetting 1992). According to their model, slopes greater than 20% hold little potential to contain recoverable prehistoric cultural resources. Applying this model, Figure III.7-1 illustrates that most relatively flat land forms with high (#10% slope) or moderate (11% to 20% slope) potential for prehistoric sites are the relatively small alluvial river and stream terraces. In the Big Creek watershed, these terraces are located along the lower reaches of the creek, with the majority extending from its mouth to the vicinity of the confluence with Brownson Creek. In contrast, most upland areas are deeply dissected with steep slopes. As expected in the Tipple and Oetting model, the majority of recorded prehistoric sites in this analysis area are located on the flat alluvial terraces.

While the steep topography is typical of this part of the Coast Range, this area also contains unusual topography; substantial areas of hummocky, marshy ground containing many small bogs are found in the northeastern half of the watershed. This area also extends into the adjacent Sandy Creek subwatershed. These areas were examined, but did not locate any evidence of prehistoric use. However, the presence of this unusual topography suggests the possibility of differing prehistoric land use patterns in these areas from that of the adjacent deeply dissected land forms.

Figure III.7−1 Prehistoric Site Potential Based on Slope



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Many of the historic activities centered along major waterways. The Middle Fork Coquille River has been a travel route between the Coos Bay vicinity and Roseburg from the late 19th century, and today State Highway 42 is one of the major travel routes to and from the coast. As elsewhere in the Coast Range, logging opportunities first drew Euro-Americans to settle along the Middle Fork Coquille River, and many of the known historic resources on upland BLM lands are remnants of early lumbering and homesteading. Prior to the use of trucks, lumbering relied on river transport to deliver logs to the downstream mills. In 1924, the Middle Fork Boom Company built three splash dams on the Middle Fork Coquille River. These operated through 1939, due in part to the persistent channel "maintenance" activities of the Port of Coquille (Beckham 1990). One of these splash dams was near the subwatershed, along the river.

Recorded Native American Cultural Resources

One village site has been recorded near this subwatershed, on an alluvial terrace along the Middle Fork Coquille River. As well, one upland hunting camp has been recorded adjacent to a meadow along the ridge marking the subwatershed boundary. Undoubtedly, these known prehistoric sites represent only a fraction of the localities used by Native Americans during their residence of several millennia. Fishing, hunting and gathering all would have been important resource acquisition activities conducted at these places.

Recorded Euro-American Cultural Resources

Known early historic cultural activities in this subwatershed are represented by homesteads. Several cabins are reported on private land on the alluvial terraces along Big Creek. A paleontological site also is recorded in a roadcut along a ridge top in the subwatershed.

NATIVE AMERICAN TRIBAL USES AND TREATY RIGHTS

As elsewhere in southwestern Oregon, modern Native American concerns in the analysis area center around three general issues; land transfer, resource acquisition and heritage protection.

Land Transfer

In United States Court of Claims testimony (Federal Supplement 1945:945), anthropologist John P. Harrington described the boundaries of the traditional territory of the Coquille Indian Tribe as extending throughout the entire Coquille River watershed (Hall 1995:26). In 1996, Congress created the “Coquille Forest”, composed of fifty-four hundred acres of BLM land in the vicinity of this subwatershed. Four parcels of Coquille Forest land are partly or completely within this analysis area (in T. 28 S.,R.10 W, Section 30; T. 28 S., R. 11 W., Section 33; T. 29 S., R 10 W., Section 5; and T. 29 S., R. 11 W., in Sections 23 & 26). (Figure I-4)

Resource Acquisition

The Coquille Indian Tribe signed two treaties with the United States. On September 20, 1851, they ceded the lands from the mouth of the Coquille River to the Summit of the Coast Range, then south to the Rogue River watershed. On August 23, 1855, they ceded the entire Coquille River watershed to the United States. Although the United States Senate never ratified either treaty, the land transfer became an accomplished fact when members of the Coquille Indian Tribe were forcibly removed to the Siletz Reservation in 1856.

The existence and extent of Native American rights to “usual and accustomed” places for modern resource acquisition (hunting, fishing and gathering) on public lands is an issue which continues to be addressed in legislative and judicial forums. The District is engaging in consultation with the Coquille Indian Tribe concerning the activity plans of both organizations. As well, regular meetings are underway concerning Coquille Forest transition planning. Coordination of planned activities affecting resource utilization locations will be possible as a result of such contacts.

Heritage Protection

Federal legislation aimed at protection and preservation of significant archeological sites addresses one facet of tribal interests in cultural heritage protection. However, the identification of land important as a “traditional cultural property” (or a “sacred site”) may not be based on physical evidence of past use, and therefore could involve properties in this analysis area which otherwise are not known to have cultural importance. At this time, the Coquille Indian Tribe has not specified public lands which contain such resources in this subwatershed. Ongoing consultations with the tribe in connection with specific activity plans and the Coquille Forest transfer also should clarify any concerns about such localities.

DOMINANT HUMAN USES

Timber Production

Approximately 60% of the analysis area is managed for timber production, leaving 40% reserved from harvest (primarily BLM lands only), and perhaps <3% in residential, agriculture, or grazing. Intensive forestry management often includes short rotation ages (40 to 60 years), site preparation after harvest (burning or mechanical), planting to desired species, removal of undesirable species, and thinning (precommercial and commercial) to obtain optimal spacing for volume production. Herbicides are commonly used on private lands for site preparation and to control undesirable tree and brush species.

The level of harvest activity can be expected to increase on private lands as their second generation forests reach rotation age. Activity on BLM lands can be expected to be stable over the next few decades, but at a reduced level than the 1970's and 1980's. due to the management direction in the RMP.

Special Forest Products

One of the most common special forest products harvested in the analysis area was cedar boughs, especially Port-Orford cedar. Understory Port-Orford cedar trees adjacent to roads or on easily negotiable terrain have been heavily pruned by bough pickers. This results in trees with approximately a 25% live crown and three to four inch stubs along the tree bole. Harvest of Port-Orford cedar boughs has been prohibited on BLM lands for the past 2 - 3 years, however, some illegal picking still occurs.

The amount of other products such as brush, mushrooms, or berries currently being harvested cannot readily be determined. Historically, except for Port-Orford cedar bough harvest, effects of removing these products have not been obvious. It could be anticipated that harvest levels might be somewhat higher than elsewhere due to its proximity to Highway 42, but how much in unknown.

Domestic Water Sources

Research located approximately 22 residences along Big Creek which use either surface water or wells as their source for drinking water. The locations of these sites are generally on tributary streams of Big Creek (Figure III.2-5).

Recreation

While most of the recreational opportunities throughout the analysis area are dispersed (hunting, fishing, sightseeing, collecting special forest products, etc.), a system of mountain bike trails have been constructed in the Jones Creek drainage. Initially built in the early 1990's, these trails utilize existing roads and ridges on BLM, Coquille Forest, and private lands. Concern has been raised as to the proximity of one segment of trail and the resulting increase in human activity to a grassy-type meadow containing special habitat. Use and their impacts are being monitored.

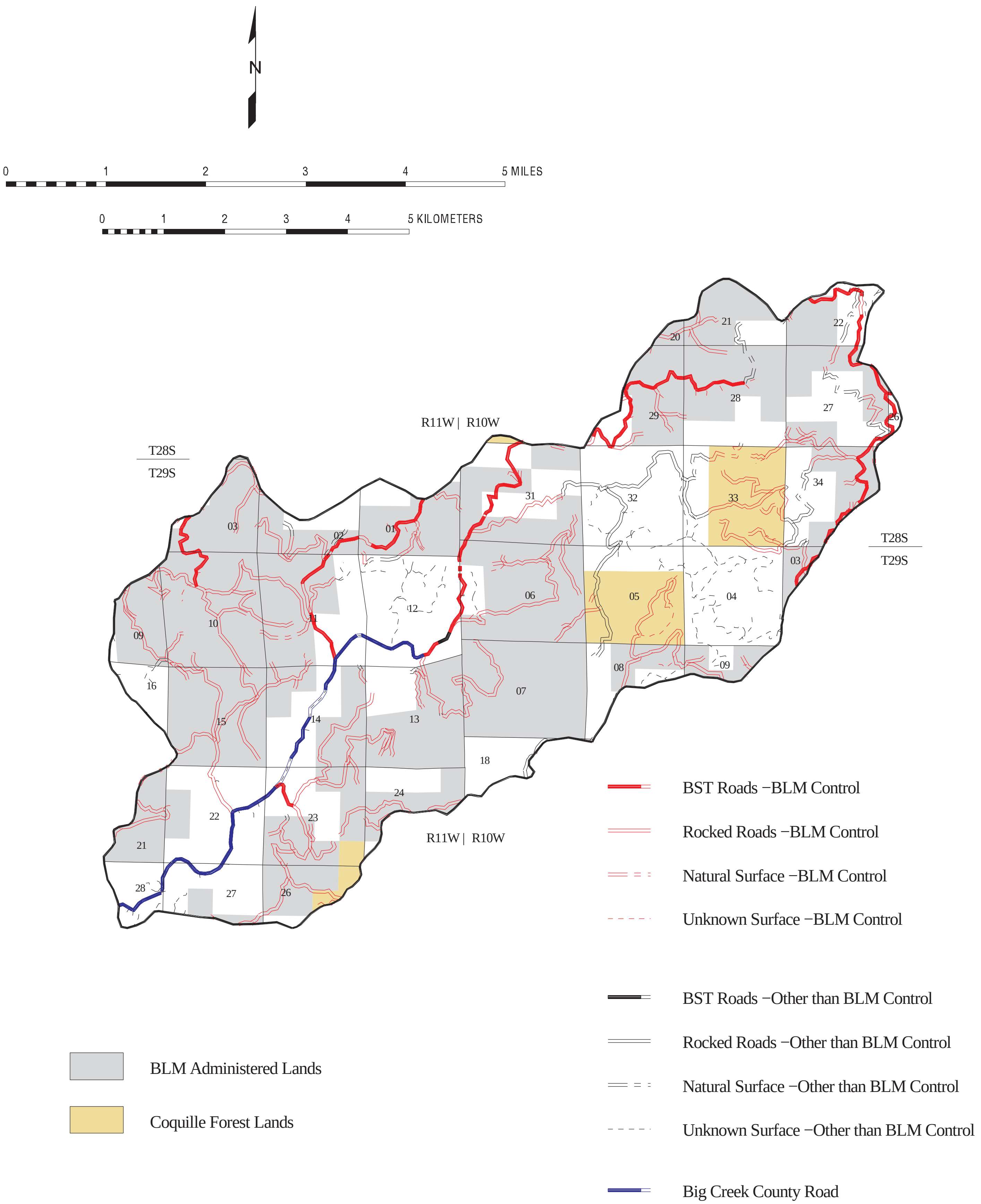
Transportation

Big Creek County Road is located adjacent to Big Creek and is the main road into this portion of the analysis area (Figure III.7-2). The road system is similar to others throughout Western Oregon in that the roads used to access the area were constructed along main streams. Midslope roads were constructed to access the ridge top network and access into adjacent drainages. These county, BLM, and private roads are used by multiple users for commercial, residential, and recreational purposes and form the backbone of the transportation system.

The road system is a complex matrix of various road users and owners; county, BLM, private timber companies, and individuals. The BLM has constructed roads on private lands through a variety of access agreements and private timber companies have constructed roads on BLM lands under ‘reciprocal’ right-of-way agreements. These agreements grant access rights to the BLM and the other party to cross each others land. These rights must be incorporated into any decision concerning road management.

The transportation system in the Big Creek analysis area is comprised of approximately 108 miles of road. The BLM controls 73.2 miles of road within the watershed constituting 68% of the total. These BLM roads are used to access approximately half the land within the watershed. At least 68 miles (63%) are surfaced either with crushed rock or a bituminous oil (asphalt) treatment. The remaining miles are natural surfaced or are private roads and the status is unknown. These figures, shown in Table E-1, Appendix E, have been derived from GIS, and while not complete (some data is missing, primarily on private lands), it does give the most precise and up-to-date information available.

Figure III.7−2 Transportation Theme by Control and Surface Type



Scale = 1:84480 (3/4" = 1 mile)

As described in detail in Section III.6 Species & Habitat - Aquatic, at least one splash dam was constructed for the purpose of transporting logs downstream

Rock Quarries

There is one large rock quarry operated by Georgia Pacific West Corp. in the very northeast corner of the analysis area (NW¼ SW¼ Sec. 26, T. 28 S., R. 10 W.). At least two other areas have been quarried to produce rock for specific road construction projects. BLM had a site adjacent to Elk Creek Ridge Road in the NE¼NW¼ Sec. 10, T. 29 S., R. 11 W. and Georgia Pacific West Corp. had a location adjacent to Road No. 29-11-28.0 Seg. K in NE¼NE¼ Sec. 32, T. 28 S., R. 10 W.

The rock source for these quarries is the massive sandstone member of the Tyee formation, commonly found throughout the Coquille basin.

TRANSPORTATION MANAGEMENT OBJECTIVES

The BLM road system was evaluated for its present and future uses using a Transportation Management Objective (TMO) process. The TMO process applies only to roads controlled by the BLM, as management of those roads lies within the Bureau's jurisdiction. Road management is guided by the desire to reduce the impacts from a large road network on the ecosystem, maintain a network adequate enough to meet the needs of land management, and to reduce road maintenance expenditures. The checkerboard land ownership pattern significantly complicates transportation management due to the right of access for landowners and the fact that different landowners often own alternating parts of the same road. In addition, roads adjacent to streams and midslope roads which often have the most impact of the aquatic resources are the main access roads into and through the analysis area. Most of the roads which present the best opportunity for closure or restricted vehicular access are the shorter, mostly ridge top roads which access only BLM lands.

Recommendations for Bureau roads can be found in Appendix E and background TMO information is on file in the Coos Bay District office.

III.8 RIPARIAN RESERVE EVALUATION

Analysis Questions

What are the primary ecological values associated with Interim riparian Reserves in the Big Creek analysis area? Which values are particularly sensitive and may need special management?

What species are present in riparian systems in the Big Creek analysis area? What is their abundance and distribution?

Which management activities are appropriate for riparian reserves? What are the potential effects of various management activities (including reductions in the reserve width) on these ecological values?

Are there areas where modification to the interim reserves along intermittent streams could occur?

What effect would modifications in the width of Riparian Reserves have on terrestrial and aquatic species?

PART I - CHARACTERIZATION

REFERENCE CONDITION

Riparian Vegetation
Information here is a summary of a detailed discussion of riparian reference condition contained in Section III.6-Species & Habitats.

Historic riparian vegetation in Big Creek may be classified into two somewhat distinct types: lowland (inhabiting floodplain terraces along the Middle Fork Coquille River and the lower five miles of big Creek, up to the mouth of Axe Cr.) and upland communities (inhabiting Big Creek above the mouth of Axe Cr. and along the higher-gradient tributaries of Big Cr.

Lowland Communities- Lowland vegetative communities are typically structured and maintained by the interaction of the stream channel with the floodplain and respond to soil composition, structure and moisture content and riparian disturbance (flood innundation, scour, deposition) (Mitsch and Grosslink 1993). Vegetation here may also be affected by the construction of dams and diversions by beaver which raise the water table, trap sediments on streambanks, and create side channels. Thus, historic lowland riparian vegetation in Big Creek probably consisted of moisture-tolerant and disturbance/colonizer species such as shrubs and low-growing woody vegetation (such as willow, vine maple), and hardwoods such as alder, ash, maple and myrtle (Mitsch and Gosselink 1993, Franklin and Dyrness 1973). Conifer (especially Port-Orford

Cedar and Western Redcedar) was probably sporadically present along lowland stream reaches, on high terraces (with less frequent fluvial disturbance).

Upland Communities-The upland riparian community in Big Cr. is associated with the higher gradient, hillslope-constrained reaches of Big Creek and its tributaries as well as higher terraces along Lower Big Creek. These communities are typically structured/maintained by disturbance processes such as infrequent floods, debris torrents, windthrow, and fire. (Swanston 1991 and others). In Big Creek, these may be divided into three types:

> **Conifer-Dominated Reaches**: located along hillslope-constrained, erosional, headwater streams and the upper reaches of low-order streams. V-shaped valleys, steep streambanks with little interaction between stream and riparian vegetation. Narrow or no discernible riparian "zones." Canopy cover is often 100%.
>
> **Hardwood-Dominated Reaches**: primarily located along low-gradient, depositional reaches. U-shaped valleys with floodplains of varying width containing recent or historic fluvial deposition. Beaver activity common. Canopy cover along these hardwood-dominated reaches can be highly variable, ranging from little (in the event of recent disturbance or intense beaver activity) to 100%. Hardwood-dominated reaches may also be located along high-gradient, hillslope-constrained streams where frequent disturbance precludes conifer establishment.
>
> **Mixed Reaches**: located along streams with moderate floodplains alternately constrained by hillslopes. Riparian area is a diverse mosaic of stands depending on local conditions (i.e., floodplain development, disturbance patterns, etc.). Hardwoods predominate where floodplains are well-developed; conifers predominate (with a narrow band of hardwoods immediately adjacent to the stream) where there is a little interaction between the stream channel and riparian area. Canopy cover along these reaches is high, often completely covering the channel.

<u>Riparian Species and Habitat</u>
Refer to Section III.6-Species & Habitats for additional information on species and habitats historically present in the watershed.

All riparian associated species (Appendix F, Table F-1) were probably more abundant and widespread historically. Habitat loss, fragmentation, degradation, and competition or predation from exotic species have contributed to population declines. While many of these factors have been affecting populations for centuries, changes have been more pronounced in this century (since European settlement). Some species, including Southern torrent salamanders and tailed frogs, are particularly susceptible to these changes and have probably experienced more pronounced declines. Other species, such as beaver, have been the target of specific removal efforts and have subsequently experienced significant population declines.

CURRENT CONDITION

Physical Characteristics

For the Big Creek analysis area, the GIS database indicates that interim Riparian Reserves occupy approximately 5,038 acres (56%) of the BLM-managed land (Figure I.-4), based on a site-potential tree height of 220'. It should be noted that this riparian acreage is an estimate; sources of error include unmapped streams and the difference between the actual location of the interim Riparian Reserve boundary (based on slope distance) and the computer-generated boundary (based on horizontal distance).

The extent of water-dependant vegetation may be used to delineate Riparian Reserves in some cases. However, in most cases, the width of this riparian vegetation width is very narrow for intermittent streams. It is highly unlikely that riparian vegetation would extend the Riparian Reserve beyond one-quarter to one-half site-potential tree height in the analysis area.

The inner gorge may also be used to delineate Riparian Reserve boundaries in some places. For the purposes of this exercise, an inner gorge is defined as the first slope break above the active channel margin and terraces. Typically, an inner gorge break would only be used to define a Riparian Reserve boundary of a canyon or similar geomorphological feature; however, such features are fairly rare within this analysis area.

Intermittent vs. Perennial Streams

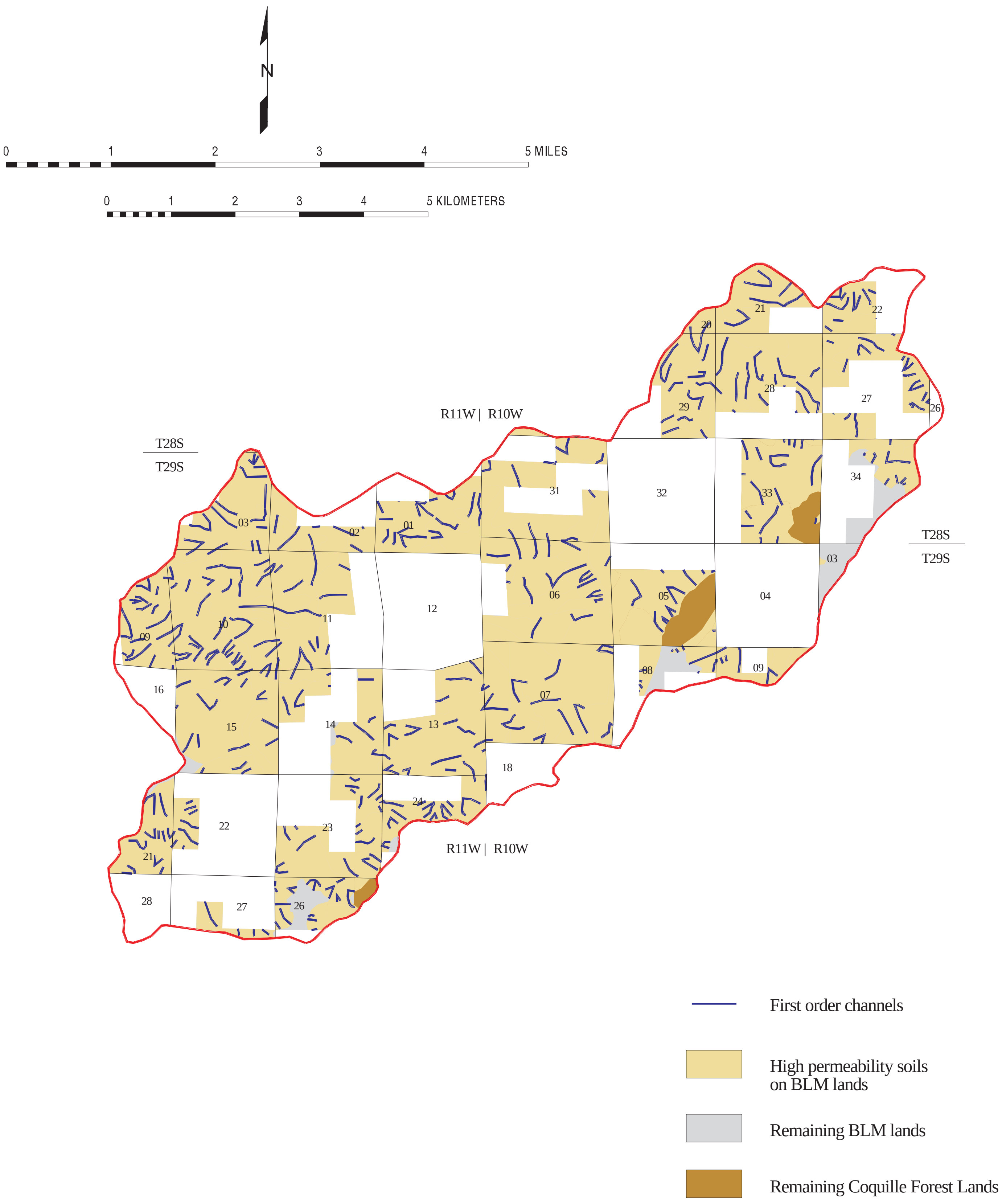
An initial stratification process to identify intermittent channels (Figure III.8-1) indicates that approximately 3035 acres of Riparian Reserve (33% of BLM-managed land in the analysis area) is adjacent to intermittent streams.

The initial stratification process used Darcy's law of groundwater flow, mapped soil types, and flow recession to estimate intermittent channels. It was found that a watershed of approximately 20-40 acres is necessary on high-permeability soil types (infiltration rates of 2-6"/hr.) to sustain perennial flow; streams in smaller catchments are likely to be intermittent (Dunne & Leopold 1978 and Haagen 1989). This drainage area roughly corresponds to the 1st order channels in the analysis area. According to this stratification process, there are approximately 102 miles of these streams in the analysis area, approximately 57 miles of which are on BLM-managed lands.

A perennial stream is "a stream that typically has running water on a year round basis" (FEMAT 1993). Alternate definitions include "a perennial stream or stream reach has measurable surface discharge more than 80 percent of the time. Discharge is at times partly to totally the result of spring flow or ground-water seepage because the streambed is lower than surrounding ground-water levels" (Meinzer 1923). Well-formed, adjustable channels have continuous channel boundaries and several distinct in-channel features. Fluvial action of sufficient duration (i.e., stream flowing year-round in most years) will carve a low flow channel. This is the so-called inner-berm, and is really a slight depression in the channel bottom which carries the minimum streamflow. Streams that have ponding, such as beaver dams, or that flow over bedrock will lack this feature. However, this cross-section dip is observable in most alluvial channels. In the

Figure III.8−1 Estimated Intermittent Streams for Big Creek

First Order Channels on High Permeability Soils (infiltration rate = 2-6 inches/hour)



Scale = 1:84480 (3/4" = 1 mile)

analysis area, some perennial seeps and outflows have not had sufficient discharge to form the inner-berm feature.

Intermittent streams in the analysis area tend to be 1st order, high gradient (>10%), low sinuosity, entrenched channels, with low width/depth ratios and bedrock, gravel, and/or sand substrates. This description fits A1a, A4a, and A5a stream types (Rosgen 1994). Other 1st order streams in the analysis area are more likely to be perennial because the deep, fine-textured soils surrounding these channels store large volumes of water, have low permeabilities, and drain slowly. This would correspond to A6a and A6 stream types. Some of these channels are lower gradient (4-10%), and may drain perched water tables.

Final determination of intermittent streams will be made in the field, based on the following definition and supporting criteria:

> Intermittent streams are defined as any nonpermanent drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria (FEIS ROD, p. B-14).

The Myrtlewood hydrologist provided the following interpretations of the terms used in the Northwest Forest Plan definition of intermittent streams:

- To be a nonpermanent drainage feature, the stream should have a streamflow duration of less than 80% of the time.

- A definable channel should have some minimum depth of incision, or be within a stream-adjacent inner gorge. The channel should be able to convey streamflow, and be essentially continuous. A definable channel can exist even though large organic debris may at times be lying in the channel or partially obscuring the channel.

- Annual scour or deposition usually is evidenced with distinct physical features. This may include: a stream scour line on the edges of the active channel, sediment accumulations behind obstructions in the channel, substrate in the channel more rounded than angular, and evidence of bankcutting on the outside of bends.

Biological criteria are also useful in distinguishing between perennial and intermittent streams, and determining the upstream terminus of perennial surface flow. The presence of aquatic invertebrates with protracted larval histories (> 1 year) (*Lara avara, Juga spp.*, *Philocasca rivularis*), or larval amphibians (tailed.frogs, Southern torrent salamanders, Pacific giant salamanders), strongly indicate perennial flow or persistent moisture sufficient to support biota associated with the perennial condition.

Riparian Vegetation

Lowland Community: Currently, the riparian zone along Lower Big Creek is predominately agricultural and residential. Tree diversity and abundance are low. The stream channel in Lower Big Creek is downcut and the channel lacks any substantial structures (debris jams, beaver dams) which might aggrade the streambed and divert water to floodplains. As a result, interaction between the stream channel and floodplain has been eliminated along most of Lower Big Creek. Elimination of a high water table in the floodplain, combined with agriculture and residential development, has resulted in the conversion of predominately wetland, riparian vegetation to predominately dryland species.

Average canopy cover in Lower Big Creek exceeds 75%, but notable exceptions may be found where grazing and agriculture have encroached on riparian vegetation. In several locations, riparian vegetation consists only of a thin strip of single trees bordering the stream.

Upland Communities: The primary impacts to upland riparian vegetation include timber harvest and road-building. Clearcut harvesting (with no or inadequate riparian buffers) and repeated salvage of trees and logs have eliminated many large old-growth conifers and logs from riparian areas. Comparison of aerial photos between 1949 and 1992 indicates incursion by red alder throughout the watershed, particularly along roads and where harvest with ground-based systems has occurred.

In general, mature and old-growth confers are lacking throughout Riparian Reserves. FOI analysis indicates that roughly 58% of riparian reserves in the Big Creek watershed are dominated by conifers younger than 80 years; only 2.4% of reserves are dominated by conifers 161 years or older.

Canopy cover: on average, exceeds 75%. While the average is high, there are several reaches along tributaries with little or no canopy cover. For example, Jones Creek averages only 33% and a substantial portion of Upper Swamp Creek is bordered only by brush and scattered alder.

<u>Riparian Species</u>

Refer to Section III.6 - Species & Habitats for information about species abundance, distribution, and population trends. Distributions for these species were not mapped because surveys for most of them have not been conducted and FOI vegetation information has limited utility for mapping many habitats. The process described in the Riparian Reserve Evaluation Techniques and Synthesis Appendix B (Feb 1997 draft) was used to develop a list of species of concern which would be the subject of further analysis in this Riparian Reserve Evaluation. The working lists and information used to develop this final list are on file at the Coos Bay District Office. Appendix F lists the riparian and aquatic plant and animal species of concern for the Big Creek analysis area.

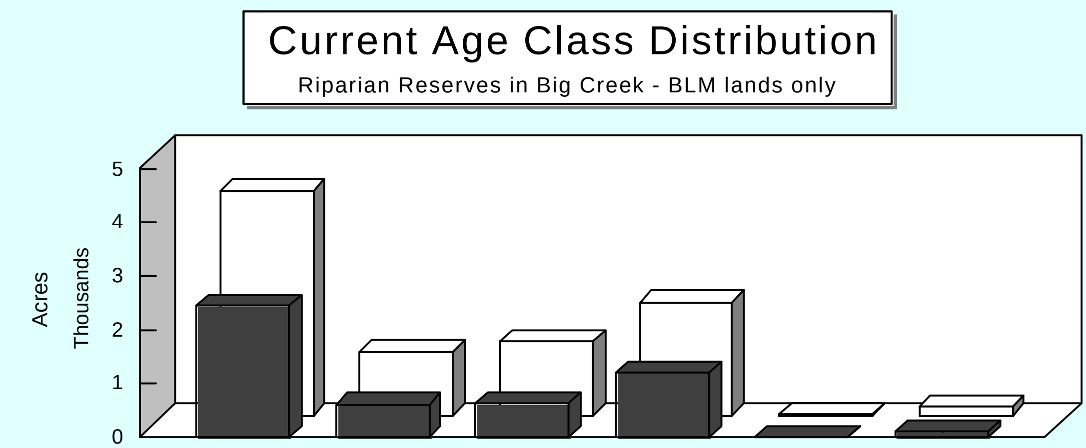
<u>Riparian Reserve Habitat Types</u>

Habitats in Riparian Reserves can be characterized into 8 general habitat types:

> *Late-successional forest* - While GIS/FOI age class information for older stands (>80 years or so) is often inaccurate, FOI offers the best available picture of forest condition. Currently, approximately 39% of Riparian Reserves contain forests >80 years of age. Approximately 2% of Riparian Reserves contain forests >160 years of age (Figure III.8-2

). Potential Reserve late-successional forest is distributed across the analysis area. The oldest forests in Riparian Reserves are located in Section 3, T.29 S., R.11 W. In the long-term, Riparian Reserves will offer late-successional forest habitat dispersed across the landscape. These habitats have two functions: providing dispersed habitat islands to temporarily support mobile species dispersing between large LSRs, providing habitat to support persistent populations of less-mobile species, and serving as refugia from which adjacent GFMA lands can be repopulated. In the subwatershed, these habitats are almost exclusively restricted to BLM lands, particularly along Bear Pen Creek, Axe Creek, and upper reaches of Brownson Creek and Big Creek. Late-successional forest habitat in Riparian Reserves is particularly important for many bat species (foraging, roosting, reproduction, and hibernation), marten, and northern spotted owls.

Figure III.8-2 Age Class Distribution in Riparian Reserves



Forest Age Class	0-40	41-80	81-120	121-160	161-200	200+
■ Riparian Reserves	2455	623	638	1207	5	109
□ All BLM	4179	1184	1369	2102	13	169

Based on 1997 FOI

Riparian - For this analysis, riparian habitat is defined *functionally* as the zone of interaction between the stream channel and floodplain. These areas are characterized by the presence of multiple terraces, woody debris deposited during high flows, variable soil moisture conditions, and a characteristic vegetative community. In the Big Creek watershed, these characteristic vegetative communities are restricted to low-gradient, wide-floodplain reaches such as the lower portions of Big and Brownson Creeks. This vegetation consists of moisture-tolerant and disturbance/colonizer species such as shrubs and low-growing woody vegetation (such as willow, vine maple), and hardwoods such as alder, ash, maple and myrtle (Mitsch and Gosselink 1993, Franklin and Dyrness 1973). Conifers may also be present on higher terraces and other areas which receive less-frequent fluvial disturbance. Riparian habitats provide optimal habitat for a large number of species. Some riparian-associated species (such as amphibians, mustellids, and invertebrates) depend on riparian habitats for all stages of their life cycle while other species (such as a variety of bat and bird species) are riparian obligates for portions of their life cycle (such as foraging or nesting), but may use upslope habitats as well.

Aquatic (lotic) - These habitats include the streams themselves and the immediate streambank and splash zones. The analysis area contains approximately 186 miles of lotic stream habitats, ranging from low-gradient 5th order streams, to high gradient, intermittent streams. Most of the aquatic species on the list of species of concern depend on stream habitats for all or part of their life history. For example, southern torrent salamanders inhabit high gradient headwater perennial streams with high water quality and low temperature. Pacific giant salamanders inhabit headwater and lower perennial streams. Tailed frogs are found primarily in larger perennial streams, often with high gradient. Foothill yellow-legged frogs inhabit still larger streams (e.g. lower reaches of Big Creek). Beaver use low-gradient streams with wide floodplains such as lower Brownson, Bear Pen, and Fall creeks.

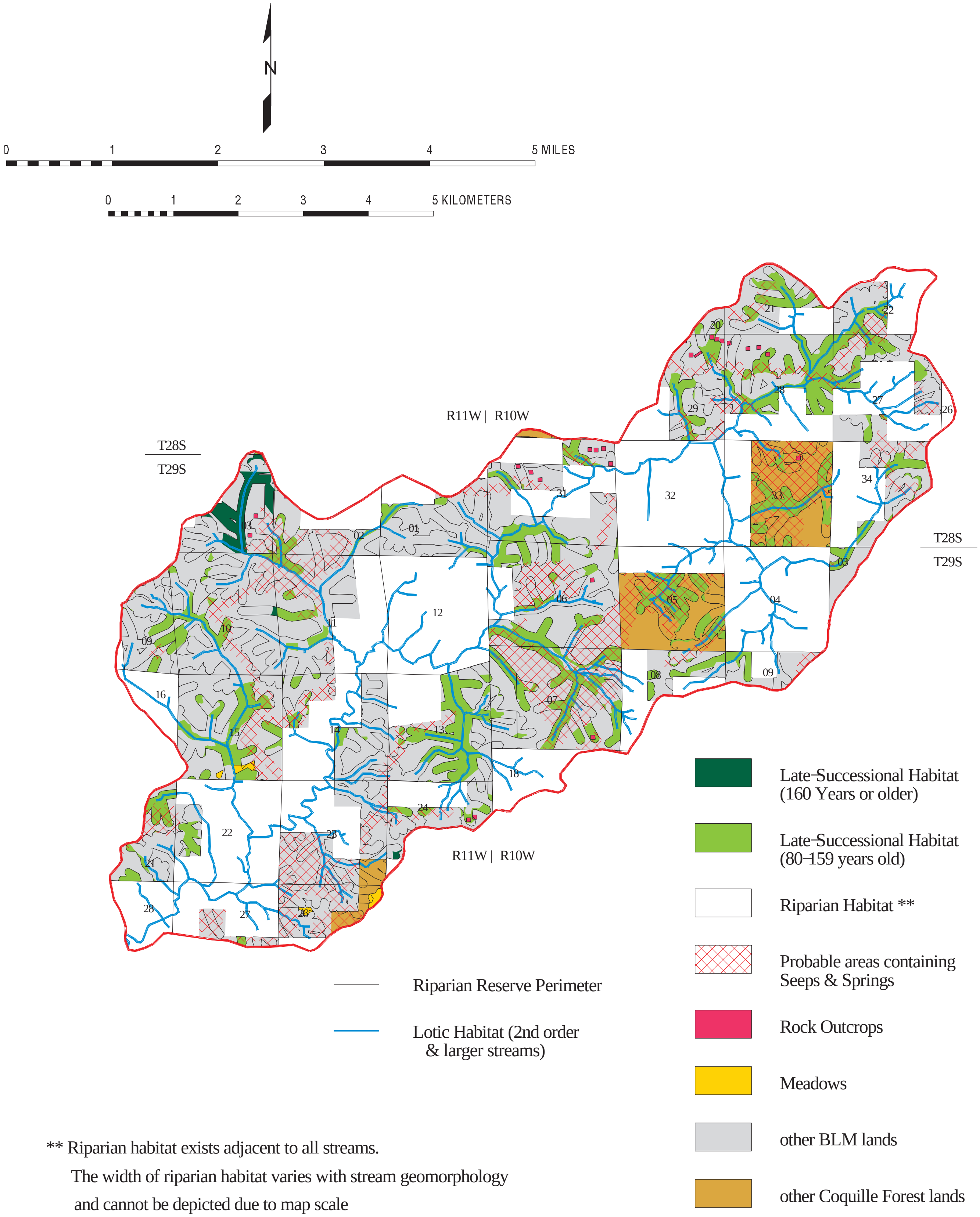
Aquatic (lentic) - With the exception of beaver ponds, no pond habitats are known to occur in the planning area. If they occur, they are most likely on private land.

Seeps and Springs - Seeps and springs are unique among aquatic habitats because they contain microclimate and habitat conditions not found elsewhere in watersheds. They provide habitat for rare and unique species (such as amphibians, molluscs, and other invertebrates) confined to constant conditions as well as facilitate dispersal (by providing aquatic "stepping stones) across the watershed for other aquatic associates . Seeps and springs are often associated with soils having low permeability rates (0.2- 0.6"/hr), such as the Preacher-Bohannon soil type (46) and along geologic faults. Additional areas containing seeps and springs can be located along contact zones between low permeable soils which are downslope from highly permeable soils. (Figure III.8-3). Groundwater within highly permeable soil types travels downslope until it flows into low-permeable soils. These soils do not allow the groundwater to percolate through it as well and the ground water flows to the surface. Roads that similarly intercept groundwater could also produce seeps.

Rock and Talus - These habitats include rocky outcrops and talus habitats. Like seeps and springs, they provide habitat-types (such as rocky crevices) not found elsewhere. These habitats are relatively rare on the landscape but critically important for species such as Dunn's salamanders, bats (roosting, reproduction, and hibernating), as well as many invertebrates and molluscs. See Figure III.8-3 for locations of known rocky outcrops. See Section III.6 (Species & Habitats) for further discussion.

Down Logs - Numerous wildlife species including many invertebrates depend heavily on down log habitat. Down log habitat in Riparian Reserves is critically important because it offers the opportunity to support significantly higher levels of down log habitat than will be available in the GFMA and it will provide this habitat scattered across the landscape to serve as centers for recolonization. Research indicates that the majority (85-90%) of LWD in streams is recruited from within 30 meters of the stream bank (M^{c}Dade et. al. 1990, Ursitti 1991). Down log habitat in the Riparian Reserves is particularly important for bats (roosting) and marten as well as a variety of invertebrates and molluscs. Their proximity to streams offer the possibility of unique microclimates which are cooler and moister than similar habitats in upland areas. Down log habitat is

Figure III.8−3 Riparian Reserve Habitat as classified by the Seven Ecological Functional Groups & other Special Habitat Areas



** Riparian habitat exists adjacent to all streams. The width of riparian habitat varies with stream geomorphology and cannot be depicted due to map scale

Scale = 1:84480 (3/4" = 1 mile)

likely more scarce on private lands. Given the level of salvage and road location, many Riparian Reserves have probably already been salvaged. See Section III.6 (Species & Habitats) for further discussion.

Snags - Numerous wildlife species including many invertebrates depend heavily on snags. Snag habitat in Riparian Reserves is critically important because it management restrictions here offer the opportunity to provide substantially higher levels of snag habitat than will be available in the GFMA. High densities of snags in Riparian Reserves habitat scattered across the landscape will serve as centers for recolonization. These habitats are particularly important for bats (roosting, reproduction, and hibernation) and marten, as well as a large number of invertebrates and molluscs.   Snag habitat is more scarce on private lands but is also still deficient in many areas on BLM land because of past salvage. See Section III.6 (Species & Habitats) for further discussion.

Potential Likely Future Condition

Vegetation and Habitat

As management guidelines for Riparian Reserves are implemented, contiguous late-successional and riparian habitats will dominate Riparian Reserves. This transition though could take many decades. It will require more than 80 years for the majority of Riparian Reserves to contain stands >160 years of age (Appendix C, igure C-4). Time will also allow structures such as snags, cavities, and down logs to develop. Small-scale disturbances such as windthrow and landslides will continue to affect Riparian Reserves resulting in small areas with earlier seral stages. Large-scale disturbances like stand-replacement fires are relatively infrequent and unlikely to affect any particular subwatershed at a given time.

Species

Improving conditions in Riparian Reserves (compared to existing conditions) will facilitate recovery of species that have been adversely impacted by management activities since the turn of the century (see Reference Conditions). Improved connectivity within the riparian/aquatic systems and across the landscape will facilitate movements and genetic interchange of wildlife; however, more limited riparian protection on interspersed private lands will continue to hinder connections for some species, particularly less mobile species.

PART II - VALUES ASSOCIATED WITH BIG CREEK WATERSHED RIPARIAN RESERVES

Physical and Biological Values of Big Creek Watershed Riparian Reserves

See Section III.6 - Riparian Vegetation for detailed discussion of ecological values of riparian zones in Big Creek and the effects of various management activities on these values.

Riparian Reserves are designed to protect physical and biological values (described in the ACS objectives) which are associated with riparian areas as well as to benefit upland species. These physical and biological values include:

- *Structural Complexity*-Riparian zones are characterized by assorted physical processes such as earth movement, deposition, erosion and disturbance which create an array of terraces, old channels, standing and down wood, snags, etc. Streamside vegetation often offers a structural contrast to upland habitats within the Riparian Reserves.

- *Diverse Array of Soil Moisture Conditions*-Riparian zones typically contain a diverse mosaic of surface soil conditions which vary in time and space.

- *High Plant and Animal Diversity*-Diversity and complexity of habitat features combined result in high native plant and animal species diversity. Additionally "soft" edges characterizing interface between upland and riparian forest and "hard" edges defining interface between riparian vegetation and stream channel promote riparian species diversity as does the proximity of water and riparian and upland habitats.

- *Sediment Regime*: Riparian vegetation moderates the rate of sediment input into stream channels. Along low-gradient streams, floodplains are zones of sediment storage, while LWD traps sediments along high-gradient channels.

- *Water Quality*-Riparian zones maintain and restore water quality through interception of sediments and nutrients, and through the moderation of solar radiation.

- *Water Quantity and Delivery*-Riparian zones store and release water, helping to maintain summer base flows and to moderate high flows. Riparian structures reduce water velocity, reducing erosion, scour and downcutting.

- *Connectivity and Interspersion of Habitat Features*- Riparian ecosystems have a linear form, providing spatial and temporal connectivity across the landscape. In addition to providing protective pathways for riparian-associated animals, riparian zones facilitate dispersal between widely dispersed upslope habitat areas by serving as "stepping stones" for animals dispersing between LSRs or across the landscape. Riparian Reserves support two functions for connectivity:

    1. Landscape scale - Facilitating the movements of mobile species associated with late-successional habitat as they move between large LSRs. Riparian Reserves can serve as "stepping stones" of late-successional habitat between LSRs.

    2. Subwatershed/Site scale - Supporting persistent populations of relatively immobile species associated with late-successional and riparian habitat in order to facilitate genetic interchange between adjacent populations and to prevent isolation of populations.

- *Nutrients*- Riparian zones provide the foundation for aquatic foodwebs through the contribution of organic material. In turn, invertebrates produced in the aquatic system provide a major food source for many terrestrial animals.

- *Refugia*-Riparian zones provide refugia for organisms during stress and disturbance. For example, terrestrial animals utilize riparian zones for thermal regulation during winter and summer months; fishes find refugia from high flows in floodplains. In the administrative sense (i.e., implementation of the NW Forest Plan), Riparian Reserves play a critical role in providing refugia for sessile and less-mobile late-successional species by maintaining a higher quality habitat conditions in relation to adjacent GFMA lands (i.e., high levels of down logs and snags) as well as serving as species source-areas for repopulating adjacent areas undergoing harvest and subsequent recovery.

Hazards to Physical and Biological Values

Table III.8-I summarizes the risks to the identified resource value associated with Riparian reserves from potential hazards. The table evaluates the likelihood that a given resource value will experience a decrease in function in the short term (zero-to-ten years) and long term (beyond ten years) if a listed hazard occurs. It is important to note that the type and severity of hazard will effect the vulnerability and that those listed below are intended to reflect the "worst case scenario". For a detailed discussion on the effects of various management activities on Riparian Zones in Big Creek, see Section III.6 - Riparian Vegetation.

Table III.8-1. Hazards to values associated with riparian reserves

Resource Value	Zone of Effect[1]	Associated species groups by habitat-type	Hazard	Vulnerability of Resource Value to Decrease in Function (short/long term[2])
Structural Complexity	1-5	Late-successional Riparian Lotic Lentic	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	Moderate/Moderate Low/Low Low/Low Moderate/Low Low/Low
Soil Moisture	2 - 5	Late-successional Riparian Seeps/Springs	Harvest Windthrow Landslides Peak/Base Flow Changes Fire	Moderate/Low Low/Low Moderate/Moderate High/Moderate High/Moderate
Microclimate	2-5	All	Harvest Windthrow Landslides Peak/Base Flow Changes Fire	High/Moderate Moderate/Low Moderate/Moderate Moderate/Moderate High/Moderate
Plant & Animal Diversity	1-5	All	Harvest Windthrow Landslides Peak/Base Flow Changes Fire	Moderate/Moderate Low/Low Moderate/Low Moderate/Low High/Moderate

LWD Recruitment-Aquatic	1 - 4	Late-successional Riparian Lotic Lentic Seeps/Springs	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	High/High Low/Low Low/Low Low/Low Low/Low
Down Logs	2-4	Late-successional Riparian	Harvest Windthrow Landslide/Debris Flow Peak/Base Flow Changes Fire	High/High Low/Low Low/Low Low/Low Low/Low
Sediment Regime	1 - 4	Lotic Lentic Riparian Seeps/Springs	Harvest Windthrow Landslide Peak/Base Flow Changes Fire	High/Moderate Low/Low High/Moderate High/High High/High
Streambank/Slope Stability	1 & 2	All	Harvest Windthrow Landslide/Debris Flow Peak/Base Flow Changes Fire	High/Low Moderate/Low High/Low Moderate/Moderate High/Low
Water Temperature	1 - 3	Riparian Lotic Lentic Seeps/Springs	Harvest Windthrow Landslide/Debris Flow Peak/Base Flow Changes Fire	High/Moderate Moderate/Low Low/Low Moderate/Moderate High/Moderate
Water Quantity	1-5	All	Harvest Windthrow Landslide/Debris Flow Fire	Moderate/Low Low/Low Low/Low High/Low
Connectivity	1-5	All	Harvest Windthrow Landslide/Debris Flow Peak/Base Flow Changes Fire	High/Moderate Moderate/Moderate Low/Low Moderate/Moderate High/Moderate
Nutrients	1-5	All	Harvest Windthrow Landslide/Debris Flow Peak/Base Flow Changes Fire	High/Low Low/Low Low/Low Moderate/Moderate High/Low

Refugia	2-5	All	Harvest Windthrow Landslide/Debris Flow Peak/Base Flow Changes Fire	High/Moderate Moderate/Low Moderate/Moderate Moderate/Moderate High/Moderate
Snags	3-5	Late-successional Riparian	Harvest Windthrow Landslide/Debris Flow Peak/Base Flow Changes Fire	High/High Moderate/Moderate Moderate/Moderate Low/Low Moderate/Moderate

[1]Zones of Effect:

Zone 1 - Aquatic (includes streams and seeps
Zone 2 - Stream bank (includes splash zone)
Zone 3 - Zone of riparian influence (includes area inhabited by riparian vegetation)
Zone 4 - ½ site potential tree height (approximately 110')
Zone 5 - One site potential tree height

[2]Vulnerability/Susceptibiliy is defined as the potential for the relevant resource value to experience a decrease in function as a result of the identified hazards (should they occur).

PART III - SYNTHESIS AND INTERPRETATION

Condition of Riparian Network With Respect to Acs Objectives
Refer to Page B-11 in Standard and Guidelines for complete description of ACS objectives.

It is difficult to evaluate riparian conditions in the Big Creek subwatershed with respect to ACS objectives because these objectives are general, subjective, and provide no quantitative criteria or benchmarks for comparison. Therefore, performance of the Big Creek subwatershed with respect to ACS objectives is addressed only qualitatively here. For specifics, readers are encouraged to consult the Aquatic and Riparian Habitat section in the Watershed Analysis for quantitative evaluations of habitat conditions based on ODFW Benchmark Criteria and the NMFS Matrix of Factors and Indicators.

Significance of Differences Between Expected and Existing Wildlife Habitats

Because of past management practices, many Riparian Reserves are not currently functioning at their potential. In order for Riparian Reserves to maximize their contribution to connectivity and refugia for wildlife, the majority must be in late-successional habitats and must contain snag and down log habitat at levels found in unmanaged stands. Only 39% of Riparian Reserves are currently in potential late-successional forests (> 80 years of age). It will take 40 years before more than half of Riparian Reserves are in late-successional condition (Appendix C,Figure C-4). Greater than 80 years are required for the majority of Riparian Reserves to contain stands >160 years of age. Many Riparian Reserves contain recent harvest units or have been subject to salvage or snag falling activities which have left them deficient in snag and down log habitat.

Table III.8-2 Evaluation of riparian conditions in the Big Creek Analysis Area with respect to ACS objectives.

ACS OBJECTIVE	RATING	JUSTIFICATION FOR RATING
Objective 1- Distribution, diversity and complexity of landscape-scale features	At risk	Watershed-scale features such as flow conditions, sediment regime, habitat condition and access to historic habitat have been altered from conditions to which aquatic populations in the subwatershed have adapted.
Objective 2 - Spatial & temporal connectivity	Not properly functioning	High densities of culverts and riparian roads in subwatershed reduce connectivity in riparian areas. Lower 8 miles of mainstem downcut and disconnected from floodplain. Poor water and habitat quality in Middle Fork Coquille river reduces between-watershed connectivity.
Objective 3 - Physical integrity of aquatic system	Not properly functioning	Most fish-bearing streams in watershed downcut due to lack of large roughness elements. Large down wood generally absent in streams and on floodplains. Extensive riparian harvest along non-fishbearing streams. Streamside roads abundant.
Objective 4 - Water Quality	Not properly functioning	Big Creek exceeds the Basin Standard for temperature, during portions of the summer. High turbidities are noted during storms.
Objective 5 - Sediment Regime	Not properly functioning	Insufficient LWD is deficient in headwaters channels to store sediment. Increased rate of landslides due to influence of roads and past harvest. Most valley bottom streams are downcut and access to bank materials. Big Creek and lower tributary streams lack floodplains to deposit sediments.
Objective 6 - Instream Flows	Not properly functioning	Factors missing that may moderate high flows including instream structure, floodplains, and beaver dams. High road density may lead to quicker runoff. Harvest in rain-on-snow zones of watershed lead to greater risk for elevated peak flows. Channel entrenchment, lack of pool-forming elements such as beaver and LWD decrease storage capacity of watershed streams.
Objective 7 - Floodplain Innundation	Not properly functioning	Most streams in lower reaches are disconnected from floodplains and receive little or no seasonal innundation. Floodplains along Big Creek supporting only dryland vegetation.
Objective 8 - Species Community Diversity and Riparian Veg Function	Not properly functioning	Riparian zones disconnected from floodplains not supporting communities of wetland vegetation. Existing riparian zones fragmented. Many areas not supporting expected abundance and diversity of riparian species.
Objective 9 -Plant, Invertebrate, and Vertebrate Habitat	At risk	Many Riparian Reserves were already heavily impacted by harvest, salvage, snag falling, and roading prior to their designation. Existing habitat is fragmented.

Connectivity & Refugia - Landscape Scale

Late-successional wildlife species dependent on Riparian Reserves for connectivity include northern spotted owls, marten, some bats, and pileated woodpeckers. Maintaining connections across the landscape for relatively mobile species requires “stepping stones” and corridors of late-successional habitat throughout each subwatershed. Riparian Reserves will provide dispersal habitat spread throughout the subwatershed. Fifty six percent of BLM-administered land (30% of the subwatershed) is in Riparian Reserves; these forest areas will provide dispersal habitat as they mature and develop late-successional habitat characteristics. Table III.6-5 summarizes current and projected dispersal habitat conditions for northern spotted owls (see also Appendix C, Figure C-1). Fifty three percent of existing BLM dispersal habitat is in Riparian Reserves. In the long term, 68% of BLM dispersal habitat will be in Riparian Reserves. Dispersal conditions for northern spotted owls may accommodate dispersal habitat needs for other mobile late-successional species as well.

Maintaining connections between LSRs for marten and pileated woodpeckers depends heavily on maintaining late-successional habitat in Riparian Reserves and on maintaining adequate levels of down log and snag habitat. Snag and down log habitat will continue to develop in Riparian Reserves at the natural (relatively slow) rate. Management activities could accelerate (tree topping or falling) or decelerate (salvage, harvest) this rate.

Overall, connectivity and refugia functions for relatively mobile species wildlife species associated with late-successional habitats are currently at some risk (due to past management activities), but conditions will improve significantly as habitats in Riparian Reserves mature. Considering the relatively high proportion of the analysis area in Reserves, these areas should support the long-term connectivity and refugia functions for relatively mobile wildlife species.

Subwatershed/Site scale

Existing Riparian Reserves must fulfill all life requirements for relatively immobile species and riparian-dependent species such as red tree voles, white-footed voles, beaver, some bats, reptiles, amphibians, and invertebrates. Riparian Reserves will serve as species source-areas for repopulating adjacent areas undergoing harvest and subsequent recovery. In order to maintain connectivity and refugia for these species, Riparian Reserves must be dominated by late-successional habitats, contain snag and down log habitat levels similar to unmanaged stands, and be relatively free of barriers such as roads and culverts.

Riparian Reserves will also serve as corridors for movements and genetic interchange of species. Late-successional forests and Riparian Reserves near the edge of the subwatershed can also provide connections to adjacent subwatersheds. Harrison (1992) and Meffe and Carroll (1994) recommend using animal home ranges as a guide for determining corridor widths. Harrison (1992) suggested to assume that home ranges are twice as long as wide. Following this assumption, Table III.8-3 summarizes the data on home ranges and movements for species potentially persisting in Riparian Reserves (as well as others with life histories similar to Pacific Northwest species). See Appendix C, Table C-5 for additional information.

Table III.8-3 Ability of various corridor widths to accommodate home ranges or movements of wildlife potentially needing to persist within Riparian Reserves.

Corridor Width	220 ft (½ tree height RR)	330 ft	440 ft (1 tree height RR)	550 ft	660 ft (1½ tree height RR)
Percent of species accommodated	65	79	88	88	97

The ability of Riparian Reserves to accommodate the full life history needs of species is heavily dependent on maintaining suitable microclimate, particularly for species such as amphibians, bats, and invertebrates. Figure V-13 from FEMAT indicates that riparian buffers of 1 tree height maintain soil moisture, radiation, and soil temperature near streams; air temperature was maintained with buffers 2 tree heights; wind speed and relative humidity required 3 tree height buffers to ameliorate edge effects. Maintaining suitable microhabitat characteristics is especially important around scarce habitats such as seeps, springs, and rocky outcrops. Maintaining connections within these riparian corridors can be impeded by roads and culverts (see Road Density in Section III.6 Species and Habitats). Some road density in Riparian Reserves should decrease as we strive to meet ACS Objectives.

Overall, connectivity and refugia functions for relatively immobile wildlife species wildlife species associated with late-successional or riparian habitats are currently at some risk, due to:

- relatively limited area available in late-successional habitat (39%).
- fragmented nature of habitats
- presence of potential barriers (roads, culverts, areas of unsuitable habitat)

Connectivity for less-mobile organisms should improve as Riparian Reserves attain late-successional status and culverts are upgraded; however, the long-term ability to retain connectivity between areas of optimal habitat will always be compromised as long as riparian roads persist and private lands (managed to offer limited connectivity) intersect public lands.

Current and Future Key Habitat Areas

Table III.8-4 is an evaluation of riparian areas in the watershed based on their capacity to provide the key physical and biological values discussed earlier. In this table, those values have been integrated into six "indicators" of key habitat areas, both for the present and future. This analysis was conducted at the sub-drainage level. Finer analysis is not possible due to lack of site-specific information.

Table III.8-4 Results of the Composite Riparian Reserve Area Ranking Process.

Indicator	Axe		Bear Pen		Brownson		Fall		Jones		Lower Big		Middle Big		Upper Big	
	Curr	Pot	Curr	Pot	Curr	Pot	Curr	Pot	Curr	Pot	Curr	Pot	Curr	Pot	Curr	Pot
Large Proportion Late-successional Habitat	H	H	H	H	M	H	M	H	L	M	L	M	M	M	M	H
Contiguous Habitats within Drainage	H	H	H	H	M	H	M	H	L	M	L	L	L	M	M	H
Provides connections betw. drainages and adjacent rip. reserves	L	M	L	M	L	H	L	H	L	L	L	M	L	L	M	H
High LWD and Snags[1]	L	H	M	H	L	H	L	H	M	M	L	L	L	M	L	H
Potential for Riparian Restoration	L	L	L	L	H	M	M	L	M	L	H	M	H	M	M	L
Road Density	L	L	H	H	L	L	L	L	M	M	M	M	M	M	H	H
Instream Habitat	M	H	H	H	M	H	M	M	L	L	L	M	L	M	M	M
Potential for In-stream Restoration	M	M	H	H	H	H	M	M	L	L	L	L	M	M	H	H

H = High value from a biological perspective (example: low road density in Bear Pen Creek=high biological value)
M = Medium value from a biological perspective
L = Low value from a biological perspective

[1]No significant inventories for snags or down logs have been conducted. The rating is based solely on the known occurrence of past salvage activities which removed these structures and the presence of roads parallel to the stream which facilitated theft and removal of individual down logs (areas with known salvage activity or roads received “L”, all others received “M”).

Site-scale Riparian Reserve Characteristics

The following are characteristics important to understanding Big Creek riparian ecosystem structure and function at the site scale.

- position in stream network
- duration of flow (i.e., perennial vs. intermittent)
- magnitude of peak and base flows
- soil type
- local topography & geology
- disturbance regime and history
- presence and distribution of riparian-dependent and associated species
- fire history
- floodplain dynamics
- geomorphology
- management history
- aspect/potential exposure to solar radiation
- presence of/proximity to seeps, springs, and rock-outcrops.

Susceptibility of Riparian Values to Management Activities

Table III.8-1 discussed the relative vulnerability/susceptibility of the physical and biological values of riparian reserves to various hazards should they occur. The following (Table III.8-5) is an evaluation of the likelihood that the *rate* or *magnitude* of those hazards will increase if certain management activities are carried out.

Table III.8-5 Evaluation of the susceptibility of various hazards to increases in rate or magnitude following a given management activity.

Management Activities (carried out under ACS requirements)	Hazard	Susceptibility of hazard to increase in rate/magnitude given management activity	
		Short Term	Long Term
Reduction in Riparian Reserve Width (Regen Harvest and accompanying activities)	Landslide/Debris Torrent Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	Low-Moderate Low Low Low Moderate-High Low-Moderate	Low Low Low Low Low-Moderate Low
Density Management, Thinning, PCT, Port-Orford Cedar Treatments	Landslide/Debris Torrent Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	Low Low Low Low Low-Moderate Moderate	Low Low Low Low Low-Moderate Moderate
Road-building and reconstruction	Landslide/Debris Torrent Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	High Low-Moderate Moderate-High Moderate-High Low-Moderate Low	High Low-Moderate Moderate-High Moderate Low-Moderate Low
Road-decommissioning	Landslide/Debris Torrent Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	Moderate Low Low-Moderate Low-Moderate Low Low	Low Low Low Low Low Low
Riparian Silviculture	Landslide/Debris Torrent Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	Low-Moderate Low Low-Moderate Low Moderate-High Moderate	Low Low Low Low Low Low
In-stream Projects	Landslide/Debris Torrent Peak/Base Flow Changes Water Quantity/Quality Sediment Regime Temperature/Humidity Windthrow	Low Low Low-Moderate Low-Moderate Low Low	Low Low Low Low Low Low

PART IV - RECOMMENDATIONS

Management Activities Appropriate for Riparian Reserves
The implementation of certain management activities in Riparian Reserves may be appropriate if the implementation and effects of those actions *meet* or *do not retard* or *prevent attainment* of Aquatic Conservation Strategy objectives. Actions proposed for Riparian Reserves should maintain existing condition or restore the ecological function appropriate for the site as defined in the Watershed Analysis (see Standards and Guidelines, B-10).

Site-specific analysis is required in order to determine the suitability of a given management action for implementation in a Riparian Reserve. However, management activities listed in Table III.8-5 (above) which are accompanied by moderate-to-high increases in rate/ magnitude of hazards following implementation in both the short AND long term should be undertaken with extreme caution or avoided. An example is road-building across stream channels, which is likely to prevent or retard attainment of ACS objectives in both the short and long term.

Activities (such as road decommissioning, POC treatment, riparian silviculture, in-stream projects) may retard attainment of ACS objectives in the short term (i.e., by increasing sedimentation or by removing riparian vegetation); however, these actions help attain ACS objectives in the long-term and are therefore appropriate for Riparian Reserves.

Guidelines for Reductions in Riparian Reserve Widths
Based on the proceeding analysis and the professional judgement of wildlife, fisheries, botany, hydrology, and soils specialists, there are opportunities to modify the interim Riparian Reserve boundaries on some intermittent streams in accordance with the Aquatic Conservation Strategy. The team recognizes that the analysis area encompasses diverse geomorphic features and habitats, and that the distributions of the species listed in Appendix F, Table F-1 within this area are not mapped or completely understood. Therefore, any modifications of interim Riparian Reserve boundaries must be analyzed at the site level and tailored to the specific features and biota of the site. To this end, the following recommendations are intended to guide the interdisciplinary team in subsequent site-level analysis and planning:

<u>General Recommendations:</u>

1. Riparian Reserves on areas subject to mass wasting or shallow-rapid debris flows (Figure III.1-ISE), extremely steep soil hazard (Figure III.1-hazard), and sensitive soils including FRGR2 (Figure III.1-TPCC) should be wide enough to protect the aquatic system from landslides and sedimentation. See drainage-specific recommendations below.

   a.. *Upper Big Creek drainage*: Based on slope hazard, mass wasting and erosion potential, and presence of susceptible soil types, recommend leaving intermittent stream interim width of 220 feet when doing regen harvest. For commercial or pre-commercial thinnings, a no-cut zone of 30' adjacent to stream channels will provide adequate filtering of surface erosion from disturbed soils created during the action. For Hardwood conversion and Riparian improvement projects a site level analysis will determine the leave strip widths. (See Appendix F-4 for specifics on soil types, erosion potential, etc.).

b. *Swamp Creek, Middle Big Creek, and Middle Upper Big Creek drainages:* Based on slope hazard, mass wasting and erosion potential, and presence of susceptible soil types, recommend leaving intermittent stream interim width of 110 feet in regeneration harvest units and no-cut zones of 30 feet in thinning units. For Hardwood conversion and Riparian improvement projects a site level analysis will determine the leave strip widths.

c. *Lower Big Creek drainage*-Based on geology (Roseburg formation and presence of volcanics), slope hazard, and mass wasting potential, recommend reserve widths of 110 to 150 feet each side of the stream in regeneration harvest units. Leave no-cut zones of 30 feet when thinning to filter surface runoff of fine sediment. For Hardwood conversion and Riparian improvement projects a site level analysis will determine the leave strip widths.

d. *Brownson, Bear Pen, Axe, and Fall Creek drainages* **-** Based on presence of susceptible soil types (such as 14 and 15F), recommend reserve widths of 110 to 220 feet each side of intermittent streams and no-cut zones of 30 feet during thinning. For Hardwood conversion and Riparian improvement projects a site level analysis will determine the leave strip widths.

e. *Jones Creek drainage*-Based on presence of susceptible soils, slope hazard, and unique geology (Otter Point formation), recommend reserve widths of 110 feet each side of intermittent stream and no-cut zones of 30' during thinning. For Hardwood conversion and Riparian improvement projects a site level analysis will determine the leave strip widths.

2. Seeps/springs/wetlands - ensure these special habitats are included within Riparian Reserves and that the reserve widths are sufficient to maintain the characteristics of the site (e.g. shading, cool water, sediments, stable substrates, similar flow patterns/timing, maintenance of riparian vegetation, etc.).

3. Rocky habitats - when rocky habitats occur within Riparian Reserves, ensure that Reserve widths are sufficient to maintain the characteristics of the site (e.g. temperature, humidity and wind velocity). Interim Riparian Reserve widths should not be reduced where such reductions would isolate TPCC withdrawal areas.

4. To maintain LWD dynamics, Riparian Reserves should be at least 100' wide on each side of intermittent streams, except: 1) where a ridge line exists within 100' of a stream, in which case the ridge line may be used to delineate the Riparian Reserve boundary, and 2) where discontinuous/disjunct stream channels preclude the possibility of downstream conveyance of LWD, in which case an appropriate site-specific prescription could be developed to maintain the characteristics of the site.

5. Riparian Reserves should generally be a minimum of ½ site-potential tree height in order to accommodate home ranges of many small mammals, amphibians, and birds.

6. The following species are terrestrial and occur within the outer one-half of the interim Reserve width. Impacts to these species will be greater through loss of habitat and changes in microclimate. Therefore, presence of the these species should be determined prior to management actions that reduce Riparian Reserve widths.

BRYOPHYTES
- Kurzia makinoana
- Plagiochila satoi
- Racomitrium aquaticum

LICHENS
- Lobaria hallii

7. The level of habitat connectivity analyzed in the is watershed analysis was based upon the assumption of maintaining at least 50% of BLM acreage in a Reserve system (TPCC, Riparian, etc.) in order to maintain long term connectivity.. Therefore, if the amount of Reserve acres fall below 50% of BLM acreage, then the analysis of connectivity needs to be readdressed.

8. Although trees in Riparian Reserves provide wildlife benefits, Riparian Reserve trees should not be used to fulfill the green-tree requirement for an adjacent harvest unit.

9. Reductions in interim widths of “high value” Riparian Reserves may pose a higher risk of adverse ecological impacts. Therefore, management activities in these areas will require careful analysis. “High value” Reserves include the following:

a. Reserves containing forests > 120 years of age (offering incipient old-growth habitat),

b. Reserves which offer connectivity to other Reserves, particularly if they connect across ridges to adjacent drainages (Figure III.6- links map). Specifically, Reserves in sections 20,21,29 of T.28 S.,R.10 W. (Connectivity Block #1); sections 9,10 (NW/4) of T.28 S.,R.11 W. (Upper Fall Creek); and section 21 of T.29 S.,R.11 W. (Anderson Mtn.) because of their potential for connecting to adjacent subwatersheds.

c. Reserves which contain contiguous mid and late-successional habitat (providing connectivity and refugia for less-mobile species) (Figure III.8-3).

d. Reserves in Bear Pen, Upper Big, Axe, and Brownson Creeks (in that order),

e. Reserves in sections 21 and 22 of T.29 S.,R.11 W. (Anderson Mtn. area) containing late-successional habitats (potential for supporting nesting for bald eagles).

f. Reserves on prominent ridgetops, which can provide bat roost habitat and facilitate lichen spore dispersal,

g. Reserves currently uninterrupted by culverts or road crossings (facilitate connectivity),

h. Reserves with high amounts of down log or snag habitat.

IV.1 - RECOMMENDATIONS -

Specific to the BIG CREEK ANALYSIS AREA

FOREST MANAGEMENT

Potential Thinning & Regeneration Harvest Areas

Identify areas of timber harvest needed to meet the District's probable sale quantity (PSQ) commitment.

The following analysis was used to identify general areas of harvest, leaving the specifics such as selection of logging systems, specific unit prescriptions and final unit boundaries to be addressed through the NEPA process.

The first step in the selection process of potential harvest areas was the development a GIS map of all available stands. The map identified areas only within GFMA designated lands; which were greater than 35 years of age; and not located within Riparian Reserve, "Withdrawn" Timber Production Capability Classification allocated lands, or other administratively withdrawn areas.

This first step identified 277 acres of potential thinning based upon stands which are between 35 and 50 years of age. In order to concentrate on areas which are economically or physically feasible to harvest, only areas 5 acres or larger in size were mapped. Additional opportunities for commercial thinning may be available in stands less than 35 years old. The timing and intensity of thinning will be dependant upon the results of site-specific stand exam analysis.

This step also identified 989 acres of potential regeneration harvest based upon stands which were greater than 60 years of age and, again, only areas 5 acres or larger in size were mapped. Recommendations used to identify the potential regeneration harvest areas were:

- Concentrate areas of harvest to lessen the effects of fragmentation. Harvest units and roads should not be placed within the interior of relatively large, contiguous late successional habitat blocks. If part of a late-successional habitat block must be modified, treatment units should be selected on the edge of the block and designed to minimize fragmentation, to maintain the largest block of habitat intact, and to avoid breaking an otherwise contiguous stand into two stands.

- Maintain late-successional forest connections between adjacent watersheds. Key areas are those in Sections 9 & 21, T.29 S., R.11 W. and Sections 21& 29, T28S-R10W.

- Maintain unfragmented late-successional forests in Sections 7, T29S-R10W and 13, T29S-R11W.

- Concentrate the timing of harvest activities to more closely emulate patterns of infrequent natural disturbance. Remove the portion of the decadal PSQ commitment attributable to the analysis area within a few years, rather than a gradual harvest schedule throughout the decade.

Potential harvest areas (Figure IV.1-1) were prioritized. It was understood that commercial thinning areas would receive first priority for treatment depending upon results from subsequent field surveys. These surveys would identify actual tree stocking density (TPA) and appropriate silvicultural prescription to obtain the desired stocking level should be used.

Potential thinning harvest areas were prioritized as follows:

Priority 1 are areas that would receive first consideration for commercial thinning depending upon results from subsequent stand exams. Road construction should be limited to short temporary spur roads. Changes to unit size and shape is anticipated upon extensive field review.

Priority 2 are areas which appear to have marginal stocking and have poor accessibility. Use of existing roads or helicopter is preferred.

Regeneration harvest areas were categorized as a harvest priority 1, 2, or 3, based upon the following definitions:

Priority 1 are areas that are available for harvest during the first entry into the watershed. These potential units do not have obvious conflicts with wildlife, fisheries, soils, and are physically harvestable. Road construction associated with harvesting these units could be limited to short temporary spur roads. Extensive field review is required prior to proposing to cross small streams, even those already impacted by roads. Changes to unit size and shape are anticipated upon extensive field review.

Priority 2 are areas that are a moderate to high preference to defer from harvest for wildlife concerns to minimize fragmentation of the remaining areas. Extensive field review is required prior to proposing to cross small streams, even those already impacted by roads.

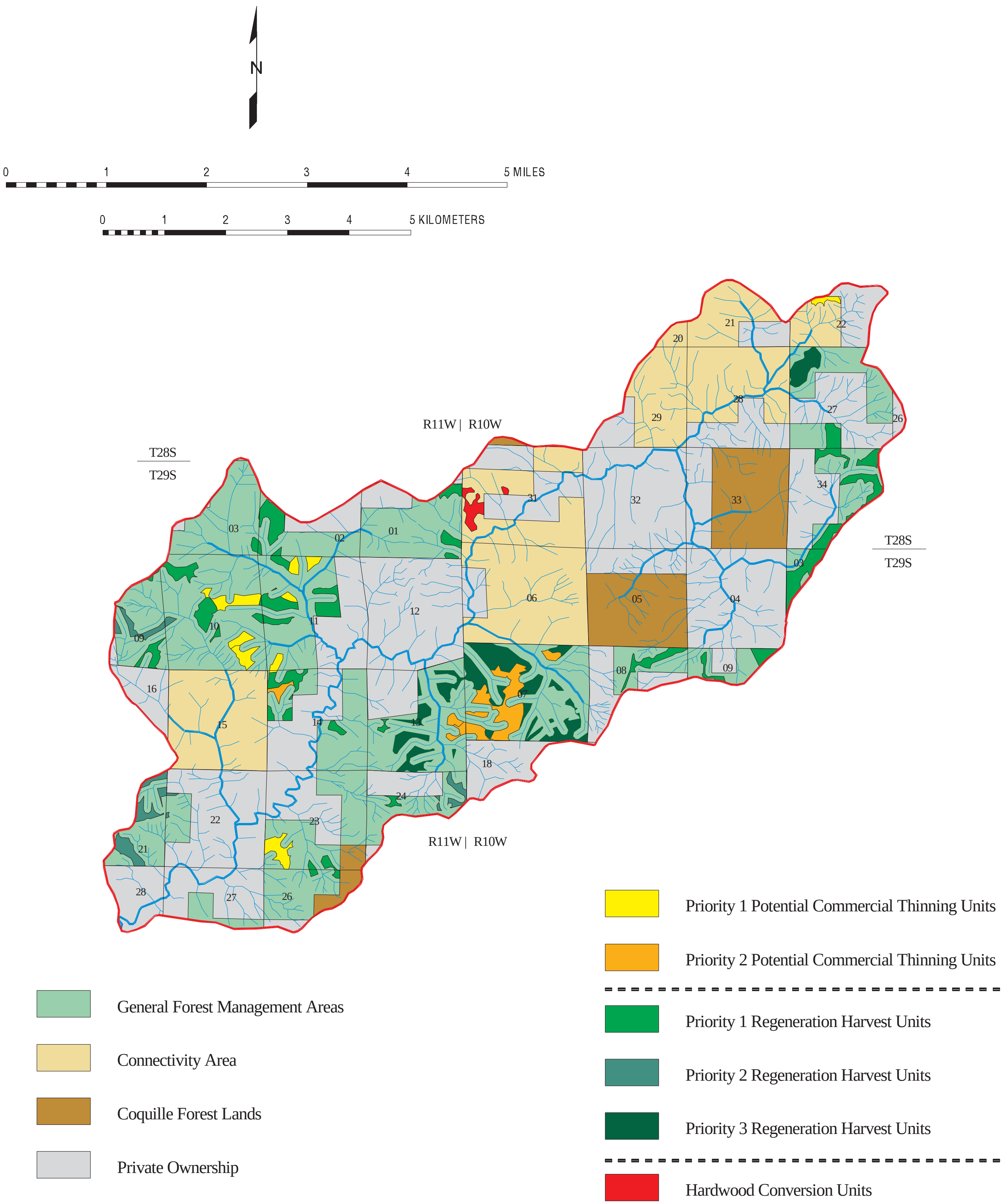
Priority 3 are areas that are a high preference to defer from harvest for wildlife concerns to minimize fragmentation of the remaining areas and to retain the oldest stands (150 yrs+) in the watershed. In addition, these areas offer a high degree of hydrologic and habitat connectivity. Road construction associated with harvesting these units could involve longer permanent type roads across streams which are currently unroaded.

Additional concerns to be incorporated into the site-specific analysis process:

- Evaluate effects of planned regeneration harvest activities on peak flow increase and channel response in the Upper Big Creek drainage.

- Use best available and effective types of Best Management Practices to minimize sediment delivery in Jones Creek.

Figure VI.1−1 Potential Harvest Areas 1999–2000



Scale = 1:84480 (3/4" = 1 mile)

RESTORATION

Aquatic and In-stream

Maintain and/or restore connection between stream channels and riparian zones, stream structure, aquatic habitat complexity, water quality and quantity.

- Big Creek (BLM-ownership reach in section 6 and 31) is a good candidate for a tree-lining project due to the availability of large conifer trees in the adjacent riparian area and apparent suitability of stream channel to this type of habitat improvement (low terrace, accessible floodplain, low-gradient channel unconstrained by hillslopes), and lack of large down wood in adjacent riparian zones and floodplains. Aquatic and riparian habitat within this reach should be further inventoried and evaluated by fishery and wildlife biologists to determine habitat conditions and project feasibility.

- Bear Pen Creek is an excellent candidate for placement of large down wood in the riparian zone/floodplain and in stream channel along the reach in the extreme southern end of Section 6. The stream is slightly downcut, but not so far that it is out of reach of its floodplain. It receives heavy spawning use but currently (due to stream cleaning and salvage from the riparian zone/floodplain) has little rearing habitat for fishes. Past salvage activites also removed down wood which provided riparian habitat for wildlife. The riparian zone is currently un-roaded so horse-teams should be used to place any logs in the riparian zone, floodplain, and stream channel.

- Axe Creek is a good candidate for placement of large down wood in the riparian zone/floodplain and in stream channel. Spawning occurs along Axe Creek, but there is little rearing habitat. The down wood currently in the channel is providing small, complex pools along the channel margins, but these pieces are few and habitat abundance is low. The smaller size of the channel in this area makes feasible the use of shorter length logs, not necessarily whole trees.

- Brownson Creek is a good candidate for placement of large down wood in the riparian/zone floodplain and in stream channel. The stream currently has numerous scour pools but generally lacks complexity. There is little down wood in floodplains to store/stabilize sediments or provide habitat for riparian wildlife.

- Reduce the impact of a segment of Upper Brownson Creek Road (29-11-11.1A). This segment , located between Road No 29-11-11.4 and 29-11-11.3, was constructed within the floodplain of Brownson Creek. Currently, the stream is undercutting the road, thereby, releasing road-grade sediments into the stream channel and undermining the integrity of the road. This area of Brownson Creek receives heavy spawning use by coho salmon and has the potential to provide excellent rearing habitat. Appropriate measures to attain ACS objectives and increase habitat quality should consider the following:

    - avoid actions (e.g. installation of rip-rap) which harden the streambank as this type of activity reduces the stream's natural tendency to meander and increases channel scour, reduces habitat quality, and prevents attainment of ACS objectives.

- consider the removal of this segment from the floodplain of Brownson Creek. The existence of a road in the floodplain and severely constricts streamflow, subsequently resulting in increased channel scour, downcutting, and substantial reduction in coho habitat quality and quantity.

Human-caused barriers and impediments to movements should be removed or modified to allow access for all aquatic species to their historic range.

- Replace, repair, or retrofit culverts blocking passage of fishes (Figure III.6-6) and other aquatic organisms. It is important to note that culverts currently providing passage for salmonids restrict access and passage by non-jumping fishes and crawling aquatic organisms. Future culvert replacements and retrofits should provide passage for all aquatic biota by placing culverts on or slightly below stream grade, with outlets in contact with the stream bottom. In areas where high habitat quality exists and non-jumping special status species are present, add roughening baffles to culverts to collect gravel throughout the culvert-bottoms.

- Cooperate with private landowners, the Coquille Tribe, and the Coquille Watershed Association to further identify and possible replace, repair, or retrofit barrier culverts in the Swamp and Upper Big Creek drainages.

Riparian

When possible, using silvicultural techniques, restore natural vegetation patterns and assemblages as well as critical components of riparian function (riparian down wood, physical and hydrologic connections between stream channel and floodplains).

- The Swamp Creek drainage is an excellent candidate for riparian restoration. Numerous reaches along Swamp Creek and its tributaries are lacking conifer, long-lived hardwoods, or even sufficient alder coverage to adequately shade the stream or provide any structure to the stream channel.

- Do not undertake riparian silviculture projects along hardwood-dominated reaches of riparian zones in lower and middle Bear Pen Creek. Analysis of early aerial photographs on-the-ground reconnaissance (determining presence of conifer stumps and extent of floodplain) indicate that this reach was historically hardwood dominated. The reach currently contains a diverse mixture of hardwood species.

- Riparian silviculture projects along Axe Creek should be undertaken with caution. Conduct further investigations of historic conifer presence and floodplain delineation along lower and middle Axe Creek. Initial reconnaissance located no conifer stumps along lower and middle Axe Creek, but aerial photo analysis was inconclusive.

- Brownson and Fall Creek are an excellent candidate for riparian restoration projects. On-the-ground reconnaissance and/or aerial-photo delineation to determine floodplain extent and past distribution of riparian conifers located several areas in Sections 11 (Brownson Cr) and 15 (Fall Cr) where cedar and Douglas fir existed on raised "lenses" in floodplains and on high terraces adjacent to historic floodplains. Riparian silviculture in these areas should focus on leaving existing long-lived hardwoods (maple, myrtle, ash), removing selected alder, and planting conifers in these locations.

C Lower Big Creek is a candidate for riparian restoration. It should be noted that the hydrologic conditions (high water table, frequent flooding, etc.) which supported the historic community have been altered and it may not be possible to re-establish the original vegetative community . Additionally, explore opportunities to establish joint riparian project between BLM and private landowners and the Coquille Watershed Association along lower Big Creek. The Watershed Association has expressed interest in riparian projects in this area.

Watershed (General)

Improve late-successional forest habitat function.

C Defer harvest of the Bear Pen and Axe Creek drainages (T29S-R10W Sec. 7 & T29S-R11W Sec.13) until consideration is given through the RMP amendment process for designating these areas as LSR. The LSR designation would provide long-term protection for two of the few drainages in the Middle Fork Coquille Watershed with few or no roads and stream-crossing structures and a high level of aquatic habitat and hydrologic connectivity. Similar acreages of LSR could be located in other subwatersheds for conversion to GFMA land allocation in order to balance the land allocation acreages.

C Pursue opportunities to convert brushfields and hardwood stands to conifer, such as areas in W1/2 section 31, T28S-R10W. (Figure IV.1-1)

C Connectivity Blocks in the planning area vicinity have been examined for potential thinning or density management opportunities to promote tree growth and stand complexity. There are no stands in the 35-45 age class available for initial thinning opportunities. Older stand (60 - 100 years) were also field examined; only one small 10 acre stand could potentially benefit from thinning opportunities (Figure IV.1-1). The naturally regenerated stands closer to the 100 year age would not benefit from intensive management at this time. Some of the stands may not contain sufficient snag and down log habitat, so creation of large-diameter snags and down logs may be needed to meet management goals.

Maintain habitats for vegetative Species of Concern.

C Protect *Iliamna latibracteata* site (along Big Creek road 28-11-28.0 below the junction with 28-10-31.0) by delaying or eliminating road maintenance work (brush removal) following seed dispersal (after Sept 1). It may be determined that some removal of roadside vegetation may actually benefit the species. Before any proposed road maintenance occurs consult with District Botanist.

C For the *Sarcosoma mexicana* site in the NW1/4 Section 10, T29S- R11W, conduct inventories during the fruiting season (winter and spring) to determine presence and extent of population in the area.

C Maintain deep litter layer around the existing site (and any future sites) of *Sarcosoma mexicana* by deferring prescribed burning of understory vegetation and other activities that would reduce litter layer.

Roads

Reduce erosion from roads caused by culvert failure, outlets, or improper location

- C Conduct a thorough culvert inventory of roads. Concentrate on roads in proximity to riparian areas or that contain streams. Replace or repair culverts and outlet erosion with "Jobs-in-the-Woods" program or upcoming timber sales, whichever is applicable. Replacement of culverts has been identified, but is not limited to:

Road System/Area	Recommendation	miles
Fall Creek Systems	culvert replacement	4.0
Brownson Creek Systems	culvert replacement	2.0
Jones Creek Systems	culvert replacement &installation*	9.5
Other Big Creek roads	culvert replacement	4.5

* several locations in the Jones Creek system have been identified to be in need of additional culverts (see TMO recommendations for specific roads).

- C Cooperate with willing landowners and Watershed Associations to identify and rectify sediment sources from roads and replace/repair culverts acting as barriers to aquatic biota.

- C Due to the high erodibility of soil types 14F, 15F, 38F, 46F, and 58F, any culvert outlet within these soils should not be 'shotgunned' and stream culverts should be placed on the original stream gradient. Add energy dissipaters at all outlets, unless natural ground conditions prevent erosion. Road fills over the large (i.e., 48") culverts should be armor-plated on both inlet and outlet to reduce erosion of the fill.

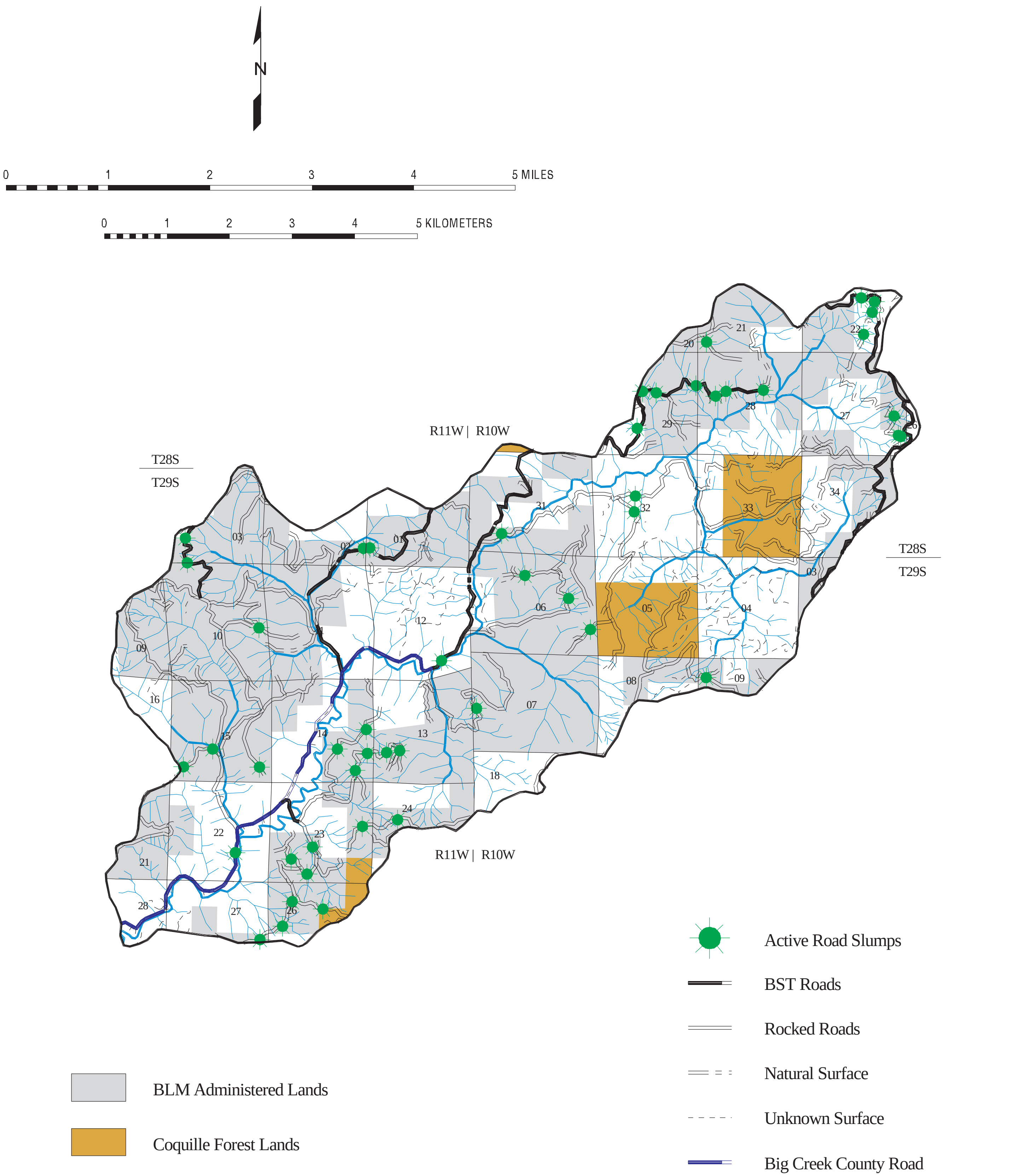
Reduce erosion from roads caused by surface runoff or lack of maintenance.

- C Improve road drainage and surface condition of the following roads to lessen erosion: 29-11-11.4; 29-11-15.0; 29-11-23.5 .

- C Develop MOU with private land owners for repair and sediment management of dirt surfaced roads in Upper Big Creek, Middle Big Creek drainages, and roads no. 29-10-9.3 & 29-11-24.2.

- C Evaluate the active slumps (particularly in Jones Creek) within the drainage (Fig IV.1-2) for repairs that will provide long term stability after repair. Do not overburden the slope with additional weight. Provide drainage prior to or within the slump area if possible.

Figure IV.1−2 Locations of Active Road Slumps



Scale = 1:84480 (3/4" = 1 mile)

Close roads identified through the TMO process to reduce their effect on erosion, water quality, and to meet road density objectives.

- The TMO process identified approximately 18 miles of road to close which could be closed through "Jobs-in-the-Woods" programs or upcoming timber sales, whichever is applicable. TMOs for individual roads to be closed are located in Appendix E-2. Generally, proposed road closures can be summarized as follows:

Recommendation	miles	BLM method	Specific Road System/Area
closure	4.7	gates	Bear Pen & T28S-R10W,Sec.29
decommission	12.2	permanent barriers	
decommission	1.3	self close	

  Installation of physical barriers on 16.9 miles will result in a BLM open road density of 2.77 mi./sq.mi. Several un-numbered spur roads are also available for decommissioning and their milage is not reflected in the above figures.

- Some roads recommended for closure are subject to reciprocal right-of-way agreements. Prior to any change in road status, consultation with the Permittee is necessary in accordance with Instruction Memorandum OR-95-87.

- Some roads are recommended to be self closing. These short roads will still allow access for reforestation purposes (planting, release, thinning). However, over time, generally a 10 - 15 year period, the encroaching vegetation would act to prohibit vehicular traffic. Roads recommended to be self closing would not be classified as 'closed' until encroaching vegetation physically prohibited vehicular access. The eventual closing of these roads would further reduce open road density.

- The current open road density on the Coquille Forest lands is 5.3 mi./sq.mi. Reduction in open road density could be accomplished as part of future activities by the Coquille Tribe.

- All self closing roads and those behind permanent barriers should be placed in a self maintaining condition. These roads will not receive further maintenance, and steps need to be undertaken to minimize possible erosion. Construction of waterbars/dips to relieve water traveling in ditches, and removal of culverts and fills in streams are some of the measures which will accomplish these objectives.

Minimize the effects of road construction in Riparian Reserves.

- Areas subject to mass wasting (Figure III.8-2) and sensitive soil areas, including TPCC designation - FGR2 (Figure III.4-1) should be used as guidelines to identify unstable areas in which new road construction should be avoided.

- Avoid fragmentation of remaining contiguous aquatic and riparian habitat areas in the analysis area.

- New road construction in areas on uninfected Port-Orford Cedar should be in compliance with the BLM POC Management Guidelines.

RIPARIAN RESERVE BOUNDARIES

See Section III.8 - Riparian Reserve Evaluation, Part IV Recommendations for appropriate management activities within Riparian Reserves and guidelines for modifications of interim Riparian Reserves.

MONITORING

Hydrology and Stream Channel

- Due to the high level of sediment delivery to Big Creek, it is of interest to determine sediment trends in this watershed. This may be accomplished by sampling stream bed substrates in depositional stream types, where stream gradients are less than 2%. A sampling scheme should concentrate on high value fish spawning riffle habitats.

DATA GAPS AND LIMITATIONS OF THE ANALYSIS

- With respect to fish populations, the role of Big Creek within the larger 5th field watershed (Middle Fork Coquille River) could not be quantified due to limited adult and juvenile salmonid population data, and highly variable ocean conditions. This limits the ability to determine short-term and long-term population trends.

IV.2 - RECOMMENDATIONS -

Generalized for the MIDDLE FORK COQUILLE WATERSHED

FOREST MANAGEMENT

Emulate the timing, intensity, variability, and scale of natural disturbance processes where practical.

- Concentrate harvest units in space and time.

- Establish stocking levels and forest patterns early in each stand's development through planting and pre-commercial thinning treatments. Planting and thinning prescriptions should consider natural stand spacing variations and species composition. The objective is to minimize impacts to wildlife species using the growing stand by reducing the number of silvicultural treatments and harvest entries conducted prior to final harvest.

- Consider wildlife trees or harvest prescriptions to feather edges of harvest units to soften the transition across edges.

- Maintain species diversity of canopy species and understory shrubs, including hardwoods, in harvest units.

Maintain and/or restore canopy complexity and vegetative diversity to plantations.

- During precommercial thinning, manual maintenance, and commercial thinning retain the natural species mix and encouraging variable spacings or forest gaps.

- Survey for opportunities and use prescribed fire as a tool to restore key habitat components and provide variation in stand level vegetation patterns in Reserve areas.

- Look for opportunities to create or retain wolf trees (trees with branches >6 cm in diameter less than 3 meters above the ground) by doing variable spaced thinning in pre-commercial and commercial thinning units. Generally speaking, these should be scattered throughout the overall landscape.

- In Connectivity Blocks, encourage development of more complex canopies on appropriate sites (typically north and east aspects, lower slopes and riparian zones) through pre-commercial and commercial thinning prescriptions.

- Low disturbance silvicultural activities (i.e. thinnings, maintenance, fertilization) could be allowed in Riparian Reserves providing appropriate buffer areas are left to protect water quality and other ACS objectives.

- Use native plant materials when available for restoration and erosion control efforts in accordance with District Native Seed Policy.

- Conduct inventories within potential sites in watershed for potential native seed collection sources.

- Utilize the green tree retention requirement to help maintain vegetative diversity by:

  a. retaining green trees of various sizes, ages, and species in well distributed patches as well as dispersed individuals.

  b. retaining the same green trees over repeated rotations,

  c. retaining trees with heavy epiphytic loads to act as an inoculum,

  d. considering the diversity of tree structure, that is trees with complex canopies, such as asymmetrical crowns or leaning boles, or trees with potential for developing 'wolf-tree' characteristics.

<u>Snags</u>

- On GFMA and Connectivity Blocks, decrease the time it would take to meet snag density goals by managing for 40% population potential by creating snags in other suitable areas not yet scheduled for harvest. Forty percent population potential equates to approximately 2 hard snags/acre. Snags should represent a variety of decay classes, topographic positions, seral stages, and distributions (i.e. large and small clumps and singly) and need to be provided through time.

- On Reserve land allocations, actively strive to meet snag density goals by creating snags in areas currently deficient. Forested Reserve areas should be managed for 100% population potential which equates to approximately 6 hard snags/acre. Snags should represent a variety of decay classes, topographic positions, seral stages, and distributions (i.e. large and small clumps and singly) and need to be provided through time.

- During pre-commercial thinning treatments, consider creating 1 small snag per acre in areas dominated by early and mid-seral stands which contain few snags.

<u>Down Logs</u>

- On GFMA and Connectivity Blocks, decrease the time it would take to meet down log retention goals by exceeding minimum requirements in harvest units and/or by creating down log habitat in areas not yet scheduled for harvest. Minimum retention levels from the RMP (120' of 16" diameter logs) equate to approximately 167 ft^3/ac of hard logs. Existing class 1 and 2 down logs can be removed in harvest units if >214 ft^3/ac (approximately 153' of 16" diameter logs) exist in decay classes 1-2 within the unit (the low end of availability in natural mature stands based on Spies et al. [1988]). Salvage of down logs in GFMA land will be pursuant to District Policy OR-120-96-05.

- In riparian areas within Riparian Reserve lands, actively strive to provide down log levels within the range of natural variability for Oregon Coast Range riparian areas. See Table III.6-1 for down log availability in natural stands. Down logs should represent a variety of decay classes, topographic positions, and orientations and need to be provided through time.

C On upland Reserve lands, actively strive to provide down log levels within the range of natural variability for Oregon Coast Range forests. See Table III.6-1 for down log availability in natural stands. See the LSR Assessment for Southwest Oregon (1997) for additional guidance on down log habitat in Reserve areas. Down logs should represent a variety of decay classes, topographic positions, and orientations and need to be provided through time.

RESTORATION

Aquatic Species and Habitat

Maintain and protect populations of aquatic biota and communities.

C Discourage or prevent introduction of non-native coho fry, parr, or smolts.

Maintain and/or restore stream structure, aquatic habitat complexity, and water quality and quantity.

C Pools throughout the watershed are fairly numerous, but consist chiefly of scour pools. Scour pools may providing moderate-quality summer habitat but, because they are erosional, do not provide adequate rearing and holding habitat at high flows. Any restoration to create pools should concentrate on creating backwater, alcove, or other complex pools which maintain low velocities are high flows and/or increasing the complexity of existing pools.

C Meet or exceed the ODFW (1994) criteria for "good" habitat with respect to all parameters in all fish-bearing reaches, as verified by aquatic habitat surveys.

C If possible, select in-stream project sites with the assistance of a hydrologist. Use the Rosgen (1994) stream classification system and Rosgen and Fittante's (1986) suitability guidelines for selecting and evaluating in-stream fish habitat improvement projects to ensure that they are appropriately matched to habitat sites based on stream and valley form characteristics. For example, where F-type stream channels occur in the area (severe channel entrenchment), be aware that channel widening may occur as a result of in-stream projects. Projects should be designed to avoid converting C-type channels to F-type.

C Where in-stream habitat projects are proposed, use techniques which emulate the habitat complexity found in streams maintained by natural processes. Design structures to mimic the complex aggregations of wood and rock typical of unmanaged Coast Range streams, facilitate trapping of additional materials, and be self maintaining. Boulder weirs, without the incorporation of large and small woody material, often do not provide over wintering habitat for juvenile salmonids. Large conifer logs should be incorporated into the design and configuration of existing or future boulder weirs, boulder clusters, or boulder/log jams. Use large boulders as anchors/wedges to secure logs in place. Structures should resemble naturally occurring jams.

C Focus restoration projects in step/pool and pool/riffle stream types (generally Type B and C channels), where they do not meet the desired trend. This may include gradient control log/rock steps to create pools, and placement of whole trees or logs and other log/rock structures to aid in floodplain connectivity, and aid near surface groundwater recharge.

Consider tree lining/cutting projects where an abundance of large conifer trees exists. At each site, select a large live conifer tree that can serve as a "key" spanner log, and one or more additional live conifers to be incorporated at various angles with the key piece. Where possible, logs should be 2 to 3 times the width of the active channel, with root wad attached. This will provide different obstruction angles for high stream flows to interact with streambanks and floodplains. Additional hardwood trees could be added to the accumulation to contribute twigs, branches, and additional edges.

C For all projects involving large wood, avoid placing cut logs of lengths less than 2 to 3 times the active channel width in the stream channel. If smaller logs are selected, expect these logs to be floated downstream. If anchoring logs at a site is necessary, it should be done with large boulders or more stable logs to minimize the use of steel cable

C Retain all log jams unless there is compelling risk of damage to the environment or property. An interdisciplinary team (ID) including a hydrologist should review all log/debris jam removal proposals to evaluate both ecological effects and risks to adjacent landowners. This ID team should consider ways to modify the log jam without total removal to meet desired habitat objectives, while assessing the risks to adjacent private property and fish passage

C During major storm events (those that increase peakflows to bankfull width or greater), consider returning woody debris and soil material resulting from an instream channel debris slide and intercepted by roads to the stream system. This could be accomplished by moving the debris below the roadway onto the stream’s flood. The next high water event can continue moving this debris along the stream course.

C During harvest activities, place large woody material in mainstems of the drainages when necessary to provide storage and settling of fine sediments.

In areas that have been severely altered by management, use silvicultural techniques to enhance natural vegetation patterns, and restore (to potential natural communities and to the extent possible) historic vegetation assemblages and other critical system components (i.e., natural hydrologic function, bank stability, water quality, and native fish and wildlife habitat).

C In lowland reaches, explore opportunities to re-establish long-lived hardwoods such as bigleaf maple, myrtle and ash. When undertaking riparian silviculture projects, explore opportunities to restore *diversity* of hardwood species (i.e., addition of bigleaf maple and ash) in addition to planting of conifer.

C Before undertaking riparian silviculture projects, determine if the sites were historically dominated by conifers, hardwoods, or both. Historical conifer presence or suitability of a site for conifer planting may be determined by early aerial photos, presence of conifer stumps, or delineation of current or historic floodplain (determined from geormorphic characteristics, presence of alluvium, etc.). Conifers can be established in areas that are dominated by alder by girdling or removing small patches of alder and planting conifers in the created gaps. Mature, long-lived hardwoods (big leaf maple, ash, chinkapin, myrtle, tanoak) should never be removed. In stands dominated by a mixture of hardwoods, alders should be preferentially removed to create the canopy gaps, below which conifers can be planted. Appropriate consideration should be given to follow-up maintenance of project sites. Some sites may require multiple treatments to sustain their recovery.

- In lowland riparian areas, silvicultural treatments should achieve a mixed hardwood stand, with scattered conifers, extending on both sides of the stream to the edge of the floodplains and flood prone terraces. The understory should include native shrubs and herbaceous species.

- In upland riparian sites, silvicultural treatments should achieve a conifer-dominated overstory or conifer/hardwood overstory. Depending on site conditions and the degree of interaction between stream channel and adjacent hillsopes, there may be a narrow strip of hardwoods immediately adjacent to the stream channel. The range of conditions depends on site conditions, reference stand conditions, and ability to meet specific wildlife and fisheries' objectives. On BLM lands, this vegetation would extend on both sides of the stream in accordance with the riparian reserve widths specified in the ROD (1994), as modified in accordance with a riparian reserve evaluation (Section III.8 - Riparian Reserve Evaluation). On private lands, this vegetation would extend on either side of the stream channel in accordance with the State Forest Practice Rules (1994). The understory would include a mixture of native shrub species, varying with site conditions.

- Hardwood dominated sites (including red alder sites), where they would naturally occur, should not be considered for silvicultural treatments (i.e., active floodplains, unstable slopes, rocky headwalls, and areas with frequent intervals of debris torrents, and other unique geologic sites). Consider the function of the alder and brush as debris racks and sediment filters during floods, as a source of litter input, and as stream shade.

- In areas where hardwood densities are planned for reduction, project design should include evaluation of stream temperatures. In areas where stream temperatures are high or moderately-high, projects should remove few overstory trees. In general, 10-30% of the trees should be girdled rather than cut and removed, to provide short-term snag and down log habitat values. Several alders should remain uncut (or girdled) in patches to provide habitat for white-footed voles.

- Sites in which the occurrence of stand/patch replacing disturbances is greater than 80 years are more logical candidates for conifer reestablishment.

- High gradient streams capable of debris torrents and dominated by red alder (associated with past management disturbance) should be considered for silvicultural treatments. Treatments should be at least within one to one and a half site potential tree width from the stream channel, but may extend upslope according to other vegetation and wildlife objectives.

- Mature, single-stemmed myrtles and bigleaf maples should seldom be removed, especially in lowland riparian areas. Their presence may indicate they occupied a given site historically.

- In stands where field or aerial photo investigations indicated a conifer-dominated stand was converted to a stand dominated by a mixture of hardwoods, small patches of hardwood could be removed to create gaps in the canopy. Conifers can then be planted, provided the gaps allow adequate sunlight for survival and growth of the conifers. To maintain habitat for white-footed voles, and patches of alder should be maintained in project areas.

- Alder conversion projects in riparian zones need to consider snag and down log retention/creation; placement of cut material into the stream for structure or hiding cover; control of streambank erosion and fine sedimentation by maintaining live root mass along the stream bank; and maintenance of shade over the stream to moderate water temperature.

- A buffer should be left along the stream to provide shade, bank stability, anchor points for mobile woody debris, and refugia for organisms which may be displaced by management activities. The stability of a site should never be jeopardized to establish conifers.

- On unstable lower slopes, release of bigleaf maples and conifers, particularly western redcedar, is desirable. Planting of western redcedar or bigleaf maple on a small scale may be worthwhile where there are no other options for obtaining coarse woody debris over very long reaches. Initial planting should be considered experimental. The probability of converting these sites to conifer by planting is low on sites with active soil movement. Leaving these sites in native shrub, and/or alder will retain shrub and hardwood habitats on appropriate sites.

- The recommendations mentioned above should be assessed against the need to obtain the reduction in 60% of the overstory canopy necessary to permit enough light to reach the forest floor in order to regenerate the desired species.

- Appropriate consideration must be given to follow-up maintenance of project sites, often each year for 3-5 years following initial treatment. Some sites may require multiple treatments to allow for establishment of regeneration.

Roads

Minimize sedimentation from roads.

- As part of the culvert inventory process, examine evidence of erosion in ditch lines and current culvert spacing. Identify stable locations for additional culverts needed to reduce ditch line erosion or to decrease ditch line length before entering streams.

- Prior to construction or replacement of existing worn out or degraded culverts, stream inventories should be conducted to determine potential impacts to aquatic amphibians. Where appropriate and possible, facilitate upstream movement of aquatic amphibians through new culverts.

- Use culverts made of polypropylene material when replacing culverts where possible as culverts associated with running water appear to be rusting through at the contact point.

- Naturally surfaced roads should be rocked at perennial streams crossings sufficiently to reduce runoff from the road surface.

- Construct waterdips or “flavels” on short, low traffic volume roads. Special consideration should be given to their location on highly erodible soil types. Opportunities for such work can occur as part of timber sale final road maintenance or part of normal scheduled maintenance.

Wildlife Species and Habitat

Minimize human disturbance to wildlife species of concern.

C Minimize construction of additional permanent roads, and when possible close temporary roads immediately following completion of logging and/or planting.

C In order to insure compliance with the Migratory Bird Treaty Act, the Oregon State Office or higher level should develop recommendations for compliance with the Act regarding timber harvest and other activities which could potentially destroy nests of band-tailed pigeons and other migratory birds.

Special habitats.

C Maintain microclimate features of important special habitat areas such as seeps, springs, wetlands, and rocky habitats.

Provide forage opportunities for wildlife where appropriate.

C Consider seeding harvest units with grasses and forbs for big game forage pursuant to the District's Native Seed Policy.

Provide roosting opportunities for bats where appropriate.

C Install bat boxes on BLM-controlled bridges to provide additional roosting habitat for bats.

Noxious Weeds

Control the spread and reduce the level of noxious weeds in the analysis area.

C General guidelines for the management of noxious weeds are addressed in the Noxious Weed Strategy for Oregon/Washington (1994), Partners Against Weeds: An Action Plan for the BLM (1996) and Coos Bay District's Weed Prevention Schedule (1996). Specifically these plan's address the following;

a. Conduct field inventories for noxious weeds to determine locations and infestation sizes within the watershed.

b. As mentioned in Partners Against Weeds: An Action Plan for the BLM (1996), work with adjacent landowners to create an awareness of this issue, and work on a coordinated effort to effectively manage these species.

c. Since most noxious weeds are associated with roads, road building and maintenance equipment should be cleaned using steam or high pressure water prior to entering an area. Cleaning of logging equipment should also be done in a similar fashion.

d. Treatment methods of noxious weeds will include manual (pulling, cutting, grubbing), biocontrol efforts, and possibly the use of chemicals. The use of chemicals is contingent on the past control measures, the size of infestation, and compliance with the Northwest Area

Noxious Weed Control Program Environmental Impact Statement (USDI 1985).

e. Following any treatment of noxious weeds monitor results of treatment by using before and after photographs or conducting spot checks. Areas should be retreated until weeds are eliminated.

Create and maintain a database inventory of disease centers and noxious weed infection sites.

- As an inventory of the watershed is obtained, the infection sites will be identified and recorded. A database exists for some infection sites, along with a monitoring effort, but there is a need to input that data into the GIS database and create a Disease and Noxious Weed theme.

Port-Orford-cedar root rot

Reduce the spread and help prevent introduction of Port-Orford-cedar root rot (Phytophthora lateralis) into new areas.

- General guidelines for the management of *Phytophthora lateralis* are addressed in the *BLM Port-Orford Cedar Management Guidelines 1994*. That document recommends the development of site specific plans to prevent the spread of the disease. The following recommendations address these site specific plans:

  a. Timber sales and service contracts, such as manual maintenance and precommercial thinning, address prevention methods. These contracts address such measures as: removing POC from areas where POC is likely to become easily infected (i.e., along roads and running water), washing vehicles before they proceed into an uninfected area, spacing of POC to reduce root contact (thus reduce spread of the disease), and removing POC within 50 feet of an infected area.

  b. Develop treatment plans to prevent the spread of the disease. Areas found not to be infected will be identified. Plans to prevent introduction of the disease into these areas will be developed. Project monitoring and evaluation will be conducted following plan development and implementation.

DATA GAPS AND LIMITATIONS OF THE ANALYSIS

- Baseline information on most wildlife and fish species abundance, distribution, and habitat associations are lacking; this limits the ability to assess population trends and effects of management.

- Baseline information on current vegetation and habitat features (e.g. snags) is lacking; this limits the ability to quantify wildlife habitats and to calculate landscape parameters such as fragmentation indices.

MONITORING

Aquatic Species

- Spawning survey efforts in the watershed should be directed at determining the spatial distribution of fishes. This effort should focus, in particular, on evaluating spawning use in small streams because spawning and rearing habitat quality in these systems are most likely to be affected by current and projected management actions.

- Fishes such as coho salmon and steelhead trout spend several years rearing in the watershed. Therefore, BLM has the greatest opportunity to positively or negatively affect population levels through management activities which regulate the quality and abundance of rearing habitat. In other words, monitoring of population levels with respect to BLM management and the capacity of BLM to manipulate populations should focus on monitoring density and abundance of fry and parr (i.e., seeding or stocking levels). Monitoring to evaluate population responses to management based on returning adults (spawning surveys) are inconclusive with because of the confounding variables of ocean conditions and return migration, as well as lack sufficient power to detect meaningful population trends.

- Separate monitoring plans (i.e., wildlife; aquatic/stream channel) which address habitat components, species, physical features, and projects have been developed or are in development. See the separate monitoring plans for further recommendations on monitoring needs.

Hydrology and Stream Channel

- Continue trend monitoring including parameters of temperature and turbidity to evaluate effects of land management activities and general watershed health.

- Estimate the flood discharge from the November 1996 flood by channel geometry techniques.

- Establish high flow crest gages on the lower ends of important fisheries drainages.

- Plan a Rosgen Stream Classification Level II Inventory for a morphological description of streamtypes in the watershed.

- When possible, plan a Rosgen Stream Classification Level III Inventory, before modification of instream hydraulics by emplacement of habitat rock or log structures.

- Establish permanent channel cross section monitoring sites to determine channel stability and evaluate changes in channel morphology (width and depth).

- Use permanent channel monitoring sites for determining bank and channel erosion contributions to the drainage sediment regime.

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